

THE NEGOTIATION OF MEANING AND EXERCISE OF POWER IN PROFESSIONAL
LEARNING COMMUNITIES: AN INVESTIGATION OF MIDDLE SCHOOL SCIENCE
TEACHERS

By

CHERYL ALTHEA MCLAUGHLIN

A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

2014

© 2014 Cheryl Althea McLaughlin

To my parents Constance and James
A full return on your investment

ACKNOWLEDGMENTS

My journey started on a multi-lane expressway pregnant with possibilities, and teeming with opportunities for professional advancement. Then came potholes, wide and deep that threatened to delay or even derail the progress made. In spite of these obstacles, I continued my journey to its expected end with the assistance and support of numerous individuals who I would like to acknowledge in this section. I am careful not to name names for fear of inadvertently excluding those whose fleeting, yet accommodating encounters were eclipsed by the consistent and unwavering support of others.

On the expressway, I was guided by competent faculty members and administrative personnel from the College of Education (COE), College of Liberal Arts and Sciences (CLAS), Florida Museum of Natural History (FLMNH), and P. K. Yonge Developmental Research School. Additionally, project personnel and participants of the NSF-funded U-FUTuRES grant supported data collection during structured cadre meetings. This support facilitated a smooth and unforgettable ride, which was a prelude to the impending mayhem. My potholes and obstacles came in the form of physical maladies and malevolent maneuverings, and were unexpected yet humbly accepted as the dramatic anticlimax to a journey that was perhaps progressing too rapidly for general comfort. I am thankful for the smooth expanse of the expressway but I am doubly grateful for the rugged terrain I encountered because it revealed the strength of character behind my gentle façade.

Like all fairy tales, I had a happy ending because of a group of individuals who stood in my corner to soften the mental and physical blows that were brought to bear against me. I am speaking of my dissertation committee members, my dissertation

accountability group, my colleagues, my friends, and my family who rallied to buttress me in the face of my protracted ordeal. Some of these individuals literally intervened to ensure timely completion of the program, while others cheered me on the sidelines literally willing me to fight against the raging tide. I am thankful to these individuals because their actions bolstered my determination to succeed.

Finally, I am thankful to the Supreme Leader of my life, Jesus Christ, without whom the journey would not have started. I was continually comforted by the thought that He would never lead me where His grace could not keep me. I am eternally grateful for His guidance.

TABLE OF CONTENTS

	<u>page</u>
ACKNOWLEDGMENTS.....	4
LIST OF TABLES.....	10
LIST OF FIGURES.....	11
LIST OF ABBREVIATIONS/ACRONYMS	12
ABSTRACT	13
CHAPTER	
1 PROLOGUE: THE PATH TOWARD ENLIGHTENMENT	15
Four Shades of Light.....	15
Babylon System.....	17
Discovering ‘I and I’	18
2 INTRODUCTION: FALLING IN THE RAIN	20
A Primer.....	20
A Dilemma	23
A Line of Inquiry.....	25
A Clarification of Statements.....	28
Professional Learning Communities.....	29
Negotiation of Meaning	33
A Declaration of Significance	35
3 REVIEW OF LITERATURE: WALKING ON SUNSHINE	38
The Review of Research on Interactions in PLCs.....	38
Nature of Collaborative Interactions in PLCs.....	40
Teacher Learning in PLCs.....	43
Perspectives on teacher knowledge	44
Constructing knowledge in PLCs	46
Micro-politics in PLCs	51
Musings.....	53
The Theoretical Constructs.....	54
Constructivism in Theory	55
Foucault’s Power and Knowledge	57
Forms of power	57
The exercise of power.....	60
Power relations.	63
Musings.....	65

The Conclusion.....	67
4 RESEARCH THEORIES AND METHODS: CHASING THE RAINBOW.....	75
About Chapter Four	75
About Epistemological Positions.....	76
About Theoretical Perspectives	81
About Methodology.....	83
Discourse Analysis	84
Foucauldian-inspired discourse analysis.....	86
Discourse as Data	89
About the Investigation	92
Research Context.....	93
Units of Investigation	95
Study Participants	96
Data Sources.....	97
Data Collection.....	98
Data Analysis	99
Foucauldian-inspired discourse analytical tool.....	101
Using the analytical tools	103
About Methodological Implications	105
Plurality.....	106
Reflexivity	107
Qualified Relativism.....	108
Representation	109
About Validity in Qualitative Research.....	110
About Self.....	114
Self as 'I and I'.....	115
Self as Researcher.....	119
About Chapters Five and Six	120
5 FINDINGS I: THE POT OF GOLD	125
Reporting Findings.....	125
Exploring Discourse Types in the Science Classroom.....	126
Summarizing the Lesson Segment.....	128
Introducing the Teacher Participants.....	129
From Battleground to Common Ground	129
Anticipating thoughts.....	130
Evidence is everything.....	133
On a personal note	135
Pressing for understanding	137
Making sense of the prompts	140
A focus on synthesizing	143
Extending the teaching activity.....	144
About the science content.....	147
Flip-flopped	148

	Selecting two discourse types.....	152
	That would be synthesizing.....	157
	Instruction as opposed to discourse.....	159
	To me that's synthesis.....	162
	We could argue anything.....	167
	The big picture.....	170
	We are overachievers.....	173
	Group conclusions.....	176
	Documenting consensus ideas.....	178
	Miss bossy pants.....	181
	Monkey wrench.....	186
	Skydiving.....	193
	Analyzing Consensus Document.....	199
	Summarizing the Interaction.....	201
6	FINDINGS II: MORE GOLD.....	205
	Reporting More Findings.....	205
	Identifying Effective Teaching Strategies in the Science Classroom.....	205
	Introducing the Teacher Participants.....	206
	From Dissonance to Consonance.....	207
	Small talk.....	208
	Asking questions.....	209
	Wait time and argumentation.....	212
	Add, modify and expand.....	218
	Unpacking scientific teaching practices.....	221
	Reviving deliberations.....	228
	Collaboration as a teaching strategy.....	232
	Claims and evidence.....	238
	The big ones.....	242
	All under argumentation.....	246
	These three words.....	251
	Pieces of one puzzle.....	256
	A claim for collaboration.....	259
	What it should look like.....	265
	Consensus claims and evidence.....	271
	Summarizing the Interaction.....	273
7	SYNTHESIS OF FINDINGS AND CONCLUSIONS: SHARING THE GOLD.....	277
	Response to Research Questions.....	277
	Negotiating Meaning Within PLCs.....	278
	Recounting teaching episodes.....	279
	Reflecting on practice.....	282
	Reorganizing knowledge structures.....	284
	Rationalizing ideas.....	287
	Reinventing practice.....	289

Re-envisioning science classrooms	291
Refining instructional strategies	292
Exercise of Power in PLCs	293
Hierarchies of power	294
Shifting hierarchies.	297
Power in absentia	299
Interpersonal power strategies.....	302
Opportunities for Professional Learning and Development in PLCs.....	304
Social interaction.....	305
Knowledge construction.....	306
Action planning	307
Conflict management.....	308
Concluding Remarks	309
Musings.....	310
8 IMPLICATIONS OF RESEARCH: AFTER THE GOLD RUSH.....	320
What Next?	320
What are the Implications for Science Teacher Professional Development?.....	320
What are the Implications for Science Education Research?	324
What Opportunities are there for Further Study?	327
What are the Limitations of this Study?.....	328
9 EPILOGUE: WHAT IS ENLIGHTENMENT	330
My Enlightenment.....	330
What is My Enlightenment?	331
APPENDIX	
A U-FUTuRES DOCUMENT #1: IQWST DISCOURSE PLAN	332
B U-FUTuRES DOCUMENT #2: CLASSROOM DISCOURSE	334
C U-FUTuRES DOCUMENT #3: LEARNING GOALS	335
D CONSENSUS DOCUMENT FOR INTERACTION # 1.....	336
E EMERGING IDEAS FROM INTERACTION # 2.....	339
LIST OF REFERENCES	340
BIOGRAPHICAL SKETCH.....	353

LIST OF TABLES

<u>Table</u>		<u>page</u>
3-1	Articles reviewed as foundation for investigation.....	69
4-1	Profile of PLC participants.....	122
4-2	Data sources and analyses	123
4-3	Foucauldian-inspired discourse analysis tool	124

LIST OF FIGURES

<u>Figure</u>		<u>page</u>
7-1	Processes initiated by activities within the PLCs	313
7-2	Negotiation of meaning in PLCs	314
7-3	Power structures external to the PLC	315
7-4	General power structures within the PLCs	316
7-5	Deliberate power strategies employed during interactions.	317
7-6	Reactive power strategies employed in the PLCs	318
7-7	Opportunities for professional learning and development in PLCs	319

LIST OF ABBREVIATIONS/ACRONYMS

AAAS	American Association for the Advancement of Science
IQWST	Investigating and Questioning our World Through Science and Technology.
NAS	National Academies of Sciences
NRC	National Research Council
NSES	National Science Education Standards
NSF	National Science Foundation
NSTA	National Science Teachers Association
PLC	Professional Learning Community
PD	Professional Development
STEM	Science Technology Engineering and Math
STL	Science Teacher Leader
STLI	Science Teacher Leadership Institute
UF	University of Florida
U-FUTuRES	University of Florida Unites to Reform Education in Science

Abstract of Dissertation Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy

THE NEGOTIATION OF MEANING AND EXERCISE OF POWER IN PROFESSIONAL
LEARNING COMMUNITIES: AN INVESTIGATION OF MIDDLE SCHOOL SCIENCE
TEACHERS

By

Cheryl Althea McLaughlin

August 2014

Chair: Elizabeth Bondy
Cochair: Kent Crippen
Major: Curriculum and Instruction

A professional learning community (PLC) typically consists of practitioners who systematically examine and problematize their practice with the intention of development and improvement. The collaborative practices inherent in PLCs mirror the way scientists work together to develop new theories, and are particularly valuable for science teachers who could draw from these experiences to improve the quality of student learning. Gaps in the science education literature support the need for research to determine how interactions within PLCs support science teacher development. Additionally, issues of power that may constrain or encourage meaningful interactions are largely overlooked in PLC studies.

This qualitative study examines, from a Foucauldian perspective, interactions within a PLC comprising middle school science teachers preparing to implement reform curriculum. Specifically, the study analyzes interactions within the PLC to determine opportunities created for professional learning and development. Audiotaped transcripts of teacher interactions were analyzed using discourse analysis building tasks designed

to identify opportunities for learning and to examine the exercise of power within the PLCs. The discourse analytical tools integrated theories of Gee (2011) and Foucault (1972), and were used to deconstruct and interrogate the data. The events were subsequently reconstructed through the lens of social constructivism and Foucault theories on power.

The findings identified several processes emerging from the interactions that contributed to the negotiation of an understanding of the reform curriculum. These include reflection on practice, reorganization of cognitive structures, reinvention of practice, and refinement of instructional strategies. The findings also indicated that the exercise of power by entities both external to, and within the PLCs influenced the process of meaning negotiation among the science teachers. The consensus achieved by the teachers reflected knowledge constructed by science education discourses external to the PLC, which regulated understandings emerging from the interactions. Additionally, some teachers, through their actions, exercised power in ways that hindered rather than enhanced constructive dialogue in PLCs. The exercise of power by external institutions was nevertheless necessary to set the stage for the series of actions, the outcome of which facilitated constructive dialogue among science teachers who were implementing the reform curriculum.

CHAPTER 1
PROLOGUE: THE PATH TOWARD ENLIGHTENMENT

Four Shades of Light

Pursuing a doctoral program of study can be likened to embarking on an adventurous journey to an unknown, yet remarkable destination. My experiences on this journey have increasingly enlightened my understanding of issues related to curriculum and instruction, particularly in the field of science education. I frequently fantasize about my destination, which I refer to as Enlightenment. What will it be like? What will I do when I get there? Will I meet other folks who took a similar journey? Does this place even exist? In various sections of this composition, I allude to the illusionary character of my destination, Enlightenment, by interchangeably using the term 'Rainbow's End'. My journey, nevertheless, is characterized by downpours of information gathered during literature reviews, accompanied by intermittent bursts of light each time I construct knowledge from readings or my inquiry process. In anticipation of the illumination associated with this journey, I will have to find ways to protect my eyes from the glare.

My eyes have always been sensitive to light and so the sunglasses became an integral part of my fashion accessories in my early teens. I have a pair of sunglasses or 'shades', as we call them in Jamaica, to match the many colors I wear. Each pair of shades has a different tint to reduce the glare of extremely bright light as well as to enhance the focus of the landscape before me. I recently discovered an interchangeable multi-lens shades that combines eye protection function, style, and moods. This shades allows me to change the tint of my lens, and thus my perception of landscapes without removing the frame from my face. This multi-lens shades is perfect

for viewing the varying conditions I am likely to experience on the path toward Enlightenment.

In this particular composition, you will encounter three lenses that I will use to filter the large quantity of light that I will continue to experience on the path to Enlightenment. The first lens is a color-neutral (not associated with any single hue) composite, which reduces the glare while mildly distorting the color of the landscape. I call this lens Self because it represents my identity, which is never static and constantly shaped by and adapted to cope with multiple experiences during my journey to Enlightenment. The second lens provides excellent depth perception although very little protection from the glare in extreme light conditions. This lens is aptly named after Foucault, whose ideas on power and knowledge will provide additional brightness to an already well-lit landscape. The third lens enhances the visibility of objects while providing excellent contrasts in certain conditions. I use this lens to represent the constructivist theory that is expected to provide a clearer understanding of how knowledge is constructed through social negotiation of meaning. The multi-lens or multi-perspective approach to be used in the interpretation of my data and my experiences on the path to Enlightenment has contributed profoundly to the simultaneous processes of inquiry and learning that have come to characterize my discovery and consequent construction of Self. Now I wear my multi-lens shades, especially at night, with a new perspective of Self, and with the lens of Foucault and others close at hand. How else would I see the light that periodically shines on the path to Enlightenment?

Babylon System

Although I treat my light sensitivity as a mere inconvenience, the medical practice has pathologized my condition as ‘photophobia’, a disorder of the optical rods and cones that causes the eyes to become extremely uncomfortable in the presence of light (DeVita 2010). This disorder is formalized within medical discourses in a way that would otherwise cause me to perceive myself as a patient or a subject of the knowledge system. Regimes of power or ‘Babylon systems’, as we call them in Jamaica, have a tendency to regulate and control the masses through institutional practices that legitimize the truth claims of formalized knowledge domains. Had I conformed to ‘Babylon system’, I would have been overdosing on supplements containing beta-carotene and lutein, constantly consuming spinach and collards, and always looking to the right when I drive at night (DeVita 2010). Instead, I chose to exercise the power of Self and addressed my light sensitivity by wearing my sunglasses during the days, and sometimes at night. I have found that I don’t always have to conform to ‘Babylon systems’. I can question dominant claims and truths, explore other versions of reality, and in the end make a choice that is congruent with my own version of the truth. In this case, my version of truth does not involve ‘pill-popping’ or ‘fad-dieting’.

It was the Foucault lens that permitted me to perceive how regimes of power or ‘Babylon systems’ dictate writing formats for what the academic discourse refers to as ¹dissertations. From the poststructural/postmodern theoretical perspective of Foucault, I question the universally accepted tradition of dissertation formats by boldly choosing to write multilayered texts that move between different perspectives and subjectivities

¹ The term ‘dissertation’ comes from the [Latin](#) word *dissertātiō*, meaning ‘path’

(Koro-Ljungberg 2008); between tradition and innovation; and between legitimized and de-legitimized discourses reflected in the lyrics of some of my favorite songs. The composition that follows, therefore, periodically 'zigs' into my personal thoughts and wonderings then 'zags' into salient aspects of my research then again 'zigs' into the shades of light facilitated by the multi-lens system of interpretation. In other words, I did not rigidly conform to any particular tradition of presentation, rather using my own creative logic to determine how I present my work. You will notice close similarities between this composition and the 'Babylon system' dissertation format. However, interpret this not as docile submission but rather as pseudo-conformity: conformity to appease the 'powers that be', and nothing much else. In any case, the hope is that you will get a clearer understanding of my 'sense-making' journey on the path to Enlightenment.

Discovering 'I and I'

Richardson (2000) characterized writing as a process of discovery: a way of knowing about the world, ourselves, and about others. As such, it is a dynamic and creative process that amplifies our inner voices while connecting the knowledge being constructed about our subjects and ourselves. I embrace Richardson's (2000) view of 'writing as inquiry' not only because it aligns seamlessly with the poststructural/postmodern theoretical position held in this composition but also because it releases me, albeit intermittently from the shackles of the 'Babylon system'. I can write freely without trying to suppress Self, or 'I and I' as we often say in Jamaica. The term 'I and I' is used mainly by Rastafarians in an attempt to demonstrate their favorable stance on pluralism, a stance I have espoused for many aspects of this composition. I have just recently come to terms with the multiple identities I assume when I switch from

one lens of my shades to the other for greater clarity or depth. I have also found that my proclivity for creative conformity, where I straddle the thin (or thick) line of conformity and outright dissent by astutely refashioning an imposed tradition to 'make it mine', has influenced my research process. The multiple identities of 'I and I' will be unearthed by my writing process.

As such, there will be occasions when I refer to myself in the third person to highlight some of the conflicts inherent in my identities. Sometimes, I will use the term 'I and I' to demonstrate congruence among my identities. Other times, I will simply use the term 'I' if the circumstances do not require a distinction. This inquiry process will unearth the diverse identities that constitute Self. As the reader, you will be able to perceive them, to question their assumptions, and to understand how they shape my interpretations. As the writer, I will lose myself in this inquiry process yet find 'I and I' somewhere on the path to Enlightenment. The composition you are about to read is the key that leads to 'I and I'.

CHAPTER 2 INTRODUCTION: FALLING IN THE RAIN

A Primer

My journey on the path to Enlightenment is perpetually besieged by a deluge of information gleaned through readings about selected topics in science teacher professional development (PD). Each reading inspires a new wondering, or problematizes taken for granted practices that have come to characterize PD models in science education. In any event, the deluge has contributed to transient moments of clarity, confusion, and conflict. The incessant deluge of information both electronically, and in print can overwhelm even expert explorers on the road to Enlightenment. Learning how to effectively manage and streamline the downpour is essential for those of us trying to see the light in the midst of the rain. I became aware of my interest in in-service teacher learning several years before I was able to identify one specific aspect of the field for special focus. During this time, I repeatedly wondered if the deluge would ever stop or if I had to take steps to end it myself. How can I find my way through this never-ending surplus? How can I zero in on a topic for research if I can barely see through the glut of data, knowledge, and truths? Do I find a topic before framing questions within a relevant context? Or do I search within the deluge of published truths for a contradiction, a rupture, a shadow of a doubt that could possibly allow me to establish a line of inquiry? Although my wonderings took many twists and turns in arriving at a subject for study, I creatively conformed to 'Babylon system' in this composition by briefly establishing a context within which I will ground my research.

Reform initiatives in science instruction are largely guided by the notion that science constitutes two essential elements: a body of knowledge reflecting current

understandings of phenomena; and also a set of practices that establish, expand, and refine these understandings (Michaels, Shouse, & Schweingruber 2008; National Research Council [NRC 2012]). At the heart of the construction of scientific knowledge is the collaboration of scientists who engage in argumentation as they rely on evidence to develop new theories and models while modifying extant knowledge or ideas. Scientists, therefore, are part of a social and professional community with well-established norms and practices that constitute one of the three dimensions of the new framework for K-12 science education. In the science classroom, the characteristic collaboration of scientists is reflected in the establishment of ‘communities of learners’ (Bass, Contant, & Carin 2009; Thomas, Wineberg, Grossman, Myhre, & Woolworth 1998) who together explore various concepts or complete assigned tasks. Science teachers play a huge role in establishing and nurturing these learning communities to ensure that students become immersed in the culture and practices of the scientific community while making sense of their own emerging conceptions (Bass et al. 2009). As facilitators of meaningful collaboration in their classroom, it is essential that science teachers themselves participate in learning communities that allow for the “collaborative articulation of experience and practice” (Roth 1998, p. 300). According to Roth (1998), learning communities comprising science teachers could contribute to the construction of new understandings that will likely enhance the design and implementation of meaningful learning experiences for the classroom community of learners.

Meaningful learning for students in communities, therefore, hinges on the establishment of parallel communities for science teachers (Roth 1998; Thomas et al. 1998). The call for collegial interaction among teachers began in the early 1980s in an

attempt to change the culture of isolation that plagued the education system (Hargreaves & Dawe 1990; Templin 1988). Since then, there has been a coordinated and systematic effort to resolve issues of teacher isolation by promoting social experiences designed to expose teachers to those skills and dispositions required to foster collegiality (Hargreaves & Dawe 1990; Little 1987). Collegiality or collaboration is currently viewed as an important prerequisite to school improvement, the transformation of teacher practices, and increased student achievement (Bolam 2008; Little 2002; Wood 2007). As a result, science teacher PD initiatives have shifted from forms that promote individualism to those that encourage constructive interactions and experiences.

The emergence of the professional learning community (PLC) as a site for the consolidation of skills, knowledge, and experiences supports calls for a shift in the way teachers are engaged in PD. PLCs are generally regarded as an effective approach to teacher development that could engender significant improvement in teaching and learning (Little 2002; Vescio, Ross, & Adams 2008). The collaborative practices inherent in PLCs mirror the way scientists work together to develop new theories, and are particularly valuable for science teachers who can draw from these experiences to improve the quality of learning for their students. Research indicates that repeated interactions with peers within PLCs contribute to an understanding and appreciation for science as a process, which could enhance inquiry-based instruction in science teachers (Boud & Middleton 2003; Marlow, Wright, & Hand 2003; Wenger 1998). Consequently, many administrators have adopted this approach to PD.

It should be clear to you at this juncture that PLCs are the subject of my inquiry as I journey on the road to Enlightenment. In establishing a rationale for my selection, I connected the dots between the science curriculum and instruction. It seems reasonable to make this connection not only because I am pursuing a degree in curriculum and instruction but also because of my personal and professional experiences with in-service and pre-service teachers. Teachers have a tendency to use strategies in the classroom that they have acquired during transformative learning experiences of their own. Frankly, the best way to get teachers to improve their teaching is to engage them in the same effective practices as learners that they are expected to provide for their students. Nevertheless, embedded within the context presented above is a dilemma, which my research will be addressing. At this stage of my discovery, I have found that the deluge never really stops. As a researcher you make an executive decision, when you reach a point of saturation, to look beyond the rain and try to find the sunlight. The sun becomes the source of light as you comb the literature for ruptures or gaps in extant research that can provide a basis for future inquiry. When the sun appears, the deluge will fade into darkness.

A Dilemma

It is amazing how clear it becomes when you put the downpour of information into perspective and consolidate your thoughts with existing research in the field. The process requires critical thinking skills that allow you to constructively question the truth claims of experts in the field, and to identify ruptures and gaps in the literature as you zero in on a specific research problem. It was my intention to address a problem that has not yet been investigated by others in science education. I wanted to tread the road less traveled where hidden treasures are often left in plain sight. More importantly, I

wanted to tackle a problem that would add other truths to those already established within the field. I understand that my truths will be subject to inquiry, critique, and criticisms but I refuse to be deterred by that eventuality. For now, my focus is on the dilemma that presents itself in the midst of the deluge; the extent of which becomes clearer as the rain fades into nothingness.

It appears reasonable to conclude that the implementation of PLCs, given the literature to support their efficacy in promoting teacher change, should be made mandatory as part of the nationwide initiative for improving global competitiveness in the field of science and technology. However, gaps in the science education literature support the need for additional research to determine the extent to which PLCs are able to provide learning opportunities for science teachers. Despite the burgeoning number of articles concerning PLCs, there is very little empirical data to describe or substantiate the learning that allegedly takes place in these groups. Neither is there much research to indicate how interactions within PLCs provide teachers with the opportunity to develop professionally. Furthermore, while there are several studies investigating collaborative interaction in PLCs involving math and language arts teachers (Horn & Little 2010; Little 2002), or social sciences and English teachers (Thomas et al. 1998), and literacy teachers (Florio Ruane 1994), there are very few studies involving science teachers. If PLCs are being established to engender science teacher development, it is important for researchers to address specific issues relating to science teacher knowledge and learning. For instance, what knowledge is generated and disseminated within PLCs? What do participants learn? What changes does teacher knowledge undergo during activities within these PLCs? How is the knowledge constructed used to

inform science teachers' practice? How is meaning negotiated in these groups? How do these negotiated meanings reflect the practice of the PLCs? Why should PLCs be considered valuable resources for the PD of science teachers?

Somehow, PLCs are being widely adopted without a clear understanding of their potential for facilitating teacher and student learning. If they are integrated within a PD program, what are the expectations for success? Can we afford not to establish PLCs due to scant evidence of their efficacy? Do we blindly accept the truths of those who guarantee the success of PLCs based on outward appearances? Do we play it safe by perpetuating the status quo? A third possibility involves an inside exploration of the dynamics and mechanisms that have come to characterize PLCs as sites of learning and development for science teachers. Investigating the utility of PLCs in engendering teacher learning is essential for informed decision making regarding the development of science teachers. Identifying this dilemma as the focus of my research signified an important stage on my path to Enlightenment because it provided the basis for establishing the requisite line of inquiry. It provided a necessary reprieve from the incessant deluge of information as I attempted to transform the research problem into carefully crafted questions. As a necessary requirement of the 'Babylon system', my questions must align with my theoretical position. Again, I will have to abandon the comfort of clarity and fall back into the rain of anxiety if only to ensure the integrity of my composition.

A Line of Inquiry

I must have edited my questions a thousand times to ensure alignment with epistemological and theoretical perspectives. It was not the case that I did not know what I wanted to inquire about. It was a case of acknowledging and conforming to a

view of 'Babylon system' that, over time, 'I and I' have come to accept as a personal truth. I believe that researchers ought to demonstrate epistemological awareness by connecting their assumptions about knowledge with research designs and argumentation structures (Koro-Ljungberg, Yendol-Hoppey, Smith, & Hayes 2009). To me, this research practice is analogous to my tendency to ensure that my accessories match choice of dress. For instance, I and I would not be caught dead wearing flip-flops with a well-tailored pants suit. It is not that it cannot be done and that others do not find it acceptable, it is just that in the reality I and I have constructed for myself, a tailored pants suit is best worn with an equally fashionable wedge heel pump (shoe). Again, a poststructural/postmodern stance does not automatically reject traditions or conventions but rather calls for critical examination and rationalization of the 'Babylon systems' we choose to embrace. Although I had a vague idea of the line of inquiry I wanted to pursue, it became necessary for me to phrase my research purpose and questions in a way that reflects congruence with my epistemological and theoretical position. To do this, I necessarily fell back into the inescapable deluge.

Rather than investigating impacts on teacher practice and student achievement, I chose to examine the potential that PLCs offer science teachers for the improvement of their practice. To do so, I thought it necessary to analyze social interactions within them to determine characteristic features, the nature of the language used and meanings negotiated as a result, and the underlying power structures that control the outcomes of these interactions. Assuming a constructionist epistemological stance (Crotty 1998) offers a clear advantage for the design and wording of my research questions. Social constructionism research focuses on social interactions, and the language used to

construct meanings in the discourse generated as a result (Burr 2003). The inclusion of a power analysis reinforces the need for a Foucauldian theoretical lens to reveal implicit or explicit actions that could either hinder or engender knowledge construction within PLCs. The line of inquiry established and the resulting research questions, therefore, reflect the pluralism that has come to characterize this research.

My intention in pursuing this line of inquiry is to examine interactions within a PLC comprising middle school science teachers who are in the process of implementing a reform curriculum, in order to reveal specific elements and processes that contribute to knowledge construction, learning, and development. The investigation was guided by the following overarching research question, and sub-questions:

- 1 How can professional learning communities (PLCs) operate as a site for learning and development of middle school science teachers in the process of implementing an inquiry curriculum?
 - a) How do middle school science teachers negotiate meaning and construct knowledge about their practice during interactions within a PLC?
 - b) How does the exercise of power influence the process and outcome of consensus making among middle school science teachers within the PLC?

The wording of the overarching question reflects the fusion of the epistemological and theoretical perspectives that guide the research. The first sub-question contains signifiers related to understandings, conceptualizations, and experiences, which reflect meaning-making process that is associated with constructionism. In the second sub-question, the deconstruction of power structures reflected in the discourses generated during interactions reflects the critical inquiry that is inherent in the poststructural/postmodern theoretical perspectives (Koro-Ljungberg 2008; Olssen 2003).

I have come to gain a deep appreciation for the periodic bouts of rain that drench my mind and stimulate the kind of introspection required to make sense of myself, and the meanings I have negotiated from the truth claims of others. I have also come to value the moments of clarity, that is, the sunny days that follow the rain. I am beginning to think that the two follow in an alternating pattern that contributes enormously to knowledge I have constructed on the path to Enlightenment. Undoubtedly, the establishment of a line of inquiry signals a sense of certainty not only about where I am in the research process but also the direction in which I can proceed. However, I am also aware of the fluid nature of the meanings I construct for myself, and that the social interactions that I participate in on this path could likely result in re-constructions, reorganizations, renegotiations, realizations, and re-conceptualizations. In any case, I have learned to capitalize on the sunny days, and the lucidity and sanity that they contribute to “I and I’ state(s) of mind.

A Clarification of Statements

I have decided to take advantage of clarity afforded me by the sunny days to describe socially constructed views of some key terms that will be used throughout this report. These terms include PLCs and negotiation of meaning. The hope is that familiarity with these concepts will enhance your understanding of my research process and findings. So far, I have indicated my interest in PLCs as well as the interactions within them. I have also indicated that the social construction of knowledge takes place when individuals interact with each other. This construction takes place when individuals negotiate meaning and arrive at consensus regarding a particular theme within a knowledge domain. In the ensuing paragraphs, the explanations provide the

context for the new ideas that findings from this research will undoubtedly generate. I embrace, with pleasure, the sunny days.

Professional Learning Communities

The term professional learning community is used in the literature to describe any number of combinations comprising school professionals, including grade level teachers, school department members, and school district administrators. The concept is based on contemporary management theory positing that groups of individuals can expand their capacity when they are continually learning together in communities where “new and expansive patterns of thinking are nurtured” (Senge 1990, p. 3). Some researchers, however, indicate that the concept can be traced back to the work of Dewey (1929), who espoused the idea that teachers should use data from educational practices as a catalyst for collective inquiry and PD (Stoll et al. 2006; Wood 2007). Although the term PLC was just recently adopted to define certain collaborative activities within the field of education (Vescio, Ross, & Adams 2008), the idea that groups of teachers could develop and share knowledge garnered from their experiences in the classroom, has been long established among researchers (Darling-Hammond 1996; Hord 1997; McLaughlin & Talbert 1993). In fact, a variety of terms have been used over the years to characterize these constructive interactions about teaching quality and student achievement (Duncombe & Armour 2004). These include collaboration (Rosenholtz 1989), collegiality (Little 1993), teacher learning community (Little 1990), professional community (Louis & Kruse 1995), and professional learning community (Hall & Hord 2001). Regardless of the name given to these teacher groups, there is a consensus that they facilitate the critical examination of practice, and its impact on student achievement (Darling-Hammond & Richardson 2009; Little 1990;

Wood 2007). They also create a setting for teachers to collectively construct knowledge, thus providing opportunities to learn.

Researchers have been reticent in establishing a standard definition for the term PLC, arguably because of variations of the interpretation in different contexts. Those researchers who advanced a definition were cautious to emphasize the activities that were central to its function rather than provide specific details about the composition and core features of a PLC. For instance, DuFour and Eaker (1998) who were the first to establish a model for PLCs (Blankenship & Ruona 2006) defined it as educators creating, “an environment that fosters mutual cooperation, emotional support, and personal growth as they work together to achieve what they cannot accomplish alone” (p. xii). This definition provided a framework for subsequent conceptualizations in the literature. Bolam (2008), after a review of the literature, proposed the following working definition: “An effective PLC has the capacity to promote and sustain the learning of all professionals in the school community with the collective purpose of enhancing pupil learning” (p. 165). Groundwater-Smith and Mockler (2009) indicated that PLCs are “deliberate arrangements that bring practitioners together in a systematic way to examine and make problematic features of practice with the intention of development and improvement” (p. 103). Darling-Hammond and Richardson (2009) also focused on the activities within a PLC. They indicated that in PLCs “teachers work together and engage in continual dialogue to examine their practice and student performance and to develop and implement more effective instructional practices” (p. 49). Despite the lack of consensus on a standard definition for the term and the arguable ambiguity of the

definitions proposed in the literature, there is unanimity regarding the characteristics of PLCs.

Stoll and others (2006) describe some of the core features that were omitted from the definitions presented in the literature. These include, shared values and vision; collective responsibility; reflective professional inquiry; collaboration; and the promotion of group and individual learning (DuFour 2004; Vescio et al. 2008). Bolam (2008) has since then indicated that three additional characteristics were key to effective PLCs. These include mutual trust, respect, and support; openness, networking and partnership; and inclusive membership (Stoll et al. 2006). These characteristics seem to underscore the importance of community, such as shared values, collaboration, and collective responsibility. They also provide guidelines for interactions within these communities, including respect, mutual trust, and sincerity. The community focus of PLCs pervades the literature as researchers emphasize the necessity of shared perspectives, interdependence, and constructive collaboration to teacher professional growth (Darling-Hammond & Richardson 2009; Dooner, Mandzuck, & Clifton 2008; Duncombe & Armour 2004). The characteristics appear to place less emphasis on the notion of learning, with only two of the eight making direct reference to general conceptions of the process. These include, reflective professional inquiry, and the promotion of group and individual learning. Despite this, researchers agree that the ultimate purpose of PLCs is the improvement of practices to ensure greater student achievement (Bolam 2008; Lumpe 2007; Vescio et al. 2008). Furthermore, Bolam's (2008) definition of PLC implies that learning occurs by virtue of the collaborative action of the group members.

The word 'professional' in the term PLC gives a vague indication of the composition of these teams. Because the term is used in the context of education, it seems logical to assume that educators typically constitute PLCs. As indicated earlier, in providing definitions or core features of PLCs, the literature does not directly address who should or should not be considered a part of the community. Bolam's (2008) inclusion of the term inclusive membership, and DuFour and Eaker's (1998) reference to educators in their definitions did very little to clarify the issue. Apart from teachers who are understood to comprise the major core of the group, who else should participate in teacher development efforts in this context? Again, there has been no consensus on this issue, and researchers reporting findings in the field have not been very forthcoming about the professional status and roles of the individuals in the group. Some of these studies alluded to the presence of external partners who facilitate activities within PLCs (Duncombe & Armour 2004; Roseberry & Puttick 1998), others mention that university professors often join these teams as equals (Little 2002), others describe PLCs as comprising solely of teachers (Loucks-Horsley & Matsumoto 1999), and others characterize entire schools as PLCs (DuFour 2004; Hord 1997). This lack of transparency or consensus regarding the composition of PLCs suggests that more emphasis is placed on the interactions and related outcomes rather than on the individuals within it. This can become problematic because the participants play an important role in determining the nature of these interactions and outcomes.

In sum, the composition of PLCs may vary depending on the institution and the goals of the collaboration. What is made abundantly clear in the education literature is that regardless of the individuals within it, interactions must be guided by, among other

things, collaboration, mutual respect, and shared vision. Additionally, a clear and consistent focus on teacher improvement and student achievement is necessary for an interacting group of individuals to be considered a PLC.

Negotiation of Meaning

According to Wenger (1998), meaning is embedded in our daily experiences, and is situated in a process called negotiation of meaning. Individuals make sense of their experiences by constantly making associations with prior ideas or beliefs, and resolving conflicts that emerge as a result (Lorsbach & Tobin 1992). When individuals are faced with conflicting cognitions, i.e., values, beliefs, experiences, emotions, they are considered to be in a state of dissonance or disequilibrium (Driver & Erickson 1983). Resolving these conflicts allows individuals to regain equilibrium, hence modifying their original perspectives as they come to embrace new cognitions. Our experiences in the world and our interactions with other individuals within in it involve a continuous process of negotiation of meaning (Lave & Wenger 1991; Little 2002). Wenger (1998) refers to the process as an “accomplishment that requires sustained attention and readjustment” (p. 53). Individuals use this process to make sense of their experiences through coordinated processes of interpretation and action. These processes are integrated into our daily actions and contribute to the generation of new circumstances that will encourage further negotiation and meaning (Wenger 1998). Seemingly mundane activities such as making breakfast, deciding what items to purchase in the grocery store, or reading this chapter involve the negotiation of meaning. Meaning, therefore, is reconstituted through a process of negotiation as a result of our experiences with the world around us.

Negotiation of meaning is also necessary if individuals are to arrive at consensus during social interactions. Discussions sometimes create a state of cognitive dissonance especially if the alternative views presented are incompatible with the existing views of others. The resulting disequilibrium stimulates the development of new understandings as individuals critically examine the ideas of others, discuss differences and similarities of multiple views, and select a single idea that is deemed viable (Lorsbach & Tobin 1992; Savery & Duffy 1996). This process of negotiation, according to Lorsbach and Tobin (1992) can lead to a consensus that reflects the understanding of those within the group. Knowledge, therefore, is generated “through social negotiation and through the evaluation of the viability of individual understandings” (Savery & Duffy 1996, p. 136). When science teachers are given repeated opportunities to make sense of their classroom experiences through a process of negotiating meaning, they are able to expand their knowledge in and about their practice.

The extended episode of clarity and the introspection that accompanied it resulted in new perspectives on the rains that highlight my path to Enlightenment. I used to see the rain as an inconvenient interruption to moments of clarity that dampens my spirit and drives me to a state of temporary confusion. I had negative feelings about downpours and my first response was typically to escape the mental distress by delaying my readings or browsing the pages rather than engaging the content in depth. Now the rain brings me joy, soothes my mind, and lifts my spirit. Sometimes, I harvest the rain for use during periods of drought. Synthesizing and making notes while I read have not only reinforced ideas, but the practice facilitates consolidation into a bank of information stored physically in my notebooks, electronically on my laptop, or virtually in

drop-box. This experience highlights the power of perception. When I perceived the rain to be undesirable, I failed to see how extremely important it is for my own learning on this journey. Now that I see the downpour of information as favorable to my development as a scholar, I go in search of it and become lost in the flood, taking comfort in the thought that the sun will shine again. Negativity is just a state of mind.

A Declaration of Significance

It is important to me that my work contributes positively to the discourse on the PD of science teachers. Otherwise, I would view this journey as unproductive and inconsequential. Perhaps, this is a state of mind that I should eschew but at this point in my journey, it is a truth I embrace. How would you feel if you planted a seed, watered the growing plant, nurtured it with fertilizers and plant food, protected it from pests and weeds, occasionally spoke to it in the hopes that it will respond, and it fails to bear fruits? Perhaps my goal-oriented nature has heightened my expectations for this composition but why would I take this journey if I were not confident about its significance? Why would I travel into the land of the unknown without an intention to acquire mementos over time? So as I pursue this line of questioning for my research, I ask myself: How does this composition contribute to the body of knowledge on PLCs? What is the greater good for which this work is being done? How will in-service science teachers benefit from my work? Finding these answers is essential to my state of mind as I plan the next steps on this journey.

There is a dearth of empirical research relating to PLCs comprised exclusively of science teachers. Furthermore, I was unable to locate substantive research in the field describing social interactions among science teachers that could explain or justify the current appeal of PLCs. Rosebery and Warren (1998) investigated research methods

that would facilitate the documentation and analysis of learning during social interactions within science teacher research communities. Additionally, Rosebery and Puttick (1998) explored how one science teacher made sense of her interactions with others in a research community. Other research relating to teacher interactions have been conducted in PLCs comprising math, language arts, social studies, special education teachers, or various combinations of these teachers. These, and other studies will be reviewed in chapter two. While none of these studies specifically addressed the line of questioning I am pursuing for this study, they certainly provide relevant background for anchoring research in PLCs.

This research, while adding to the existing literature on PLCs, will uncover the learning that occur when science teachers collaboratively engage in activities designed to improve their practice. The examination of power relations that may constrain or encourage meaningful interactions adds a dimension to the study of PLCs that is largely overlooked in the science education research literature. Locating the learning in PLCs, identifying those elements that contribute to teacher development, and recognizing potential issues of power are critical to the pronouncement of PLCs as effective tools in PD. Not only could this investigation validate the extensive implementation of these learning groups for science teachers, it could also inform the way administrators design and monitor the activities used to engage teachers within them.

This affirmation of significance has provided the impetus for my next steps on the path to Enlightenment. It is my intention to ensure that the findings from this research contribute to the deluge of information that others face on their own paths of Enlightenment. I would hate to have my composition relegated to file thirteen because

of its lack of relevance to the field. As I look down the road, I feel energized by my new state of mind. Not only am I at peace with the downpours, but I am also beginning to embrace the sunshine. With my light-sensitivity issues, I get to wear my multi-lens shades. I have identified four different lenses, which will be comprehensively described in the upcoming chapter: the composite lens of Self, the lens of Foucault, the lens of constructivism, and the transitional lens of legitimate peripheral participation (LPP). The hope is that you will come to understand claims I have made, the meanings I have negotiated, and the realities I have constructed from my experiences and reflections.

CHAPTER 3 REVIEW OF LITERATURE: WALKING ON SUNSHINE

The Review of Research on Interactions in PLCs

The emphasis of my research is on the processes associated with PLCs rather than the impacts of their presence in schools. The literature review contained in the next few pages reflects this emphasis as I delimit the boundaries of my inquiry. I find that setting boundaries is a very good way to focus my attention on the issues under investigation while bringing the context of my study upfront and center. I am particularly interested in the questions that have been asked about teacher interactions in PLCs as well as the methodologies used in addressing these questions. At this stage of my journey, the review of literature is less grueling because of the new and improved state of mind I have adopted during the journey so far. I have rejected the gloomy depiction of rain in favor of a more optimistic stance towards reading and synthesizing the literature that will contextualize my research. Rather than thinking about the literature as deluge, I now think of it as a sun shower. A sun shower is a meteorological phenomenon during which rain falls while the sun shines. The use of this metaphor confirms the mental clarity that I have come to associate with careful management of extant literature. More importantly, it ushers in a new phase of my journey on the path of Enlightenment. Now I think the sun is here to stay.

Much has been written about the positive impacts of PLCs on teacher practices, student learning, and school improvement (Bolam 2008; Lumpe 2007; Vescio et al. 2008). Most of these studies have focused on teachers' perceptions of the way their instruction has changed as a result of participation in PLCs (Andrews & Lewis 2002; Snow-Gerono 2005), and on data garnered from students' performance on various

assessment tasks (Bolam, McMahon, Stoll, Thomas, & Wallace 2005; Hollins, McIntyre, Debose, Hollins, & Towner 2004; Louis & Marks 1998). However, researchers were unable to establish a direct link between student achievement and PLCs, rather indicating that higher student achievement occurred in those schools with active PLCs (Bolam et al. 2005; Louis & Marks 1998). For instance, rather than arguing a causative connection between student achievement and PLCs, Louis and Marks (1998) demonstrated that PLCs are typically present when classrooms are organized, and student performance on authentic assessments was high. Evidence of the value of PLCs in engendering changes in instruction and student achievement is, therefore, preliminary at best (Stoll et al. 2006; Vescio et al. 2008). Further studies are required to determine the nature of the interactions in PLCs that contribute to teacher learning and changes in practice (Little 2003; Wilson & Berne 1999).

The purpose of this review is to explore the existing body of work that provided a foundation for my investigation into the content of collaborative interactions among science teachers. As indicated in the previous chapter, there are very few studies that focus on PLCs comprised exclusively of science teachers but reports on interdisciplinary teams proved very valuable in establishing the basis of this research. In selecting articles for this review, I examined the research purpose and/or questions to ensure that the research explored issues that related directly to my own research questions. Consequently, articles investigating the nature of interactions in PLCs, teacher knowledge and learning in PLCs, and micro-politics or issues of power within PLCs were preferred for this review. I was particularly interested in examining the

data sources, methods of analysis, findings, and conclusions. My search, which was by no means exhaustive, yielded fourteen articles, which are summarized in Table 3-1.

Nature of Collaborative Interactions in PLCs

Investigations of collegial interchange (Little 2003) within PLCs provide valuable information regarding specific activities, interactions, and resources that could contribute to teacher learning (Horn & Little 2010). According to Little (2003), claims regarding the benefits of PLCs must be substantiated by empirical studies that demonstrate how collaborative interactions constitute a potential for teacher learning. Horn and Little (2010) examined two teacher teams to determine how conversational routines contribute to or limit thorough examination of practice, and hence contribute to teacher learning. Analyzing conversational routines, such as turns of talk that shape the flow of interactions, provides insights into various ways in which collaboration can yield opportunities for professional learning. For instance, conversations focusing on problems of practice facilitated the description, elaboration, and re-conceptualization of problems. This problem-solving process has a huge potential for learning because teachers moved beyond conversations that simply report challenges faced in the classroom. Horn (2010), in pursuing this particular line of questioning, also determined that during conversation about their practice, teachers typically integrate two discourse structures namely teaching replays and rehearsal.

Teaching replays are specific accounts of teachers' interactions with students and rehearsals describe ongoing or anticipated interactions in the classroom (Horn 2010; Levine & Marcus 2010). They are both considered valuable resources for professional learning because they "provide a means for teachers to reimagine their classroom practice" (Horn 2010 p. 228) in conversational routines designed to stimulate

pedagogical reasoning. For instance, a routine in which teachers are prompted to give an elaborated account of problems could potentially encourage reinterpretation or reconceptualization of the problem during which teachers reimagine different approaches to its solution. The re-visioning of these accounts indicates that teachers are learning from their colleagues (Horn 2010).

Conversational routines provide resources for teachers to make sense of problems emerging from their practice while focusing the interactions on specific issues. Structured conversations involving formal protocols or highly structured procedural guidelines hold a similar promise of focusing teachers' attention to problems of practice (Little & Curry 2008). In an investigation of interactions within a PLC comprising eight teachers from various departments, Little and Curry (2008) observed evidence-based conversations that were driven by articulation of problems of practice, presentations of selected artifacts that constitute evidence of the problem, followed by formally structured discussion designed to explore possible solutions. They determined that although protocols contributed to the productivity of teacher interactions by ensuring substantive and focused discussions (Curry 2008), there were drawbacks to the regimented nature of such discussions (Scribner, Sawyer, Watson, & Myers 2007). First, rigid constraints on timed protocols facilitated the development of mechanical responses that allowed only superficial examination of the problems. In other words, participants paid more attention to moving through the protocol phases than actually probing the issues in a way that would enable reinterpretation and reconceptualization. Furthermore, limits on time would likely prevent the exploration of issues that may emerge during discussions. Second, the generic nature of protocols and the ease with

which participants can proceed through the phases present an oversimplified view of the generative potential of these structured conversations. Nevertheless, Little and Curry (2008) conclude that protocols have great potential for enhancing individual growth in the participants within PLCs as well as advancing school-wide reform.

In addition to a strong reliance on protocols, Curry (2008) identified three other features of a specific PLC, a critical friends group (CFG) that could contribute to teacher development. These include a wide range of activities that link classroom practice with reform objectives; a decentralized structure that creates possibilities for constructive controversy; and interdisciplinary membership to strengthen school-wide communication. Curry (2008) also identified several limitations associated with these features but concluded that the possibilities for teacher improvement far outweighed the constraints. Levine and Marcus (2010) conducted a similar study with seven teachers across different subject areas. From their investigation, they identified two features that created opportunities for teacher learning: the structure, and the intended focus of the collaborative activity. Teacher interactions may be loosely structured, highly structured with a facilitator and agenda, or protocol-driven. They may either be focused on instruction, student achievement, or on school operations. Collaborative activities that are intentionally structured, and focused on those aspects of practice that teachers would like to improve, are more likely to succeed (Levine & Marcus 2010). These conclusions seem to suggest that the strategic design of PLCs is crucial to the productivity and hence potential to engender teacher professional learning.

In sum, teacher interactions within PLCs range from a loosely structured format where teachers report on issues or challenges emerging from their practice (Little 2003)

to highly structured, protocol-driven routines facilitated by various members (Horn & Little 2010; Levine & Marcus 2010; Little & Curry 2008). Researchers seem to think that teachers benefit from structured interactions that focus their attention on those issues that require attention. The use of student and teacher artifacts in evidence-based conversations (Little & Curry 2008) can also provide teachers with multiple opportunities to restructure and re-organize their perceptions of problems of practice. The restructuring and reorganizing of ideas as a result of these interactions contribute to learning as they engage in the re-visioning of the accounts of their peers (Horn 2010) during problem-solving episodes. The various forms of interactions described in this section provided huge potential for learning and development. In the next section, I explore more specifically learning experiences of participants both from an individual and collective point of view.

Teacher Learning in PLCs

Our perception of learning is largely influenced by theories regarding the genesis of knowledge that we choose to embrace. The literature acknowledges two main metaphors to reflect our characterization of knowledge, namely, acquisition and participation (Paavola, Lipponen, & Hakkarainen 2004). The acquisition metaphor conceives of the mind as a vessel for storing knowledge, and hence learning as the process of filling that container. In this regard, learning is conceptualized as the capacity of an individual mind (Eraut 2000) in which “learning is a matter of construction, acquisition and outcomes, which are realized in the process of transfer” (Paavola et al. 2004, p.557). In other words, learning is the process of applying knowledge in a new context. The reorganization of some aspects of one’s knowledge into a new context facilitates subtle changes in meaning and as such may also be considered as

knowledge construction and transfer (Borko 2004; Knight 2002). The participation metaphor, on the other hand, portrays learning as a process of engagement with others in the various practices and activities of a given group (Greeno 1997; Paavola et al. 2004). From this perspective, learning is defined as enculturation (Brown, Collins, & Duguid 1989), or as legitimate peripheral participation (Lave & Wenger 1991). The participation perspective, therefore, focuses on how knowledge and practices are transmitted from one generation to the next in various cultures (Paavola et al. 2004). In exploring specific instances of learning in PLC, it may be useful to explore various perspectives of knowledge identified in the literature, and used to frame some of the studies reviewed in this section.

Perspectives on teacher knowledge

Cochran-Smith and Lytle (1999) classified various types of knowledge considered necessary for the complex art of teaching. 'Knowledge for practice' usually acquired from experts in the field; knowledge in practice, which is tacitly acquired in the workplace; and 'knowledge of practice' deliberately constructed in PLCs comprising teachers, administration, and university faculty members (Wilson & Berne 1999; Wood 2007). The tacit knowledge generated in practice is of importance to researchers because it is reflected in intuitive action (Duncombe & Armour 2004), and appears to play an important role in the decisions made during instruction. This contrasts with explicit knowledge, which is formalized in literature and disseminated during instruction (Knight 2002). Eraut (2000) also proposed a typology of knowledge based on the variety of learning modes associated with knowledge in practice. His learning modes include deliberative learning during a time that is allocated for that purpose; implicit learning that takes place unintentionally and often with little awareness by the learner of its

occurrence (Knight 2002); and reactive learning that is spontaneous and in response to various situations. The experiential nature of professional work suggests the need to also consider an additional mode of learning called experiential learning that involves “deriving explicit knowledge through reflection on experiences” (Eraut 2000, p. 124). Through these various learning modes, several categories of knowledge emerge, which may be appropriately explored as two parallel characterizations: codified knowledge and personal knowledge.

Codified knowledge may be defined as that which is subject to quality control efforts such as peer reviews and as such is given status when integrated into various education programs (Eraut 2000). This type of knowledge is also typically generated in formal settings (Eraut 1985) and is granted greater legitimacy and status than other forms of knowledge (Boud & Middleton 2003; Eraut 1982; Webster-Wright 2009). Codified knowledge may include discipline-based theories and concepts derived from systematic research, generalizations and principles for professional application, and case-specific propositions (Eraut 1985). Personal knowledge consists of the cognitive tools (Eraut 2000; Martin 2004) and other resources that enable individuals to reorganize other forms of knowledge in a way that is applicable to the learning context. Personal knowledge, therefore integrates codified knowledge that has been modified based on cognitive and affective aspects of previous experiences (Falk 2005; Rennie et al. 2003), and the cultural norms and values embraced (Eraut 2004; Rennie & Johnston 2004). An integration of codified and personal knowledge can also generate individual practical knowledge (Knight 2002; Webster-Wright 2009), which is expressed only in

practice and cannot be codified. It is derived through experience and intuitively used by professionals as they transform their practice.

Shulman (1986), in his seminal article on teacher knowledge explored the domains and categories of teacher knowledge and distinguished among three types: subject matter content knowledge, pedagogical knowledge, and pedagogical content knowledge. The subject matter knowledge refers to the amount and organization of concepts and principles as well as the set of rules that determine what is legitimate within the domain. Pedagogical knowledge includes the strategies associated with teaching particular subjects and involves issues of student learning, classroom management, lesson planning, and assessment (Shulman & Shulman 2004). The third type called pedagogical content knowledge integrates the two types described earlier by considering the representation of the concepts in a way that makes it comprehensible to others. It also includes knowledge of students' prior knowledge and misconceptions as well as effective strategies to facilitate the reorganization of their understanding of a given concept (Knight 2002; van Driel, Beijaard, Verloop 2001).

Constructing knowledge in PLCs

The studies reviewed so far focused on the nature of the interactions of participants in PLCs and investigated conversation routines, structured protocols, and prompts that are potential resources for teacher learning. However, questions regarding specific processes that lead to collective and individual learning have largely been left unattended in these studies. A few researchers have explored the sub-processes involved as teachers construct knowledge from their interactions in PLCs (Coburn 2001; Goodnough 2010; Rosebery & Puttick 1998). Coburn (2001) determined that three sub-processes, mediated by teachers' pre-existing beliefs and practices, enable "collective

sense-making” (p. 152). These include constructing understanding through interpersonal interaction, gatekeeping, and negotiating technical and practical details (Coburn 2001). During conversations, teachers construct an understanding of the issues being discussed then either accept or reject the ideas during a gatekeeping process that is guided by individual worldviews. These individually held views, beliefs, and assumptions are referred to as personal knowledge (van Driel et al. 2001). Ideas that were accepted during the gatekeeping process are then further negotiated as teachers attempt to translate specific approaches to the classroom context. It is this negotiation that determines the knowledge teachers construct from collaborative episodes.

Coburn (2001) contends that as teachers continue to work together, their practice and worldviews become increasingly similar through a process called reciprocal influence. This idea seems to suggest that the knowledge constructed by individual teachers is largely influenced by the pre-existing beliefs and shared understandings of the members of the PLC. Nevertheless, the process of sensemaking as proposed by Coburn (2001) has the potential to engage teachers in ways that will encourage them to question their pre-existing assumptions or personal knowledge about science teaching (Roseberry & Puttick 1998). It also facilitates the reconstruction of individual practical knowledge (Webster-Wright 2009) as teachers reorganize various knowledge structures that will likely facilitate the transformation of abstract ideas into practice (Goodnough 2010).

Goodnough (2010) explored the reorganization of various knowledge frames in a case study involving a science teacher who engaged in a collaborative action research

community. Findings from this study indicated that the teacher relied on codified and personal knowledge to facilitate the reconstruction of conceptual frameworks that allowed her to make decisions about her practice. In other words, she used theories and concepts constructed by others as she pursued her wonderings about practice. During this process, she negotiated her pre-existing beliefs and practices with the ideas generated during interaction. As she reconsidered these knowledge frames, she developed new insights into different aspects of her professional knowledge and improved many aspects of her practice as a result (Goodnough 2010). It seems, therefore, that individual teachers can come away from the same collaborative activities with substantially different understandings and meanings. Although Coburn (2001) alluded to differences between individual and collective learning, Thomas and others (1998) presented empirical data to support this position.

Thomas and others' (1998) conducted a study about a PLC comprising 11-12 literature, history, and special education teachers who participated in activities such as book clubs, video clubs, and the development of an interdisciplinary curriculum. Participants reported considerably different understandings from the group interactions. For instance, experienced teachers within the PLC perceived the community as an agent of political change within the school while new teachers saw the interactions as a means to focus on issues beyond classroom management. Student teachers were able to identify the dissonance between theories learned in university courses and practices observed in the classroom. During their interactions, they were often explicitly told by experienced teachers to "forget the theory of the academy" (Thomas et al. 1998, p. 29). This chasm between theory and practice could potentially hinder professional growth of

novice teachers especially if interactions with experienced mentors broaden rather than bridge the gap. The special education teachers who participated in the PLC, thought that the interactions were helpful in creating a heightened awareness of the special needs students within the school population. The teachers' perspectives largely reflected their personal knowledge as they attempted to make sense of the idea of a PLC. It was unclear from this article, whether or not the teachers learned anything from the interaction. What exactly did they learn from their interactions? How did their learning translate into practice? Subsequent publications from this project indicated that teachers, as a result of their interactions in the PLC, designed their instruction to create similar learning environment for their students (Wilson & Berne 1999; Wineburg & Grossman 1998). However, this change in practice does not specifically reveal the knowledge teachers constructed as a result of their participation. According to Rosebery and Warren (1998), teacher learning in PLCs is not easily captured. Analyzing the groups' discourse provides insights into shared understandings that the group constructed over time as well as some of the processes involved in the construction of such.

Research conducted by Kazemi and Franke (2004) documented math teachers' learning experiences in collaboration involving the examination of student work. In this study, learning was viewed as participation, and activity was used as the primary unit of analysis. In this regard, examining how teachers engage in interpersonal activities allowed researchers to determine individual development. Researchers noted two shifts in participation that involve changes in teachers' roles, and the creation of new identities (Kazemi & Franke 2004). The first centered on attending to the details of students'

thinking as reflected in the artifacts examined, and the second focused on the development of instructional possibilities that emerged as a result. The shifts in participation enabled teachers to explore new ways of 1) interacting with each other as they focused on a common goal, 2) thinking as they reorganize knowledge structures for future development, and 3) experimenting within their classroom based on new understandings. In other words, teachers created new identities as they adopted the practices of the group. This study addressed the issue of teacher learning through the lens of the participation metaphor, hence providing insights about the 'how' and 'what' of teacher learning in PLCs.

Andrews and Lewis (2002) in a study investigating teacher experiences within a PLC used focused group discussions and surveys to determine perceptions of collective and individual learning. Teachers shared a wide range of shared understandings. They indicated that they learned 1) to demonstrate respect for differences in practice, 2) about the possibilities that exist when teachers engage in professional dialogue and critical thinking about different forms of pedagogy etc., and 3) about the power of focusing attention on classroom practice (Andrews & Lewis 2002). When asked to share how their new understandings inspired their practice, the responses were a bit vague. One teacher indicated that the experiences facilitated the use of "concepts and questions to take a structured approach to changing my teaching" (p. 245) while another claimed, "I understand more about what I am doing and why" (p. 246). The ambiguity that characterizes teachers' perceptions of what was learned as a result of community interaction begs several questions at this point. What specifically can teachers learn from PLCs? Does the nature of the interaction limit the type of knowledge that they can

construct? Do they appropriate codified knowledge to the issues emerging from their practice? Can we rely solely on self-reports to determine what is learned? Why are teachers finding it so difficult to explicitly state what was learned? Is it possible that teachers are learning more than they are even aware of learning? How can we make their tacit knowledge explicit? These questions suggest that much more research is required to provide a more specific understanding of what is learned by teachers in PLCs and precisely how subsequent development is reflected in their practice. This next section explores research reporting how power relationships are manifested during collaborative interactions.

Micro-politics in PLCs

Issues regarding conflicts emerging from teacher interactions in PLCs have largely been ignored in the science education literature. In fact, much of the study reported, paint a picture of constant camaraderie among teachers as they achieve consensus on issues regarding their practice. Although some researchers allude to the existence of micro-politics in PLCs (Scribner et al. 2007; Stoll et al. 2006), very few have explored issues of power that could potentially enhance or encumber teacher learning. The term micro-politics here refers to “formal and informal power by individuals and groups to achieve their goals in organizations” (Blase in Achinstein 2002, p. 422). It is relevant to studies of interactions within PLCs because individual differences coupled with motivations to influence the outcome of certain discussions tend to activate micro-political process during meetings (Achinstein 2002). Additionally, understanding group dynamics and the complexity of the collaborative process within a PLC could improve the design of activities, and conversational routines within it. To what extent, though, do conflicts hinder or enhance teacher learning within communities? Can issues of power

be addressed in ways that improve conditions for learning? Should micro-politics be allowed to naturally proceed or should administrators attempt to curb the emergence of such? How do participants respond to micro-political issues?

Achinstein (2002) explored how teachers embrace or suppress differences, and how micro-political issues define community borders. Using case study ethnographic techniques, teachers were interviewed, observed, and surveyed as researchers attempted to explore conflict as a process in PLCs. Findings from the study revealed that in formal settings, the group typically achieves quick consensus by accepting the ideas supported by the majority. In so doing, dissenting voices are suppressed in an attempt to ensure unity in the group. This leads to 'groupthink', a process in which individuals uncritically accept group decisions without exploring alternative ideas or viewpoints (Achinstein 2002; de Lima 2001). The avoidance of cognitive conflict, arguably fosters conformity, impedes professional learning, and could lead to the acceptance of flawed ideas. Achinstein (2002), who also studied a PLC that actively engaged in public conflict, determined that this divergence is an essential element in collaborative interactions that can lead to significant changes in practice (de Lima 2001; Hargreaves & Dawes 1990). However, open conflicts can result in increased discomfort and negative reactions among some teachers. In Achinstein's (2002) study, as a consequence of open conflicts, several teachers withdrew from responsibilities while others resigned their jobs citing burnout and frustration. The pros and cons of actively engaging groups in open conflict in order to engender professional change present somewhat of a dilemma for administrators who harbor high expectations for the value of PLCs in school improvement. Rather than demonizing or disregarding micro-political

processes in PLCs, researchers should explore them so as to assist administrators as they set goals and expectations for interacting teachers (Achinstein 2002; de Lima 2001).

Musings

The literature provided clear ideas regarding research that has already been carried out on teacher interactions within PLCs. Additionally it surfaced gaps in the science education literature regarding the potential of PLCs in the learning and development of science teachers. Can I create a niche for this line of inquiry in science teacher PD? Will my findings illuminate the darkness that exists due to the dearth of research into science teacher interactions in PLCs? For now, the darkness of the dearth establishes the next step on my journey. Ironically, I feel good about the darkness because I expect my findings to provide additional light now that the sun showers have subsided. When the sun begins to shine again, I will have to use my multi lens shades to determine how to process the information I am now in search of. My preference for plurality explains my use of multiple theoretical lenses to guide my interpretations but begs several questions about my research preferences. Questions with answers that elude me at this point in my writing: but questions that will hopefully be answered as I complete my journey. For instance, if the power of multiple theories proves tremendously successful, will I ever be satisfied with one? Will I conceive of 'one' as the loneliest number and as such refuse to even consider the value of a single lens approach to examining data? Do I have commitment issues? Do I always need to have options just in case the main plan does not fit as perfectly as I would like? These questions may appear trivial at this point of my journey but they could have consequences, albeit positive, for the way I design my research and interpret my

findings. Needless to say, I am excited about the possibilities of multiplicity. More importantly, I am excited about the sun.

The Theoretical Constructs

My light sensitive eyes require the use of sunglasses or 'shades', especially when I am in the sun. The intensity of the glare necessitates various tints that will enhance depth perception, improve clarity, and otherwise provide an aesthetic appeal when the need arises. The line of inquiry I established in the previous chapter dictated the lenses I plan to use. I will appropriate a Foucauldian lens to examine micro-political processes within PLCs as well as the macro-politics of the wider school community that could contribute to, or otherwise impede teacher learning. I will also use the theory of constructivism to provide a robust explanation of teacher learning through negotiation of meaning in PLCs. Now that I have found a place in the sun as a vantage point for my investigations, a pricey multi-lens shades will be well worth the investment.

For my multi-lens 'shades', the Foucauldian lens will provide excellent depth perception although very little protection from the glare in extreme light conditions. It will reveal the irregularities, power relations, and contextual significance that are inherently embedded in discourse; as well as some of institutional policies and practices that contribute both positively and negatively to the discourses generated. The lens of constructivism enhances the visibility of objects while providing excellent contrasts in certain conditions. I will use this lens to provide a clearer understanding of the nature of the knowledge created in PLCs, as well as the processes involved in the negotiation of meaning required for socially constructed knowledge. I have come to appreciate plurality as essential to the interpretation of phenomena from different perspectives, thus facilitating the increased explanatory, descriptive, and prescriptive power of

theories (Bikner-Ahsbahs & Prediger 2010). In the next section, I explore these theories, focusing specifically on those tenets that can readily be applied to social learning experiences of science teachers in PLCs. The constructivist theory provides a useful framework for understanding how individuals interact to achieve consensus in a learning community. Additionally, Foucault's theory of power offers profound insights into power relations among interacting individuals and the larger context or institutions within which they are embedded.

Constructivism in Theory

Constructivism is regarded both as an epistemology, and a learning theory that views learning as an “an active process of knowledge construction influenced by how one interacts with and interprets new ideas and events” (Yilmaz 2008, p. 165).

Constructivism is typically used to address various issues such as the development of scientific knowledge, relationships between knowledge and reality, as well as the nature of learning (Gredler 2009). From a constructivist viewpoint, knowledge is socially negotiated (Tobin & Tippins 1993) and constructed through interactions with the environment (Crawford 2000; Gordon 2009). The knowledge constructed is then verified and if there is congruence with other codified understandings, it is accepted and advanced within the learning community as valid interpretations of a given issue (Driver et al. 1994; Tobin & Tippins 1993). The knowledge generated, therefore, is influenced by the goals and problems of the group, with the experiences of the individuals involved, and the way in which individuals interact during the process of meaning negotiation. This view of knowledge as socially constructed and negotiated is central to the theory of constructivism, as it emphasizes the active generation of ideas through experiential learning and intellectual discourse.

The constructivist perspective suggests that the process of knowing involves the adaptive interaction between existing knowledge or beliefs and new understandings and individual experiences rather than the discovery of absolute truths and realities. Individuals learn by integrating their own ideas about natural phenomena with new experiences. They actively construct viable knowledge through a process of careful deliberation on their interactions with ideas and objects in the social or natural environment as well as their own interpretation of these experiences (Gordon 2009; Sprague & Dede 1999). Learning, therefore, involves a process of conceptual change; a product of the adaptive modification of teachers' prior knowledge based on the organization of formal instructional experiences. Collegial interactions within PLCs, therefore, aim to provide teachers with various experiences that will stimulate discord with existing cognitive structure, consequently convincing them to create new ideas that better align with these experiences.

The constructivist view of learning also emphasizes the social component of knowledge and as such considers the social and cultural context in which ideas are created as well as all other factors including protocols that mediate of teacher understanding. PLCs constitute a community of learners who collaboratively engage in reflection and discourse with teachers and peers as they attempt to make connections between their experiences and the diverse sources of information to which they have access. Knowledge is, therefore, created from the dialogic process that takes place when teachers socially interact with shared experiences (Driver et al. 1994) such as collective problem solving, and the examination of student artifacts, and other investigations into their practice. This view of the nature of learning places teachers,

their experiences, and constructed knowledge at the center of the community's enterprise, and this is central to the constructivist theory.

Foucault's Power and Knowledge

In ancient societies, power was conceived of as being manifested through a supreme authority that controls subjects, primarily through intimidation and violence. In modern societies, however, the notion of power transcends corporeal control (McHoul & Grace 1997) to consider subtle, yet pervasive actions that are at once enabling and constraining (Deetz 2003). Power is exercised through the actions and practices of individuals as they interact with their peers or with the environment. Foucault (1982) described this form of power as the mode of actions upon the actions of others. The analysis of power is an essential component of studies of PLCs because interacting groups tend to accommodate action upon other actions. Additionally, power plays an essential role in the production of knowledge (Bevir 1999; Henneman 1995; McHoul & Grace 1997), and is integral to the process of learning (Fox 2000). In this section, I will discuss various forms of power and the different approaches to knowledge supported by each. This is important to our understanding of the significance of Foucault's notion of power to this discussion of knowledge construction in PLCs. Next, I will explain the main tenets of Foucauldian power with an emphasis on the various techniques through which it is exercised. The section will end with an exploration of power relations that appear within the larger context of the institutions in which PLCs are embedded, demonstrating both the empowering and disempowering capacities of such.

Forms of power

Theorists conceptualize power in different ways, and each interpretation has a characteristic approach to knowledge. Gaventa and Cornwall (2001) identified four

dimensions of power that have implications for the way knowledge is constructed in society. The first dimension emphasizes the overt exercise of power through informed debate among groups. Scientific knowledge is constructed in a similar fashion where scientists engage in debates and discussions that conclude with acceptance of the most rational argument. The assumption is that the knowledge of experts is superior and, therefore, has greater influence on the outcome of the discussion (Hardy & O'Sullivan 1998). These experts have a tendency to speak for others based on research findings, and theories rather than their own lived experiences (Gaventa & Cornwall 2001). This form of power may be demonstrated in the introduction of reform efforts (McHoul & Grace 1997) that impose science curricular materials and instructional strategies that do not reflect the expressed views of the teachers. In some forms of PD activities where science teachers are engaged in discussions with experts regarding pedagogy, teachers' practical knowledge is often disregarded in favor of the codified knowledge generated by the experts. The emergence of PLCs signaled a shift in the way researchers and policymakers perceive science teacher knowledge. However, administrators and researchers participating in the activities of PLCs are cautioned not to use their status to influence processes involving the negotiation of meaning.

The second dimension of power suppresses the views or needs of certain groups or individuals. It is similar to the first dimension in that power legitimizes the knowledge of some groups while rendering those of others flawed or unfounded. The difference is that in the first dimension, both the powerful and powerless participate in the negotiation of meaning although one group has the power to influence the outcomes of the decisions (Hardy & O'Sullivan 1998). For the second dimension, the powerless are

often excluded from the process of knowledge construction, and meaning is transmitted rather than negotiated. The traditional workshop model, for instance, consists of external experts with little knowledge of local conditions, who present pre-packaged information that is irrelevant to the participants' practice (Wilson & Berne 1999). Workshops structured using this transmissive model reflect veiled messages of teachers as entities in need of improvement and upgrading (Eraut 1977). They also focus on technical, codified knowledge while excluding practical, personal knowledge of the teachers. This model perpetuates the view of experts as 'knowledge generators' and teachers as 'translators of such knowledge' (Cochran-Smith & Lytle 1999; Palinscar et al. 1998). Yet, it is widely used to monitor professional standards, and to implement staff training in response to organizational changes (Webster-Wright 2009). The transmissive model is often resisted by some teachers; typically results in token responses; and does not encourage development (Boud & Middleton 2003; Eraut 1977).

The third dimension involves the exercise of power through overt or covert conflicts between the powerful and powerless (Gaventa & Cornwall 2001). Emphasis is placed on the ways in which the construction of knowledge influences the consciousness of the powerless. In other words, there is a common view that the powerless can escape the control of the powerful through knowledge (Hardy & O'Sullivan 1998). This form of power is often reflected in race relations, and bears some resemblance to hegemony in which power is disguised in legitimate practices within society. The fourth dimension views power not as repressive or oppressive as the first three but rather as productive and relational (Deetz 2003). In other words, power is manifested through social interactions and institutions, and demonstrates dynamic

characteristics when the actions of some individuals enable actions in others (Henneman 1995). Gaventa and Cornwall (2001) suggest that the productive element of power is evident when individuals with relatively less power work collaboratively with individuals who are more powerful. In this way, the powerful can act to influence the action potential of the other as they collaboratively construct knowledge. In PLCs, all participants are expected to engage in the construction of knowledge, and collective action rather than individual power influences the outcome. The next section provides a closer look at Foucault's perspective on power and various ways in which it is manifested.

The exercise of power

According to Foucault (1982), power exists only when it is put into action. Specifically, it is considered as a set of actions that is triggered by the actions of others. This mode of action does not act on others rather upon other actions whether they exist in the present or are likely to arise in the future. In this sense, power is not a possession to be wielded over others to dominate and constrain them but rather acts as a force to stimulate action. Foucault (1982) maintains,

In itself the exercise of power is not violence; nor is it a consent which, implicitly is renewable. It is a total structure of actions brought to bear upon possible actions; it incites, it seduces, it makes easier or more difficult; in its extreme it constrains or forbids absolutely; it is nevertheless always a way of acting upon an acting subject or acting subjects by virtue of their acting and being capable of action. (p. 789)

From a Foucauldian perspective, the manifestation of power is so subtle and ubiquitous that it is often overlooked or misinterpreted by both those who act and those who are acted upon.

Foucault's theory of power also points to the notion of agency, which refers to a state of being in action or a capacity to exercise power based on personal reasoning (Gaventa & Cornwall 2001). The action of an individual that produces further action that encourages self-regulation (Bevir 1999) or resistance (Fox 2000) demonstrates the power of self over the actions of self. The power to act is stimulated by an individual as they negotiate meaning throughout the course of their careers. This agency is an essential prerequisite to teacher empowerment, which contributes to action being brought to bear upon other actions. The empowerment of teachers is a commonly used initiative in PD programs designed to establish greater partnerships and collaboration. By implementing practices of empowerment, administrators encourage teachers to perceive themselves as having power over certain aspects of their practice, promoting increased ownership and commitment to their jobs. As such, teachers working collaboratively in PLCs are encouraged to make decisions regarding their practice, then take the necessary actions required to engender change. This is not to say that teachers will always achieve desired goals or outcomes. They are still subjected to a 'regime of power' (Bevir 1999; Foucault 1982), a hierarchy of power relations evident in the practices and micro-practices of institutions, which can either promote or suppress teacher empowerment. Therefore, teachers in PLCs are typically allowed to take action or exercise their agency only within the specific policies and procedures of the institution within which their group is embedded. It is necessary to point out here that teachers are capable of exercising power over their actions through agency, and if provided with relevant resources and support, are able take appropriate actions to improve existing conditions. Learning is considered an outcome of the process of self-action, action on

the action of others, and action on the environment (Fox 2000). Teachers who are denied agency due to micro-practices within institutions are, therefore, likely to lose out on opportunities to develop their practice through their learning experiences.

The link between power and learning goes beyond issues of agency and empowerment. The composite term power/knowledge reflects the inextricable bond between both concepts. Fox (2000) pointed out that Foucault's thinking about power and knowledge was consistent with Brown & Duguid's (1991) expression learning-in-working, which also merged knowledge (learning) with power (working). Foucault believed knowledge is the product of science and scientific methods, and is widely accepted as the 'truth' that controls the way we live (McHoul & Grace 1997). He contended that we are "subjected to the production of truth through power and we cannot exercise power except through the production of truth" (Foucault 1980, p. 93). This suggests such a close link that one seems indissociable from the other. Foucault's conceptions of knowledge and power are linked to his work on discourse. According to Foucault, discourse is defined as "a group of statements which provide a language for talking about (a way of representing the knowledge about) a particular historical moment" (Hall 1997, p. 44). In other words, discourse involves the production of knowledge domains through language. These knowledge domains play a very important role in controlling and normalizing individuals and institutional practice. For instance, knowledge constructed within the domain of science education stipulates the way science is to be taught. Pedagogical strategies designed as a result of this knowledge or 'truth' guide the PD of teachers and dictate what good science teaching should look like. Consequently science teachers regulate or normalize their practice based on these

mechanisms of power, developed and maintained by producers of such knowledge and 'truths'. Science teachers have the option to exercise power by either resisting or conforming to these 'truths'. As such, power is held both by those who construct knowledge within the field of science education as well as the science teachers whose practices this knowledge is meant to govern. From this perspective, relations of power permeate every level of society and affect both the powerful and the powerless (Gaventa & Cornwall 2001).

Power relations.

A power relationship is a mode of action that acts upon other actions rather than on others. Foucault (1982) explained,

A power relationship can only be articulated on the basis of two elements which are each indispensable if it is really to be a power relationship: that 'the other' (the one over whom power is exercised) be thoroughly recognized and maintained to the very end as the one who acts: and that faced with a relationship of power, a whole field of responses, reactions, results, and possible inventions may open up (p. 789).

This characterization suggests that the exercise of power is a necessary condition for action and that the nature of such actions may set the stage for other possible actions. In a sense, school administrators are attempting to shape the field for the actions of teachers when they mandate collaborative activities for PD. They typically envision a desired outcome then employ strategies to ensure its achievement. These strategies ensure effective implementation and maintenance of power. According to Foucault (1982), power strategies are employed when administrators, based on knowledge constructed by experts in the field, designate PLCs as necessary for improving student performance. Not only do administrators determine the composition of these learning communities, they also specify the communication acts (Horn & Little 2010) and

protocols (Levine & Marcus 2010) that must be used to guide the actions of participants. By designating the activities within PLCs, administrators can control to large extent the actions of teachers within it. Power strategies are, therefore, rationalized, institutionalized, and mobilized in ways that ensure that the required actions are employed to achieve certain outcomes.

It is evident that power relations are coordinated with certain domains of knowledge (McHoul & Grace 1997). Early in the discussion of knowledge, I pointed to the production of systems of knowledge to inform decision-making, and influence policies and practices (Gaventa & Cornwall 2001). The establishment of PLCs in response to scientific studies by experts in the field demonstrates the link between knowledge and power as well as the hierarchical nature of power relationships. According to Gaventa & Cornwall (2001), expert knowledge producers typically exert power over others through their expertise. Hierarchies of knowledge and power are reproduced when experts impose their 'truths' or realities while devaluing or disregarding knowledge and experiences of others. This action accounts for the mechanisms by which regimes of truth are sustained through institutional practice and discourses. To what extent are PLCs reinforcing regimes of truth? Are teachers' creativity constrained by the protocols and conversational routines instituted by administrators? Do these rituals of truth encumber knowledge construction within PLCs? Do administrators or researchers legitimize knowledge constructed by teachers in PLCs?

Foucault (1977) expressed an interest in the knowledge generated by unpretentious or less credible systems of knowledge (McHoul & Grace 1997), such as

PLCs. Together teachers problematize their practice, and analyze possible solutions through trial and error. From his perspective, teachers construct their own realities based on their own experiences, acquiring the power to structure their own field of actions albeit within the limits imposed by school officials (Hardy & O'Sullivan 1998). Administrators and researchers who participate in PLCs are encouraged to 'listen and learn' as a means of symbolically shedding the mantle of dominance (Gaventa & Cornwall 2001). In PLCs, teachers socially constructed the knowledge that led to new actions resulting in innovations in practice (Fox 2000) as a 'power over' perspective gives way to a 'power to'. A 'power over' approach hinders knowledge construction while a 'power to' perspective engenders innovation, change, and learning.

Musings

It was not so long ago that I came to realize the value of theories in the interpretation of data. A critical incident that has forever changed my methodological approach is to be blamed for my proclivity for wearing shades. While pursuing a master's degree in Education at St John's University in New York, I collected data in a large urban school in an attempt to understand motivational strategies used by biology teachers to improve student learning. Using a thematic analysis, I coded and categorized, then presented my findings as seen through the lens of Self. At that time, I was relatively new to the country and knew very little about the perspectives of theorists and philosophers whose work could have illuminated my interpretations of the data. Furthermore, the mono-cultural society in which I was raised did very little to enhance my visual acuity, which would have otherwise allowed me to perceive the underlying currents of race and racism that were evident in the language used by the teachers I interviewed. The fact that the teachers were all middle class white professionals while

their students were all African American and Hispanic did not, at that time, raise a red flag when I examined the data. I was clearly out of touch.

My learning experiences during qualitative data analysis and critical pedagogy courses here at University of Florida changed that. As part of a class project, I appropriated a 'critical race theory lens' to re-examine the data, and what I saw bore little resemblance to the findings I presented in my master's thesis in New York. The experience was like looking at three-dimensional images or stereograms. At first sight, all you see is what is at the surface. But with a trained eye or with the help of a stereoscope, you will find that the image has width, height, and depth. Armed with ideas influenced by Gloria Ladson-Billings and Derrick Bell, I was able to see dimensions of the data that were invisible to my naked eye. Since then, I appropriated a Foucauldian lens in examining the same data, and lo and behold, I saw different dimensions from which I was able to construct even greater understandings.

I now support the use of a wide variety of theoretical lenses to strengthen interpretation of data. In this research, I will be appropriating four including the lens of Self, which has evolved over the last several years. My learning experiences have contributed enormously to the development of Self, and have shaped my perceptions of this path to Enlightenment. Chapter 4 will provide a more comprehensive description of the lens of Self that has influenced my methodological decisions so far. I feel confident that the other three lenses selected for the interpretation and explanation of my findings will provide insights that would otherwise have been invisible to the naked eye. My hope is that the tenets explicated so far will allow you to see what I see when I wear my multi-lens 'shades'.

The Conclusion

The review of literature on interactions within PLCs exposed some of the gaps, ruptures, and irregularities within the field of science teacher PD. It amplified the need for research on teacher interactions within PLCs to determine the affordances that might be made available for learning and development. Protocols and other mandated conversational routines are currently being used to guide teacher interactions but it is not very clear from the literature whether or not such practices facilitate meaningful learning. Do protocols stimulate meaningful conversations or do they promote mechanical interactions? Do protocols or conversational routines provide a means to organize the interaction process or do they function as tools to guide teacher learning? Are department meetings being held under the guise of PD sessions in PLCs? These meetings are often used as a medium for decision-making regarding issues of importance to the department. Researchers intimated that many teachers engage in 'groupthink', which is a way to minimize conflict when reaching a consensus without critically evaluating alternative ideas. Do teachers engage in 'groupthink' simply to bring these meetings to a timely end? Is 'groupthink' an act of resistance to mandated collaboration? Is the collaboration characteristic of PLCs genuine or contrived? It is not my intent to address all of these provocative questions in this particular composition. However, these questions emerged from my review of the literature and will certainly provide context for the line of inquiry established in Chapter 2.

The theoretical constructs identified in this chapter provided a lens for examination of the data collected for this study. Theories offer generalized ideas that can be contextualized to explain specific practices and natural or social phenomena. In order to effectively appropriate a theoretical lens, one has to become familiar with the

tenets or the ideas proposed in a way that allows modification of a previous perspective to reflect the theory in use. In other words, in order for me to appropriate a Foucauldian lens in the examination of certain practices or policies, I have to immerse myself in his theory so that I can view the subject of my analysis in a way that Foucault would. It is like getting into his head so that I can see through his eyes. Switching lenses may not be as easy as it seems. It is like moving out of one head into another, and then another. At some point I will have to allow the original lens of Self to adjust before donning another. Needless to say, I look forward to the opportunity to analyze data from these different perspectives or vantage points. The sunshine visible from these four vantage points will take me on a natural high, high enough to see the Rainbow's End.

Table 3-1. Articles reviewed as foundation for investigation.

Articles	Research Purpose/Questions	Participants	Data Sources	Data Analysis	Findings/Conclusions
Andrews & Lewis (2002)	To capture the experiences of a group of teacher leaders as they engaged in a process of learning & development during a whole school change process.	Teacher leaders (no subject area, grade level, or number indicated)	Interviews, transcript of focus group discussions, survey	NUDIST & NVivo for coding. Narratives developed.	Collective learning facilitated development of PLC, and grew out of common factors, such as shared purpose/experience, and professional dialogue. Learning involved connecting as a group, being tolerant and respectful, creating something of significance.
Horn & Little (2010)	To examine how conversational routines in two teacher-work groups enhanced or limited opportunities for the in-depth examination of practice and hence shaped opportunity for teacher learning.	9 math teachers	Interviews, audio/video taped records of teacher meetings, observations	Analyzing transcripts by focusing on moments of significance to researcher (not clearly articulated)	Focus on routines and group resources permitted close investigations of teachers' professional interactions. Conversations potentially conducive to learning if it supplied specific means for defining, elaborating, and re-conceptualizing problems.

Table 3-1. Continued

Articles	Research Purpose/Questions	Participants	Data Sources	Data Analysis	Findings/Conclusions
Little (2003)	To explore how classroom teaching practice comes to be known, shared, and developed among teachers through their out-of-classroom interactions.	English, math, literacy teachers (no numbers & grade level indicated)	Transcripts of meetings	Analysis not clearly stated	<p>One English meeting started with a prompt for teachers to verbally respond to. Math teachers used a “check in” routine where participants take turn to report how things are going in the classroom. In the literacy meeting, one teacher takes the lead to address teachers’ inability to meet deadlines.</p> <p>Teachers elaborate problems in ways that open up new considerations and possibilities when they invite comments and advice from other teachers.</p>
Little & Curry (2008)	To examine how conversations structured by a formal protocol and focused on artifacts of classroom practice operate to enable or impede teachers’ attention to problems of classroom practice.	8 teachers from various departments, principal, instructional aid, counselor	Videotaped monthly meetings, copies of artifacts and protocol guidelines, interviews	Parsing conversation based on ways teachers use student work as evidence; considering part this evidence plays in practice; exploring trajectory of conversation in relationship to protocol structure.	<p>Participants attributed productivity of conversations to protocols.</p> <p>Protocols have constraints on use of time so participants privilege form over substance. This results in superficial examination of evidence.</p>

Table 3-1. Continued

Articles	Research Purpose/Questions	Participants	Data Sources	Data Analysis	Findings/Conclusions
Thomas et al. (1998)	<p>1) How does intellectual community form among HS teachers?</p> <p>2) How does formation provide opportunity for teacher learning?</p> <p>3) How do teachers learn from colleagues?</p> <p>4) What do teachers take from participation in a community of learners?</p>	11-12 English literature and math teachers	<p>Interviews, think aloud protocols of teachers engaging in textual analysis, transcripts of project meetings, written self reports, email correspondence among teachers, ethnographic field notes.</p>	Focus on what teachers reported learning. Using filed notes to confirm or disconfirm evidence from self reported data.	<p>Experienced teachers saw the community as emerging political actor within the school. New teachers thought that interactions opened them to issues beyond classroom management.</p> <p>Specialists felt that interactions allowed them to participate in broader discourse of the school. Student teachers saw differences in observed pedagogy and the traditions of the discipline</p>
Achinstein (2002)	To explore how teachers suppress or embrace their differences, how that defines the communities' borders, and ultimately the potential for organizational learning and change.	Not clear	Ongoing interviews with teachers & administrators, observation of formal and informal meetings, document analysis of archival documents, teacher survey.	Not clear	In public formal settings the community comes to rapid consensus by finding out what the majority wants and calling it consensus. This suppresses dissenting voices to maintain a sense of unity. Active engagement in public conflict leads to increase in levels of discomfort among teachers who may withdraw participation.

Table 3-1. Continued

Articles	Research Purpose/Questions	Participants	Data Sources	Data Analysis	Findings/Conclusions
Kazemi & Franke (2004)	1) What do teachers learn through collaborative examination of student work? 2) How is teacher learning evident in shifts in participation in discussion centered on student work?	Work group of 10 elementary teachers (cross-grade). Math focus.	Meeting transcripts, teacher reflections, student artifacts, and teacher interviews.	Grounded theory approach	Two shifts in teacher participation. The first centered on details of children's thinking, and the second on developing instructional trajectories based on children's thinking. Teachers experienced new ways of working together, new ways of being, and experimenting in their classrooms.
Goodnough (2010)	To examine how conceptions of teacher knowledge and learning emerged from/within a collaborative action research community.	Case study of one teacher who participated in professional community.	Teacher/student artifacts, electronic journal entries, interviews, teacher observations	Coding, labels, identify concepts, constant comparison	The teacher used formal knowledge to theorize about her own work, constructed and reconstructed conceptual frameworks that link action and problem. She also examined her beliefs about science teaching and learning, garnered insights into many facets of her professional knowledge and improved her teaching practice as a result.

Table 3-1. Continued

Articles	Research Purpose/Questions	Participants	Data Sources	Data Analysis	Findings/Conclusions
Curry (2008)	To analyze how teachers' professional inquiry community (critical friends group CFG) a constitute a resource for reform and improvement	Not clear	Field notes, videotapes of meetings, interviews	NUDIST to code transcripts, meta matrices to assemble descriptive data, discourse analysis, analysis of video records for triangulation.	Four design features of CFGs that held consequence for nature and scope of teacher development. These include: 1) Diverse menu of activities 2) Decentralized structure 3) Interdisciplinary membership 4) Protocol reliance
Scribner et al. (2007)	1) What factors contribute to or interfere with team decision-making? 2) What discursive patterns are associated with leadership? 3) What organizational conditions foster/impede leadership?	Two teacher teams: N=7 and N=6.	Audio/videotaped meetings	Code transcripts for representative or unique segments Deconstruct dialogue into constituent elements (discourse analysis)	Three conceptual constructs found to have interdependent influence on the nature of collaboration in professional learning teams (PLTs) 1) Purpose - problem solving 2) Autonomy - capacity to make decisions to lead to action and change 3) Patterns of discourse - passive or active

Table 3-1. Continued

Articles	Research Purpose/Questions	Participants	Data Sources	Data Analysis	Findings/Conclusions
Levine & Marcus (2010)	To explore whether or how different types of collaborative activities afford different types of teacher learning.	7 participants, different subject areas.	Field notes of collaborative meetings, only 2 meetings audiotaped, interviews to explore links b/w collaboration & practice, classroom observation	Iterative process of memoing & coding to identify types of meetings Data arranged in matrices to identify trends.	Two factors emerged as being important in affecting opportunities for learning: 1) Structure of the activity – protocol-guided, structured & facilitated, loosely structured 2) Intended Focus – instruction, student, school operations
Horn (2010)	To explore the interactions that take place within a collaborative teacher community, seeking to specify how conversations can support teacher learning through emotional & intellectual involvement in problems of practice.	6 math teachers	Audio/videotaped records of collaborative meetings	Development of a unit of analysis to determine how teachers were learning from each other in their conversations.	Two discourse structures identified: 1) Replays of what teachers did 2) Rehearsals of what they might do in a given situation
Coburn (2001)	To explore collective aspects of sense making with attention to the way that it is situated in and shaped by teachers' broader embedded contexts.	Not clear	Sustained observation, in-depth interviews, document analysis	NUDIST, grounded theory	Three sub-processes that characterize and facilitate collective sense making. 1) Constructing understanding through interpersonal interaction 2) Gatekeeping 3) Negotiating technical and practical details

CHAPTER 4
RESEARCH THEORIES AND METHODS: CHASING THE RAINBOW

About Chapter Four

Chapter 4 focuses on specific components of my qualitative inquiry process, which investigated the process of knowledge construction, and power shifts in PLCs constituting middle school science teachers in the process of implementing reform curriculum. The investigation was guided by the following overarching research question and sub-questions:

- 1 How can professional learning communities (PLCs) operate as a site for learning and development of middle school science teachers in the process of implementing an inquiry curriculum?
 - a) How do middle school science teachers negotiate meaning and construct knowledge about their practice during interactions within a PLC?
 - b) How does the exercise of power influence the process and outcome of consensus making among middle school science teachers within the PLC?

I also present the methodological framework including the epistemological, and theoretical perspectives that guided my choice of methodology. Additionally, I demonstrate epistemological awareness by highlighting points of convergences, rationalizing my choices, and justifying my positions. I also declared myself. In other words, I shared aspects of Self that was brought to bear on my interaction with and interpretation of the data. This declaration may surface potential predispositions that frame the reality I constructed as a result of my data analysis. This chapter also provides the context within which the inquiry was designed, and divulges specific details regarding the processes used in the collection, analysis, and interpretation of the data.

About Epistemological Positions

Very early in this composition, I indicated that my inquiry aligned with the constructionist epistemological stance. What does this mean, and why do I need to declare an epistemology in the first place? Epistemology is concerned with the nature and scope of knowledge. It provides “ a philosophical grounding for deciding what kinds of knowledge are possible and how we can ensure that they are both adequate and legitimate” (Maynard in Crotty 1998, p. 8). Identifying, explaining and justifying my epistemological stance is, therefore, important to allow readers to understand my design choices while establishing a level of trust and confidence in the knowledge constructed from this inquiry. Crotty (1998) identified three epistemologies: 1) objectivism, which posits that meaningful reality existed outside of human consciousness; 2) constructionism, which proposes that meanings are constructed within the human mind, and through interactions with the realities of our social world; and 3) subjectivism, which suggests that meanings are imposed on others and that the object of study does not contribute to the generation of meaning. It is not my intent at this juncture to obfuscate or confuse you with detailed explanations of each of the ‘isms’ I acknowledged above. My intent is rather to provide a justification of my decision to assume the epistemological stance of constructionism. However, sharing the premise of each of these positions further justifies and rationalizes the decisions I made regarding my inquiry approach. It also provides an insight into my thoughts as I explore the landscape in my search for Rainbow’s End.

Constructionism. From the viewpoint of constructionism, there is no objective truth and as such no approach to inquiry can bring forth exact and definite knowledge (Burr 2003). Constructionism, therefore, supports the view that knowledge “is contingent upon

human practices, being constructed in and out of interaction between human beings and their world, and developed and transmitted within an essentially social context” (Crotty 1998, p. 42). For instance, the term PLC has been used extensively in the field of education, particularly those areas concerned with teacher PD. It seems likely, therefore, that professionals and practitioners in this area would recognize a PLC when they see one. After all, it would possess all the characteristics that researchers ascribe to PLCs. What we often overlook, however, is that it took individuals within the field to collectively construct the idea of what constitutes a PLC, hence facilitating the associations we are able to make today with the terminology. A PLC may have slightly different implications for a PD school, a department preparing to implement reform curricula, and a group comprising university faculty and school personnel attempting to write a grant. Individuals outside of the context of teacher PD may have absolutely no idea what a PLC is because knowledge constructed about this concept is contextually bound and, as such, transmitted within the field in which it has relevance.

Subjects or humans construct meaning through engagement with the world or objects they are interpreting. My conceptualization of PLCs resulted from engagement not only with the available literature but also from actual interactions with collaborating science teachers in groups identified as such. Prior to my exposure to this construct, PLCs held absolutely no meaning for me. Yet, my ignorance of the term did not preclude their existence. Eventually, my consciousness of PLCs stimulated a need to engage with them, thereby facilitating an understanding, a construction of meaning based on the context within which the engagement took place. It is important to note here, that my understanding of the construct PLC is not a universal or true

interpretation. It is based on the interpretation of others, which I found useful, rational, or meaningful. It was not a meaning imposed on my consciousness, as some subjectivists may believe, but rather a meaning that I constructed for myself based on my various interactions with the object. Constructionism invites us to reject the notion of being “straitjacketed by the conventional meanings we have been taught to associate with the object” (Crotty 1998, p. 51) but rather to take a receptive and adaptive approach to knowing. In so doing, we are able to construct more meaningful realities as we re-interpret the interpretation of others (Jorgensen & Phillips 2002).

In case you are wondering about the relevance of what I just explained to my inquiry approach, I will go ahead and provide clarity. It is not my intent that the knowledge constructed through this inquiry process be taken as objective, universal, and final. Neither do I have the temerity to suggest that the meanings I constructed are somehow better or superior to the other interpretations available in the field. The realities I construct for myself should be subject to critique and debate by others who are similarly attempting to make sense of interactions within PLCs. In fact, I would welcome such discussions that would allow for a collective reinterpretation of meaning, which could possibly lead to new and more robust understandings of PLCs. It seems reasonable to make a distinction here between the individual meaning-making involved in the construction of my own reality and the collective sense-making associated with social construction of knowledge. Regardless of inconsistencies in the literature, there seem to be a level of consensus supporting the use of the term constructivism for epistemological considerations where the research focus is exclusively on the individual construction of meaning, and constructionism when the focus involves the collective

construction or generation of realities (Burr 2003; Crotty 1998; Koro-Ljungberg et al. 2009; McNamee & Gergen 1999). The notion of social constructionism is, therefore, embedded in the constructionist epistemology but I think further exploration of the tenets of social constructionism is germane to this discussion.

The social constructionist theoretical position acknowledges the social origin of meaning and suggests that individuals have access to preexistent realities constructed by institutions within which we are embedded (Crotty 1998). Through enculturation, we adopt the social meanings constructed and sustained by continuous interpretation and re-interpretation made possible through human engagement with the world (Gergen 1985). What, then is social constructionism, and what does it have to do with this research? Burr (2003) outlined four tenets that explain its connection with various ways in which we come to understand the world. First, social constructionism invites us to critically assess our assumptions about the ways in which we understand the world and ourselves. This includes taken for granted knowledge that we are likely to adopt from the social milieu in which we are embedded. Second, we are reminded that the ways in which we understand the world are specific to the historical and cultural conditions in which we live. In other words, explanations of the world are not universal and as such cannot automatically be accepted as truth to be imposed on others. Third, knowledge is constructed through daily social interactions and the meanings generated become our social reality. These interactions play an essential role in shaping the version of reality constructed by an individual participating in social processes. Fourth is the notion that knowledge and social action are inextricably linked. Burr (2003) conceptualizes

language use as a form of action that facilitates meaning construction during interactions.

Crotty (1998) explained that the word 'social' in social constructionism refers to the process of meaning generation rather than on the object to which the meaning is ascribed. Social constructionism, therefore, regards as an appropriate focus of inquiry, the dynamics of the interactions that generate social constructions of the world (McNamee & Gergen 1999). You may recall that the line of inquiry I established in the first chapter focuses on social processes within PLCs that contribute to meaning construction by interacting science teachers. Burr (2003) refers to this as micro social constructionism in which understandings are negotiated during regular discussions between individuals in interaction. During these interactions, multiple versions of reality are advanced with the understanding that one person's reality cannot be assumed as more exact or more real than the other (Jorgensen & Phillips 2002). With this in mind, I would like to reiterate that it is not my intention to impose the understandings constructed as a result of my inquiry on others as universal or objective truths. My intent is to construct a version of reality regarding PLCs through my investigations of the interactions within them, and through engagement with preexisting truth claims that were socially constructed and maintained. My next step is to share the interconnectedness between my epistemological position and the theoretical perspectives that guide my research decisions. In doing so, I hope to demonstrate that my decisions were deliberate, premeditated, and methodical. Also, that I am chasing this rainbow with transparency and a strong sense of purpose.

About Theoretical Perspectives

The issue of transparency is key to qualitative research, and elaborating the theoretical underpinnings of my research design is one way of ensuring that readers understand the methodological choices I made during this inquiry. This inquiry reflects an alignment between the constructionism epistemological stance chosen and the theoretical underpinnings of the poststructuralist/postmodernist ideas to which Foucault subscribes. The ideas of Foucault are central to the component of my study focusing on power/knowledge relations in PLCs. It seemed logical, therefore to select the theoretical perspective(s) that embodies his philosophies about knowledge and power. Foucault was affiliated with both the poststructuralist and postmodernist movement (Agger 1991) and his focus on power as an effect of the knowledge transmitted in discourses added a distinctive character to his philosophy (Olsen 2003).

There are several poststructuralist views embraced by Foucault, which are significant to the inquiry I am currently undertaking. The first is a commitment to pluralism and diversity rather than totalizing and universalizing perspectives characteristic of the human sciences (Jorgensen & Phillips 2002; Olssen 2003). This perspective reiterates the poststructuralist view that it is impossible to arrive at a universal truth about any phenomenon (Harcourt 2007; Luke 1995). Truth claims are sometimes imposed on others as a reflection of realities but the poststructuralist perspective encourages us to critically examine these taken for granted knowledge structures and social and cultural effects they produce (Sondergaard 2002). The second is the privileging of socially generated experiences that draw on the diverse combination of existing, available discourses (Vick 2006). Individuals participating in these social practices assume identities that they constructed as a result of meanings generated by

discourses (Agger 1991; Richardson 2000). Many poststructuralist thinkers, therefore, embrace constructionist views of the construction of social realities, the rejection of universalism and objective reality, and the historical and cultural specificity of knowledge (Burr 2003; Jorgensen & Phillips 2002). As a qualitative study, this inquiry did not generalize to a larger population rather it provides rich descriptions of socially generated interaction among middle school science teachers who were collaborating to achieve a common goal.

Postmodernism also rejects totalizing perspectives on history and society, referring to them as grand narratives or metanarratives that legitimize or privilege particular interests or cultural traditions (Lyotard 1984). Postmodernism invites us to be suspicious of any method, theory, discourse, or genre with universal claims of truth or authority (Richardson 2000). Knowledge is, therefore, not a mirror of absolute reality but rather a linguistic and social construction based on the negotiation of meaning of the lived world (Kvale 1995). In accordance with social constructionism, knowledge is constructed through communication between individuals and not through interaction with a nonhuman or objective reality. Subsequently, valid knowledge claims emerge as “interpretation and action possibilities are discussed and negotiated among members of a community” (Kvale 1995, p. 24). This study analyzed specific contextual power relationships through observations of processes involving the negotiation of meaning in specific situations (Powers 2007). The knowledge constructed as a result focused on situated interpretations of a PLC comprising middle school science teachers rather than on universal claims for all PLCs. Additionally, truth claims emerging from this study were

deliberated and negotiated among members of the academic fraternity prior to dissemination.

Researchers acknowledge numerous similarities between poststructuralist and postmodernist perspectives that overshadow minor differences (Agger 1991; Crotty 1998; Koro-Ljungberg 2008). As such, the composite term poststructuralist/postmodernist is adopted in this composition to demonstrate the close, albeit undecided relationship between the two. This composite has already been adopted in previous chapters of this composition and will continue to be used throughout. The following section addresses the methodology or the theories, which framed my inquiry process.

About Methodology

My inquiry is grounded in the epistemological and theoretical perspectives explicated in previous sections. Each perspective has its own set of guidelines regarding the principles associated the collection and analysis of data, also called the methodology (Grbich 2007). In describing the methodology, I give “an account of the rationale it provides for the choice of methods and the particular forms in which the methods are employed” (Crotty 1998, p. 7). There is, therefore, a distinct difference between ‘methodology’ and ‘method’. Outside the realm of qualitative research, both terms are perceived as synonyms and are used interchangeably to refer to the concrete steps taken by the researcher to address the research problem. The methodology explained here sets the stage for the appropriate implementation of the various procedures used in this inquiry process. I will make explicit the alignment with epistemological and theoretical perspectives while at the same time rationalizing my choice.

In light of my research questions, it seems reasonable to select a methodology that allowed me to examine ways in which knowledge is socially constructed in various social settings (Gee & Green 1998). Discourse analysis is the most widely used approach within constructionism (Flick 2009; Jorgensen & Phillips 2002), and poststructuralist/postmodernist (Grbich 2007) perspectives, and as such was used as a framework to support my inquiry into PLCs. Generally speaking, discourse analysis is concerned with patterns inherent in language used in various domains of social life (Jorgensen & Phillip 2002).

Discourse Analysis

There are many variants of discourse analytical approaches including discursive psychology, critical discourse analysis, and poststructuralist discourse analysis (Flick 2009). These varieties differ based on the central focus of the analytic process. For instance, discursive psychology focuses on the context, variability, and constructions in the texts (Potter & Wetherell 1998); Gee's analysis focuses on how the structure of language functions to make meaning in specific contexts (Gee 2011); and critical discourse analysis focuses on issues of critique, ideology, and power (Parker 2004). Despite the lack of a unified, unitary approach to discourse analysis (Cheek 2004), all approaches converge on several points. According to Jorgensen and Phillips (2002), discourse analytical approaches agree that; 1) language is not a reflection of a preexisting reality; 2) language is structured in patterns or discourses, and the meanings change from discourse to discourse; 3) these discursive patterns are maintained and transformed in discursive practices; and 4) maintenance and transformations of discursive patterns should be explored within the contexts in which the language is in action.

This inquiry combines elements from different discourse analytical perspectives in an attempt to construct a deeper understanding of PLCs. This multi-perspectival approach requires a consideration of the constituent approaches in order to identify the various types of knowledge that can be constructed from each, and then making modifications in light of this reflection (Baxter 2002; Jorgensen & Phillips 2002). My first research sub-question seeks to examine interactions with a specific PLC, with a view to understanding how realities are constructed among middle school science teachers attempting to implement reform science curriculum. Gee's (2011) discourse analytical approach was designed to provide insights into the complex and dynamic relationship among discourse, social practice, and learning (Gee & Green 1998). From Gee's (2011) perspective, interacting individuals are shaping their identities, while simultaneously being shaped by the actions between and among each other. As a result, interactions are examined with special focus on social and discursive practices as reflected in the language in use. According to Gee and Green (1998), these interactions typically result in learning, which is situated within the context of the discursive practices of the collaborating group or PLC (Lave & Wenger 1991). In other words, science teachers, through interactions construct understandings through social practices that over time define the PLC.

In examining these interactions, Gee and Green (1998) suggest that I view the collective as an entity "and consider individuals and their actions in relationship to the opportunities for learning they are afforded" (p. 148) while simultaneously examining how the members are shaping, and being shaped by the knowledge they are collaboratively constructing. How does this suggestion guide the collection and analysis

of my data? Gee and Green (1998) recommended that my analysis “include the moment by moment, bit by bit construction of texts (oral and written), the chains of concerted action among members, the role of prior and future texts in connecting these bits of life, and what members take from one context to use in another.” (p. 149). In so doing, I constructed one of many realities that reflect the social and discursive practices that science teachers draw on to learn. My overarching research question states: How do PLCs operate as a site for learning and development of middle school science teachers in the process of implementing an inquiry curriculum? I am particularly interested in identifying practices within a given PLC that provide middle school science teachers with an opportunity to learn about pedagogy associated with reform curriculum. Gee and Green’s (1998) assertion that discourse practices are socially constituted by and constitutive of learning opportunities reinforces the value of this perspective to my inquiry process.

Foucauldian-inspired discourse analysis

My second sub-question seeks to uncover power structures associated with PLCs comprising science teachers. This necessitates the appropriation of a Foucauldian lens. I am quick to add, however, that this appropriation does not equate to what some researchers call a Foucauldian methodology (Diaz-Bone et al. 2007; Scheurich & McKenzie 2005). Contemporary Foucauldian analysis generally falls within two main paradigms: critical discourse analysis, and poststructural discourse analysis (Diaz-Bone et al. 2007; Graham 2005). Critical discourse analysis focuses on the structural and linguistic features of text and talk (Graham 2005), and is often used by sociologists and social psychologists to examine ways in which discourses reproduce or resist social and political inequalities (Fairclough 2003). Analysis of this nature takes

place predominantly at the micro-level (Diaz-Bone et al. 2007) where syntax and linguistics are the primary consideration. Discourse analysis, however, is not confined to the micro-level; it may also be conducted at the meso- or macro-level. The meso-level of analysis considers the ways in which discourses are produced and practiced, as well as the way power is made manifest in the process, while the macro-level explores the broader societal contexts within which discourses are situated (Alvesson, & van Karreman 2000). The poststructural analytic approach is typically conducted at the macro and meso-level (Diaz-Bone et al. 2007) rather than the micro-level, and recognizes Foucault's skepticism towards empiricism and absolutism (Graham 2005; Nicholls 2009). This approach is often used to examine socially constructed practices and institutions, as well as the historical and political ideologies that shape or govern them. Graham (2005) emphasizes that poststructural analysis is interpretative, and is always contingent on the researcher's understanding of Foucault's theoretical perspectives.

The methodology employed in this investigation approaches discourse at the three analytical levels outlined above. Gee's discourse analysis is often categorized as critical discourse analysis because while it examines, at the micro-level, how the structure of language or grammar functions to construct meaning in specific context, it also investigates the micro-politics of social interactions for patterns that reflect the wider society (Gee 2011; Luke 1995). Discourse approaches focusing on the linguistic (micro) and socio-linguistic (meso) analyses of texts pay close attention patterns of discourses (Gee 1990) in order to examine, how language mediates power relationships for instance, in social interactions (Cheek 2004; Rodgers et al. 2005). These micro and

meso-level approaches, however, prove inadequate in exposing broader formations of discourse, such as reform science curriculum, and the associated power structures that are manifested in these social interactions (Luke 1995; Rodgers et al. 2005). This is where the Foucauldian perspective comes in. By providing the framework for questioning large-scale social discourse, it allows for a macro-analysis of institutional practices that have the potential to influence the outcomes of smaller face-to-face interactive practices. Taken together, these approaches provide a powerful analytical tool for interpreting an aspect of the discourse data that may have been overlooked by one or the other (Baxter 2002). Integrating recommendations made by Gee & Green (1998) for moment-by-moment analysis, this Foucauldian-inspired analysis revealed “the continuously fluctuating ways in which speakers, within any discursive context, are variously positioned as powerful or powerless by competing social and institutional discourses” (Baxter 2002, p. 828). PLCs provide fertile ground for such investigations.

The Foucauldian-inspired discourse analysis designed specifically for my investigation, therefore, comprises a trifecta for interrogating interactions among science teachers who are attempting to implement reform curriculum. It integrates the analysis of 1) spoken or written texts, 2) speech acts enacted during interpersonal interactions, and 3) institutional and societal practices. In this approach, the deficiencies of linguistic and sociolinguistic approaches are compensated by the broader focus on macro-practices inherent in Foucauldian critique. This integration has implications for what constitutes data or discourse in this study. Analysis at the micro and meso-level is limited to written or spoken text whereas a macro-analysis is typically conducted beyond the confines of text to include socio-historical and institutional practices (Hook 2001).

Discourse as Data

In this qualitative study the main data source was the discourse generated as a result of interactions within the PLCs. Discourses were not limited to that captured in transcripts; it transcended the present by going back into events in the past that likely influenced the causes and consequences of the interactions. I find it necessary, therefore, to provide you with a clear characterization of what constitutes discourse or data in this investigation. My analytical tool integrated perspectives from Gee and Foucault, so I drew from their work in order to reconstruct the meaning of the word discourse.

Gee (2011) defines discourse as language-in-use. Language is essential to our interactions; it allows individuals to engage in various activities as well as to assume various identities depending on the context in which it is used. As users of language, we have access to various possibilities for meaning making that facilitate the representation and construction of dialogue (Rodgers et al. 2005). Language is, therefore, a social construction that influences, and is influenced by political, social, historical, and cultural contexts (Gee 2011). Language may be codified within various contexts to create discourses, each with its own distinctive practices, identities, and interactions. For instance, the education discourse comprises certain terminologies that have specific meaning to those embedded in the practice, while holding different meanings for others in other discourses. The word 'scaffold', for example, has different connotations in the field of education, construction, and criminal justice. Likewise, the term 'weed' has different meanings for Jamaicans and Americans because of differences in the cultural context within which meaning was negotiated.

Gee (2011) makes a distinction between discourses that are laden with meanings, and connected to social, political, and cultural practices. He refers to them as 'Big D' Discourses, while using 'little d' discourses to represent the linguistic element that connect with the Discourses (Rodgers et al. 2005). According to Gee (2011), by using Discourses, individuals are associated with specific institutions, cultures and practices, thereby assuming identities that will likely vary based on the context within which they interact. For instance, the language I use to communicate with professors and fellow graduate students in a colloquium in America is markedly different from that which I and I use to communicate with friends and family at a party in Jamaica. Shifts in the context of my interactions allow me to speak from different subject positions as I engage in multiple Discourses, and enact various practices. Although I find the use of 'Big D' and 'little d' useful for my own understanding of discourses, the distinction is not absolutely necessary for this composition. Both Big D and little d discourse have social and political consequences because the language associated with them are socially constructed through power/knowledge relationships. My composition recognized two related and possibly overlapping dimensions to discourse: text and institutional practice.

Texts provide instances of spoken and written language, which are coherent and have coded meanings (Gee 2011; Luke 1995). We use texts to make sense of our world, and also to create and maintain relationships required in our daily life. According to Luke (1995), texts are used to "position and construct, individuals making available various meanings, ideas or versions of the world" (p. 13). Texts, therefore, represent various aspects of reality and play an important part in the construction and subsequent maintenance of discourses in various contexts (Cheek 2004). Texts are made up of a

series of statements whereby a preceding statement builds on the context of previously enacted statements (Diaz-Bone et al. 2007; Gee 2011). When taken together, these statements constitute the repertoire of discourses available for use. Foucault (1972) also conceptualized discourse as constituting interrelated units called statements that collectively identify and delineate certain knowledge domains or discursive formations. This conceptualization of discourse focuses on the linguistic and sociolinguistic component of discourse. My regard of discourse as text brings into focus the spoken and written language generated in PLCs, and how they convey social constructions of reality. Additionally, texts are embedded in particular social actions, and also reflect inter-subjective relations of power (Luke 1995), hence accommodating analysis at the micro- and meso-level.

According to Diaz-Bone and others (2007), Foucault viewed discourse as a collective practice located in social areas. He believed it to be a set of historically contingent practices, which influence human thought and action (Fox 1998). Institutions, such as hospitals, schools, and prisons are governed by a set of practices that reflect the ideologies of groups of individuals who are credited for their establishment. These practices shape the way we think and speak about certain aspects of reality thus playing an essential role in the construction of knowledge. Cheek (2004) suggested that socio-historical influences on institutional practices facilitate the legitimization of certain forms of knowledge by ascribing them truth status. Foucault's concept of institutional practice, therefore, focuses attention on the power of discourses in establishing dominant representations of reality (Diaz-Bone et al. 2007) that arguably control the outcome of socially constructed understandings of reality. Discourse, when

conceptualized as institutional practice, influences socialized individuals and interactions in social situations, and is therefore more applicable to macro-level analysis (Diaz-Bone et al. 2007).

About the Investigation

This section addresses specific components of the inquiry process, for instance data collection and analysis. So far, I have laid the framework for my investigation by explaining the epistemological, and theoretical perspectives that guided my choice of methodology. I have been careful to demonstrate epistemological awareness by highlighting points of convergences, rationalizing my choices, and justifying my positions. So far, I have endured the downpour of information, I have delighted in the periodic bouts of sunlight, and now as the rainbow appears I feel a sense of optimism as I share with you details of this inquiry process. I was careful though not to use the word 'method' lest I mislead you into false anticipation of a recipe for my data analysis. According to Law (2004), research methods "passed down to us after a century of social science tend to work on the assumption that the world is properly to be understood as a set of fairly specific, determinate, and more or less identifiable process" (p. 5). This positivistic view of universality of method embraces the existence of an objectivist reality outside the scope of our consciousness (Crotty 1998). As this runs counter to the epistemological and theoretical positions assumed by Self, she respectfully resists 'Babylon system' in favor of a reality congruent with her inquiry stance. Instead, she provides below as much information as possible regarding the research context, the study participants, and the process of data collection. She presents the tool, which was used in the analysis of her data. She explicitly describes the inquiry process in a way that does not formalize or standardize the practice (Foucault 1980). In a way that would

make it possible for other researchers to create alternative interpretations of this socially constructed reality without dictating to them what must be done.

Research Context

A National Science Foundation (NSF) funded project titled 'University of Florida Unites Teachers to Reform Education in Science' (U-FUTuRES) provided the backdrop for this investigation. The project goals include, 1) designing, implementing, and institutionalizing a job-embedded Science Teacher Leadership graduate degree co-facilitated by UF College of Education and UF STEM partners; (2) supporting science teacher leaders (STLs) as they lead a transformation in 6th-8th grade science teaching to improve first generation middle school students' science achievement in high-poverty, low achieving school districts; (3) assisting STLs as they organize district leadership to support reform-oriented science instruction in middle school to increase success among underrepresented student populations; and (4) continuing the development of UF cross-departmental partnerships dedicated to supporting improvements in K-12 science achievement. The job-embedded Science Teacher Leadership Institute (STLI) developed is designed to effectively prepare middle school science teachers to enact a reform oriented science curriculum called 'Investigating and Questioning our World through Science and Technology' (IQWST).

The IQWST curriculum is a middle school science project that features scientific practices aimed at developing students' literacy in science and reflects recommendations made by the American Association for the Advancement of Science [AAAS] (1993), and the National Research Council [NRC] (2012). As such, the IQWST curriculum focuses on scientific practices that include the design of scientific investigations, the collection and analysis of data, and the construction of evidence-

based explanations of scientific phenomena. For the duration of the project, STLs have committed to meeting monthly in order to collectively debrief their experiences and consider how to improve their efforts as leaders in the implementation of IQWST. Now in the second year of its inception, the first cohort of eighteen science teachers have completed eighteen credits including subject-matter and pedagogical coursework, and are currently implementing IQWST in their classrooms. Their monthly meetings, which are facilitated by UF faculty, allow them to develop professionally in preparation for leadership roles they will assume in their respective schools and districts.

My involvement in the project goes beyond that of mere researcher. I taught this cohort of science teachers during the first semester of the program and I have been attending monthly cohort meetings as an observer for the past nine months. The course I taught them consisted of an online component, which introduced them to the IQWST curriculum, and face-to-face workshops aimed at demonstrating the enactment. During cohort meetings, I interacted with teachers during small group discussions as they share both challenges and successes of curriculum implementation. I also interacted with them socially during lunch or coffee breaks as they share personal stories about their families and future career plans. As an avid people watcher, I and I observed how they navigate group discussions in order to make their voices heard; I and I listened to their views about reform science instruction; I and I detected underlying tensions that emerge during discussions; and I and I analyzed the gestures, facial expressions, and other speech acts the teachers used during their interactions. Needless to say, I was somewhat familiar with the cohort of science teachers who interacted in the PLCs under study.

Units of Investigation

During the cohort or cadre meetings the science teachers were divided into smaller groups to discuss various issues regarding the reform curriculum, instruction, and student learning. I collected data from group discussions during three monthly meetings, and then purposively selected two group interactions that adequately addressed the objectives of this inquiry. My unit of investigation was a collaborating team of science teachers, who were assigned to groups by facilitators of the cadre meetings. It was not my intent, in purposively selecting a sample, to focus on a standard group from which to make generalizable statements, but rather to select productive and interesting interactions that reflect power dynamics and collaborative knowledge construction. Flick (2009) suggests that groups be selected “according to the intensity with which the interesting features, processes, experiences, and so on” (p. 122) are reflected or assumed to be present in them. The two group interactions were, therefore, selected based on the following criteria:

- 1 An overwhelming demonstration of power strategies by individual(s) to influence the outcome of meaning negotiation. These interactions directly addressed the second research sub-question.
- 2 The length of the process of achieving consensus. Longer interactions with intense deliberations were selected to demonstrate shifts in positions.
- 3 The opportunities that were afforded for learning. Interactions during which cognitive shifts were identified were selected for analysis. Interactions of this nature directly addressed the first research sub-question.
- 4 The potential to appropriate the theories selected for this inquiry, including Foucault theories of power, constructivism, and Lave and Wenger’s legitimate peripheral participation.
- 5 A combination of professional and personal conversations that mirror real life social interactions.

Study Participants

Typically during the cohort or cadre meetings the science teachers are divided into smaller collaborative groups to discuss various issues regarding the reform curriculum, instruction, and student learning. These collaborative groups shared essential characteristics of PLCs including shared values and vision, collective and reflective dialogue, clear and consistent focus on student achievement, and the promotion of group and individual learning (Lumpe 2007; Stoll et al. 2006). The collective vision of the science teachers in this PLC is the improvement of student performance through the implementation of reform-oriented curriculum. Additionally, the PLCs were established within the context of a larger PD program so ultimately, there is a clear emphasis on teacher learning. The selected participants worked as a group specifically for my data collection but will continue to work within the larger cohort for the duration of the five-year project. The group interactions selected comprised a total of eight participants as follows:

- 1 Megan² started using the IQWST curriculum approximately two years prior to its introduction to the rest of the cohort. She participated in numerous training sessions and videotapes of her science lessons have been used to market the curriculum to district officials.
- 2 Jessica also started using IQWST before she started the Institute but was not privy to the extensive training that was afforded to Megan. Despite this, she was able to make adjustments to instruction or assessment based largely on her own practical knowledge.
- 3 Nina started using IQWST in her classroom during the fall 2012. She has a very strong personality and tends to dominate the conversations she participates in. She has very strong views on curriculum and instruction, and is very persuasive during discussions requiring consensus.

² All names are pseudonyms

- 4 Rob is the only male in the cohort. He is pleasant and soft-spoken, often demonstrating a preference to listen rather than speak. Rob started using IQWST during fall 2012 and, when requested, is always willing to share his experiences with the curriculum.
- 5 Sue was an administrator in a regional educational agency that provided various programs and services to school districts in Northeastern Florida. She was accepted into the Institute on the condition that she would find employment as a science teacher. To date, Sue has not yet started implementing the IQWST curriculum in a science classroom. She has a very strong personality and is very open about sharing her views and past professional experiences as a district administrator.
- 6 Erin started using the IQWST curriculum in the fall 2012. Although Erin can be outspoken, she has an accommodating attitude to views that oppose those she advances. She currently allows another member of the cohort to observe her implementation of IQWST lessons, and sometimes they both engage in debriefing sessions afterwards.
- 7 Drew started implementing the IQWST curriculum during fall 2012. She has a relatively reserved personality and often sits by herself during coffee and lunch breaks. Nevertheless, she participates during group discussions when required and maintains, at the very least, a cordial relationship with her peers.
- 8 Jenna has a quiet disposition. She is not very outspoken but participates reasonably well during group discussions. She started implementing the IQWST curriculum during fall 2012 and is typically open to suggestions to improve her practice.

A more detailed of the study participants is provided in Table 4-1, which focuses on their academic and professional profile rather than the subjective descriptions of dispositions provided here.

Data Sources

For this composition, data or discourse was considered as product and process. Data was defined as the structure of the texts reflected in material documentation such as books, spoken words, policies, and institutions; it also encompassed the historical contexts within which such documents are created and practiced in society; it acknowledged the power relations that shape and govern discourses; and it also considered the authors of such discourse including the cognitive or mental processes

involved in the act of creating discourses. In other words, data or discourse encompassed the past, present, and future; the not-said, the already-said, and the said; the texts, the practices, and the actions; and the spoken language and the body language. Discourse as text, therefore included interaction transcripts, observation notes, and visual images. Discourse as institutional practice considered historical conditions and policies (Diaz-Bone et al. 2007), which are generally archived in document format. Contingent on the interaction transcripts, other documents were analyzed including portions of the IQWST curriculum, policy documents from specific schools district, and historical information on reform oriented science curriculum.

Data Collection

In order to collect data, I audiotaped and videotaped interactions of science teachers during small group interactions in cadre meetings. Audiotaping the discussions allowed for accurate recording of the conversations in order to ensure that speech patterns, such as hesitations, pitch, tones, and inflections are included. According to Gee (2011), these speech patterns reveal tension among speakers, situated meanings, and subtle changes in emotions. The speech data was transcribed in a fairly detailed way, and included elements such as, changes in pitch, long pauses, sighs, and under-the breath comments. These details enhanced my ability to find hidden meanings embedded in discourse; meanings that reflected power relations among interacting participants. Videotaping the interaction provided an added dimension to the data collected. According to Flick (2009), videotaping facilitates repeated observations of fleeting episodes, and captures non-verbal portions of group interactions. I would like to point out that these video recordings were not the primary data source but were a necessary complement to the audiotaped transcripts from the interactions. As such,

video analysis software programs were not used for this investigation. Nevertheless, non-verbal communication such as facial expressions or hand gestures viewed from these recordings enhanced the interpretation of verbal statements.

I also wrote observational and reflective notes during the interactions, as well as during the transcription of audiotaped data, and the viewing of videotaped footage. During the meetings, my role was that of a complete observer where I maintained some distance between the group and myself so as not to influence the proceedings. My reflective notes documented my approach to the inquiry process, including problems that emerged during the ongoing data collection. Observation notes allowed me to capture relevant events that took place outside of the video camera's field of view. Additionally, reflective notes contributed to the reflexive stance assumed for this composition. Archival documents were also collected from the UFUTuRES project directors primarily for clarification purposes. In collecting these documents, I considered origin, purpose, credibility, and authenticity (Flick 2009) so as not to compromise the integrity of the primary audiotaped data. These documents provided context and clarification for specific episodes that were discussed during the interaction.

Data Analysis

The data collected were analyzed using tools I designed specifically to question issues of politics and discourses in PLCs. A summary of the data sources and analysis is provided in Table 4-2. In accordance with the situated nature of my methodology, these tools were not meant to be a standard instrument to facilitate replication of this research. Indeed, poststructural/postmodern inspired analysis cannot be repeated as a sort of technique (Koro-Ljungberg 2008; Sondergaard 2002), and on a grand scale. The analytical tools were used to interrogate the data so as to unearth issues associated

with power, truth, and knowledge that emerged when individuals interact in PLCs. The design of these tools was informed by the ideas of Foucault, and involved reconstructions and reinterpretations that combined perspectives of Gee's (2011) discourse analysis. I refer to this approach as a 'Foucauldian-inspired' discourse analysis.

The design of these tools presents several issues for some right-wing poststructural/postmodern researchers whom I will refer to as Foucauldian watchdogs. These individuals are self-proclaimed experts who are bold enough to assert what 'accurate' Foucauldian analysis should look like, and this ironically and arguably establishes a dominant interpretation of Foucault's theories. First, many Foucauldian watchdogs are wary of researchers who attempt to employ modified versions of discourse analytical approaches that are inspired by Foucault, often accusing them of adulterating these 'dominant interpretations'. Second, the design of analytical tools elucidates the research process to the extent that it opens opportunities for Foucauldian watchdogs to portray my research as prescriptive, and running counter to Foucault's critique of universal truths and science (Nicholls 2009). Prescribing or declaring procedures, in their view, formalizes a Foucauldian discourse analysis thereby reinforcing the methodological conformity that is evident in other research paradigms.

It was not my intent, in the design of these tools, to create linear, concrete 'how to' recipe for analyzing discourses with a Foucauldian perspective. Neither did I attempt to channel Foucault in a bid to 'correctly' reflect his expressed ideas regarding discourse and its analysis. I designed these tools specifically for my research questions, and as a methodological possibility that generates specific questions to ask of the

discourses I analyzed during my inquiry process. This methodological possibility was situated (Lather 1993) within the specific context of my investigation; was not prescriptive but rather fluid and adaptable to the shifting circumstances of my inquiry process. In the next section, I share the tools I used to analyze the data collected.

Foucauldian-inspired discourse analytical tool

The objective of this Foucauldian analysis is to uncover power structures inherent in PLCs, to examine institutional contexts within which discourses are generated, to highlight the importance of the speaking subject, and to reveal discontinuities and irregularities associated with knowledge construction and the negotiation of meaning. As such four inquiry tools were designed to guide my interrogation of discourses in PLCs. These tools are by no means exhaustive but rather focus on issues that emerged during group interactions within the context of learning and knowledge construction. The statement is the unit of analysis and the analytical tools, which are not mutually exclusive, include knowledge/meaning, author, politics, and context. Although I performed a thorough analysis of the entire interaction, I used only those tools/questions that were relevant to the segments under analysis. For instance, if the circumstances of a given dialogue were already re-constructed through analysis, the context tool will not be used for subsequent segments of conversations occurring within the same context. Representative questions from this tool are outlined in Table 4-3.

Knowledge. This tool is concerned with *connaissance* and *savoir*, or the 'what' and the 'how' of the knowledge being generated as a consequence of the discourse. In the case of PLCs, what meaning (*connaissance*) did the group negotiate as a result of the discourse? What were some of the points of contention, disagreements, and

coercions (savoir) that led to the formalization of connaissance? Which form of knowledge was legitimized and which was disregarded? What specific knowledge emerged from what was said? What can we interpret from what was 'not-said'? What is the relationship between the various opinions (savoir) generated during the discourse? What knowledge was believed or accepted to be true? Is the knowledge generated casually accepted as true? How does this new knowledge relate to that already generated in the past? How do historical events influence the construction of knowledge within such communities?

Author. This tool focuses on the author, the speaker, and the actor of the discourse. Not only is it concerned with the conscious activity or speech of the individual, it also explores the subconscious or unconscious formulations that contribute to the discourse being generated. It separates the thought from the language and makes visible the author's intentions and cognitive processes. In PLCs, there will likely be several authors each bringing their own frames of reference to the discourse they generate or enact. And so I will ask of the author, what was said and what was meant? What is the meaning of what is said? What can be read between the lines? What did the author leave unsaid? What unconscious or subconscious activity preceded or ensued what was said? What is the intention of the author? What identity was the author intending to enact? What identity does the author attribute to others as a result of what was said? What frame of mind was the author in? How thorough or rational was the author's contribution to the discourse? What qualifies the author to create the statements contributed to the discourse?

Politics. The term politics is used here to convey social relations that involve authority or power. As a tool for the analysis of discourse within PLCs, the notion of politics extend beyond the power structures evident in verbal interchanges to include those inherent in educational systems. The use of this tool requires an understanding of the institution in which the PLC is embedded and asks of the discourse, what are some of the constraints that institutional practices place on the generation of the discourse? Does the institution value the knowledge constructed in such learning communities? Do individuals use their positions of power to subtly manipulate the outcome of the discourse? How are power struggles demonstrated during exchanges? How do related statements reflect the authors' notion of authority?

Context. The term context refers not only to the circumstances that shape the environment in which the discourse takes place but also the historical events that influence the statements made. The context often sheds light on the meanings constructed during discourses and provides researchers with a better understanding of the statements made. The use of this tool requires researchers to investigate the recent history of the PLC: past relationships among participants, occurrences, and interactions that may contribute to the discourses generated. This tool asks of the data, what is the purpose of this particular discourse? What are some of the events or interactions that were referenced during this discourse? What is the significance of such events to the discourse? What past event or interactions contributed to underlying tensions in the discourse?

Using the analytical tools

This analysis took place in chronological in order to examine shifts and transformations as the interaction progresses. The data were analyzed using discourse

analysis tools designed, in part, to identify opportunities for learning from various interactions (Gee & Green 1998). According to Gee and Green (1998), these opportunities are created among participants through activities on a moment-by-moment basis as they collectively construct knowledge. I first read the selected audiotaped transcription in its entirety in order to reconstruct the context from supplementary data sources including notes, archival documents, and videotaped footage. The first reading allowed me to identify individuals, events, or institutions that were referenced during the discussion, and also guided the collection of supplementary data sources. The texts from the transcripts were then broken down into segments that reflected significance or relevance to my research question. The segments were further divided into statements, which are interrelated units within the discourse. These statements were further deconstructed on a line-by-line basis, and then interrogated using relevant questions from the analysis tools designed for this inquiry. After deconstructing, the segments were then reconstructed through the multiple lenses that were appropriated during the research, including Foucault's theory of power and knowledge, constructivism, and legitimate peripheral participation. The findings, therefore, are reconstructed accounts of the events of the interaction.

Due to the chronological nature of my analysis, I was able to deconstruct and reconstruct each segment before moving on to the next. In so doing, the documentation of reconstructed accounts was concurrent with the deconstruction of the segments. Additional ideas were subsequently added to the reconstructed document, and therefore the writing process involved periodic refinement to accommodate the dynamic nature of my analytical process. Each segment was given a subtitle that reflected the

significance I attached to the interactions within it. In some cases, in vivo codes or other notable quotes were used as subtitles.

My analysis was grounded in both an emic perspective based on the ways in science teacher participants perceive their practice, and an etic perspective that acknowledged my own understandings of advances made in science education (Gee & Green 1998). In order to avoid conflicts or biases in my analysis, I attempted to keep both perspectives separate. However, due to the nature qualitative data analysis, it was not always possible to achieve absolute separation. The analytical procedures allowed me to determine the opportunities for learning and development created as a result of the interactions or activities within the PLC.

The following section briefly addresses issues regarding alignment of perspectives and the research process. It explains the various ways in which the theories explicated above will be reflected in my inquiry process. What are the methodological implications of the epistemological and theoretical positions outlined above? What does social constructionist research look like? What assumptions do poststructuralists/postmodernists bring to the research process? What is the significance of the discussing epistemological and theoretical perspectives at this juncture of my inquiry process? How will this guide the choices I will make? In articulating the interconnectedness between my epistemological position and the theoretical perspectives that guided my research decisions, I hope to demonstrate that my decisions were deliberate, premeditated, and methodical.

About Methodological Implications

In waxing philosophical about the constructionist and poststructuralist/postmodernist epistemological and theoretical framework, I was able to

reveal important connections between the two. How then, do I translate theory into practice? How will my philosophical stance inform my inquiry process? Why do you, as the reader, need to know? For one, I and I promote transparency in all its forms. As such, I and I behave in ways that make it clear to others why I and I make certain decisions and perform certain actions. These decisions and actions are open to critique, discussion, and dispute. Also, as I take you with me on this path, I do not wish to run ahead of you or to fall behind you. I want to keep you abreast of the shifts and transformations that characterize this inquiry process as I continue construct realities. In the next sections, I will share some of the methodological consequences of my epistemological and theoretical positionings.

Plurality

A central theme of the constructionist and poststructuralist/postmodernist philosophies is the rejection of a singular, universal grand narrative (Agger 1991; Richardson 2000). According to Agger (1991), this notion challenges singularity arguing rather for multiple methodologies and perspectives on problems. Embracing multiple perspectives, and subjecting universal truth claims to critique embolden researchers to expose the ruptures and ambiguities in mainstream positivist views (Harcourt 2007). In this composition, I will not appropriate privileged status to any one methodological tradition (Koro-Ljungberg 2008; Richardson 2000), neither will I factitiously declare the knowledge constructed as a result of this inquiry as absolute truth. The truth claims constructed as a result of this process should be subjected to the same level of critique as all other forms of knowledge (Jorgensen & Phillips 2002). This inquiry is focused on PLCs constituting middle school science teachers who are being prepared to implement instructional reform therefore, the knowledge constructed as a result will be historically

and culturally specific (Burr 2003). The intent is not to generalize or speak on behalf of all PLCs, but rather to represent a context-specific understanding, which will be one of many other possible truth claims or realities about interactions within PLCs.

As far as methodological traditions are concerned, standardization of research procedures reflects an underlying belief in absolutism and objectivism. The idea of a structured standardized methodological tradition, therefore, runs counter to my epistemological stance, which embraces situated methodologies (Lather 1993) that are context-specific. As a result, exact procedures are typically not “prescribed ahead of time but can be negotiated in ways that address poststructural problematics” (Lenzo 1995, p.17) including representation and ethics. Poststructural/postmodern perspectives challenge researchers’ heavy reliance on method to solve intellectual problems (Agger 1991; Powers 2007), and encourage them to create their own approaches by combining elements from different analytical perspectives (Jorgensen & Phillips 2002; Sondergaard 2002). According to Vick (2006), rather than achieving replication, poststructuralist/postmodernist research seeks the multiplication of different data in order to unearth power relations embedded in specific discourses. This composition will not present grand stories about all PLCs, just small stories that illuminate situational truths (Koro-Ljungberg 2008) viewed from specific perspectives, and connected to the discourse of science instruction in an era of reform.

Reflexivity

In constructionist research, the issue of the researchers’ role in knowledge construction is exacerbated and has to be addressed reflexively (Jorgensen & Phillips 2002). The aim of the reflexive researcher is to position truth claims not as authoritative or universal but as one form of knowledge among other possible forms. By assuming

the constructionism stance, I acknowledge that reality is socially and discursively constructed, and should not be endowed with undeserved sovereign authority.

Jorgensen and Phillips (2002) suggest that researchers “show the construction of the text in the text” (p. 200) in order to constantly remind readers that what they are reading is a contingent representation of reality. On the basis of this recommendation, I have chosen a multi-layered approach (Koro-Ljungberg 2008) where I interrupt the traditional flow of my script with discussions on my new understandings, and how these were constructed as a result of the inquiry process. I will also frequently reiterate the historical and cultural specificity of my findings without attempting to persuade you that I am writing the absolute truth. Richardson in Lenzo (1995) suggests that researchers constantly reflect on their methods, perspective, ways of knowing, and acknowledge how they shape the decisions made during the process. These reflections, according to Lenzo (1995) should permeate the text rather than being relegated to a specific section of the research report. Based on this suggestion, I will engage you in open, honest, dialogue at every stage of the inquiry process as part of my quest for transparency.

Qualified Relativism

Relativism may be viewed as skepticism toward claims to knowledge about reality (Jorgensen & Phillips 2002), and is inherent in social constructionist research. This skepticism invites researchers to question all truth claims without promoting our own understandings as superior to the ones we criticize. Our skepticism does not preclude us making claims of our own; it just opens these claims to debate and discussions. Thayer-Bacon (2003) proposes the use of the term ‘qualified relativism’, which suggests that although inquirers are “situated knowers” (p. 418), they can compensate for their “cultural embeddedness” by embracing the perspective of others in

the inquiry process. The truths we construct are typically related to other truth claims, and are usually relative to particular contexts. As a result, the knowledge constructed through this process will make several references to truth claims, many of which are venerated in academic discourses. So far, I have addressed issues of qualitative relativism in this composition by declaring the epistemological and theoretical underpinnings of the research (Jorgensen & Phillips 2002), substantiating choices relating to methods, theories, and designs (Koro-Ljungberg et al. 2009), and acknowledging how the truth claims of others contribute to the claims I make about reality.

Representation

Poststructuralist/postmodernist perspectives reveal how language facilitate the construction of reality and hence, offers innovative ways to read and write science (Agger 1991). In rejection of the traditional and inviolable scientific prose, poststructuralist/postmodernist writers adopt literary strategies that allow them to understand themselves reflexively as they write from various subject-positions (Richardson 2000) while surfacing their own fundamental assumptions (Agger 1991). First person writing is, therefore, not only embraced; it is encouraged. In this composition, my voice permeates the text in staunch support of non-positivist literary representation. Without sacrificing my attention to technical details, I employ a multilayered approach (Koro-Ljungberg 2008), which uses several degrees of complexity to represent understandings constructed from varying subject positionalities. Rather than concealing Self in the nooks and cranny of sacrosanct methodological traditions, she is exposed to you as raw as ever. Her vulnerabilities are laid bare for scrutiny, critique, interrogation, and skepticism. The prose of this composition is not

super creative, cerebral or abstract; neither is it static, disembodied, or mechanical. It alternates between convention and candor. It invites readers to be a part of the process of constructing Self and the subject of this inquiry. More importantly, it frees me from the hassle of having to try to represent social realities the 'right' way.

About Validity in Qualitative Research

In qualitative research, the term trustworthiness, which implies credibility, transferability, dependability, and confirmability (Guba & Lincoln 1989; Morse et al. 2002) replaces the positivistic concepts of validity, reliability, and generalizability. Lather (1993) suggests that researchers “rupture validity as a regime of truth” (p. 674) and substitute it for the concept of authenticity in qualitative research (Maxwell 1992). As a researcher assuming a poststructural/postmodern stance, I question the notion of replacing or substituting one truth claim with another. By formalizing validity criteria, such as construct validity or face validity (see Lather, 1986) for poststructural/postmodern research, are we not establishing and perpetuating a parallel regime of truth? If validity is concerned with truth or correctness (Kvale 1995), why are we talking about it in poststructural/postmodern research? How do we address issues of the legitimatization and representation in poststructural/postmodern research? How useful is it to replace positivistic terms such as reliability and validity with euphemistic synonyms such as trustworthiness and authenticity respectively? If there are multiple truths, why is it so important for me to persuade others to believe mine?

I chose to address the issue of transparency to counteract truth claims of validity, reliability, and generalizability imposed on researchers by Babylon system. According to Kvale (1995), these truth claims have obtained “status of a scientific holy trinity worshipped and respected by true believers of science” (p. 20), and create a clear

delineation between what is true and untrue. In this study, I question this positivistic notion of objective or universal truths and embrace the poststructural/postmodern view of multiple ways of knowing and multiple truths (Kvale, 1995). The most important responsibility I think I have as a researcher is to be transparent about the decisions I make as I navigate the inquiry process, as I reconstruct or reinterpret existing truth claims about interactions within PLCs, and as I consolidate my findings with other constructed realities in science education. What does transparency mean to me? It means being forthright and open about methodological decisions, and holding myself accountable for the outcome of these decisions. It means becoming sensitive to possible questions that may emerge from the process, and to address them before they emerge. It means being comfortable with vulnerability, and exposure to scrutiny.

How did my inquiry reflect the transparency that I so adamantly espouse? Lenzo (1995) proposes the notion of transgressive Self. My transgressive Self recognizes paradoxical positions assumed throughout the inquiry process. For instance, Self is zealously pursuing an educational title from the same 'Babylon system' she seeks to challenge or condemn. It is as if she needs validation from 'Babylon system' in order to rupture 'Babylon system'. Self is not unique to this situation. There are many scholars who are swimming against the tide of absolutism and foundationalism inherent in many institutional practices. Self has decided, however, in the interest of transparency, to openly confront these issues by adopting an ethos of self-reflexivity for the entire inquiry process (Sondergaard 2002; Richardson 2000; Rodgers et al. 2005). Lenzo (1995) suggests that transgressional positionings are reflected through researchers' "scrutinous and playful self-reflexivity" (p. 21) as they position themselves within and

against their field of study, their epistemological and theoretical attachments, and traditional views of researcher/researched relationships. Writing reflexively from these multiple positions moves the emphasis from post-evaluation of written product to more constructive “quality control throughout the stages of knowledge production” (Kvale 1995, p. 26). It allows me to adapt to the changing circumstances of the inquiry process through continuous reflection, clarification, confirmation, and interrogation (Guba & Lincoln 1981; Morse et al. 2002).

Several researchers have addressed the issue of validity within the context of poststructuralism/postmodernism (Kvale 1995; Lather 1993; Vick 2006). I see the two as diametrically opposed. In this section, I share some of the features of this inquiry process, which reflected some of the views proposed by scholars regarding what I will collectively refer to as transparency. First, methodological coherence between epistemological positioning and research design (Koro-Ljungberg et al. 2009; Morse et al. 2002) demonstrated consistency in the approach. Second, the concurrent collection and analysis of data facilitates mutual and iterative “interaction between what is known and what one needs to know” (Morse et al. 2002, p. 18). Third, the inclusion of substantial direct quotations from textual discourse collected accompanied by thorough description of how the data was interpreted. This allows readers to make critical assessment of analysis approach (Vick 2006). Finally, due the gatekeeping nature of this composition and the ‘Babylon system’ that holds the key, I included other internal procedures including peer debriefing, audit trails, prolonged engagement, and persistent observations (Gee 2011; Lincoln & Guba 1985) to ensure trustworthiness. Amidst the plethora of standard procedures outlined by scholars to ensure trustworthiness of

qualitative research, Miles and Huberman (1994) alluded to the inherent fallibility of these decision rules. Again, in the interest of transparency, I exposed inadequacies and deficiencies as soon as they are perceived.

I am aware the huge responsible that I have to represent my truth claims in a way that challenges rather than perpetuates systems of domination. I am also aware that as I analyze the data, I may be imposing meanings on the text based on the multiple subject positions that I assume throughout the process. None of these positions allow me to determine if the text is true or false because a universal truth is inaccessible. As you read, your prior experiences and understandings will be brought into bear as you make sense of what you read. You will likely be reconstructing, and reinterpreting my truth claims as you read the following pages. This composition is open to debate, discussions, and critique and should be seen as a contingent representation of the realities I construct on this path.

So far on this journey, I have experienced confusion and disorientation during incessant downpours, intermittent bouts of clarity when the sunlight appeared, and promising rays of hope when the rainbows formed. I do not know what is beyond the rainbow but I am aware of truth claims suggesting blue skies, dreams coming true, and pots of gold. What will I find at Rainbow's End? What will be my reality when I get there? Will it be the same as the dominant reality imposed on our psyche through discourses in society? Will my account uncover ruptures or discontinuities inherent in dominant truth claims? Your guess is as good as mine. In the final section Chapter 4, I describe characteristics of Self that influenced not only the interpretation of my data, but also they way I conducted this investigation. Declaring these attributes is very important

because as the analyst of the data, and author of this composition, I bring elements of my personality, personal history, and habitual tendencies that will permeate both the process and the product.

About Self

Of all the lenses mentioned so far, the lens of Self is the most powerful. It is characterized by its complex mosaic of experiences, beliefs, worldviews, cultural perspectives, and professional predispositions that interact in various ways to shape my interpretation and representation of reality. As such, it is important for you to understand who Self is in order to appreciate the theoretical and methodological decisions made on the path to Enlightenment. Self is a product of the social, cultural and historical factors that have shaped her characteristics over time. Self, is therefore, largely defined by where she was born and raised. Self is a middle class Jamaican woman who grew up in a society characterized by racial and cultural homogeneity. In her native country, she was never identified as marginalized, disenfranchised or otherwise inferior to a dominant group because in her country, she is a member of the dominant group. In her country, her identity is easily defined, uncomplicated and never a question of concern. In the United States, where she now studies, her identity seems to depend largely on who the persons around her say that she is. Because of the color of her skin, she is typically identified as African American, or an ethnic minority. While she has acknowledged dominant interpretation of a reality that positions her as part of the minority or inferior group, she refuses to identify herself based on the realities of others. Her reality is what she says it is. And she says that she is an individual, who like many others before her, has taken a journey on this path of Enlightenment. Her journey became one of introspection and reflection as she participates in new experiences, and

becomes transformed by the inquiry process she is currently undertaking. In the sections below, she will offer a brief insight on her background, past experiences, and perspectives that may have influenced her methodological decisions, and her interpretation of the data collected. It is important to note that her sense of Self is still under construction. Perhaps she will find it at Rainbow's End.

Self as 'I and I'

I have multiple, often contradictory ambitions. There is a part of me that wants to live on a beach in an island somewhere with nothing to do but be entertained by music, movies, and red wine. Yet, there is another part that wants to work with in-service science teachers in various projects aim at improving their practice, and consequently student achievement. There is also a part of me that supports collaboration in all its forms, yet for the most part I have a preference for undertaking assignments individually. There is a part of me that criticizes and sometimes rejects 'Babylon systems'; the bodies of knowledge they produce, and the inherent power they exercise in the normalization of appropriate behaviors in society. Ironically, there is that part of me currently taking a journey mapped by 'Babylon system', and that will take me to a place controlled by 'Babylon system', where my future work will be inspected and legitimized by 'Babylon system'. My constant struggle with these contradictions is reflected in various portions of this composition. For instance, quotes of some of my favorite songs are included in my writing style, which switches from the relaxed tone of the Self on the beach with the Self aspiring to work with science teachers. Additionally, my epistemological stance promotes reflexive or imaginative representation of research yet I chose to be cautiously creative in recognition of the gatekeeping nature of this endeavor. My struggle with contradictions may be evident in other aspects of my

research process but it is my intention to share them with you as I take you with me on my journey.

I have commitment issues. This is not to say that I would never commit to anything, to anyone, or to any cause. It is just that I prefer to have the freedom of choice rather than to feel constrained by the old ball and chains. Freedom of choice allows me to explore different places, people, and ways of doing. It offers me the flexibility to change my beliefs and practices based on the realities I construct for myself. Meaning for me is therefore never immutable but rather fluid, tractable, and contingent on my circumstances, and experiences. That is not to say I conform readily to 'Babylon systems'. I reserve the right to construct my own realities in the face of those imposed by dominant cultures. Therefore, in a society with prescribed normative perceptions of a beautiful woman, a healthy diet, and an ideal weight, I beg to differ. My aversion to commitment is reflected in the plurality evident in 1) the theoretical perspective selected for guiding my research design, which seamlessly fuses post-structural and postmodernist perspectives, 2) the three theoretical constructs selected to interpret my data, and 3) the discourse analytical approach designed, which integrated a few elements of Gee with ideas of Foucault. These choices are not coincidental, neither were they deliberate. They were a natural reflection of the way my mind works. A single plan 'A' is never enough. A plan 'B' is required to avoid disappointment, and a combination of both guarantees satisfaction.

I love to psychoanalyze people. I am an avid people watcher. To clarify, I am not a voyeur; I just enjoy observing people and their interactions in public locations such as parks, playgrounds, and airports. I developed this hobby, approximately fifteen years

ago and so I have developed some level of expertise in the area. As a way to pass time, I would observe the body language of my unwitting subjects, and eavesdrop on their conversations in order to construct my own account of the circumstances surrounding the interaction. For instance, two sixth-grade girls engaged in their own hushed, yet animated conversation during small group activity in a science class I recently observed. Listening in on the conversations, reading lips, and investigating speech acts and other actions could provide evidence to support the claims I make about this interaction. They are smiling and laughing with each other, so this is not disharmonious dialogue. They are periodically glancing at a fellow student – a boy who was seated on their right. One of the girls had flushed cheeks. Does she have a crush on him? The boy got up and walked over to speak with the teacher who was working with another student group. As they watched him walking away, one girl leaned over and whispered to the other then they both spontaneously erupted in giggles. What were they talking about? Are they making fun of him? The laughs did not seem derisive. Did he say something earlier that they are just now finding hilarious? Why aren't they focusing on the activity the teacher assigned?

I think my propensity to ask questions of interactions, people, and their actions; to use previous experiences and current observations to shape my reasoning; and to construct a truth, which I know is subject to change with the circumstances, factors favorably in my choice of research. However, it has led to a tendency to overanalyze and read too much between the lines, which could possibly lead to illusionary associations and manipulated meanings. Then again, it is even possible to overanalyze data in qualitative research?

I have never taught science in the American K-12 education system. I taught math and science at a community college in the Bahamas, where the curriculum and instruction is strongly influenced by the British education system. These students were adults whose ages ranged anywhere between 18 and 60. My knowledge of the American K-12 system was constructed through a combination of classroom observations, interactions with teachers and professors, assigned and voluntary readings, workshops, and teacher conferences. As my understanding of K-12 science curriculum and instruction developed, I became increasingly confident about facilitating professional development workshops for science teachers, teaching a K-8 science methods course to pre-service teachers, and teaching a science curriculum development course to middle school teachers pursuing a masters degree in science education. These experiences can never compare to the opportunity to interact with actual middle school students in a science lesson, but to a large extent they provide a frame of reference for deliberations during this study. I have had extensive interactions with my study participants in forum discussions established for an online class I facilitated, face-to-face discussions during cadre meetings and workshops I attended as an observer, and personal conversations over lunch and coffee at designated meetings. Despite these interactions, I cannot truthfully relate to the vicissitudes of middle school science instruction. I am, therefore, conducting this research on the periphery of the PLC established for this research, not participating fully but granted legitimacy by the middle school science teachers within it. My inquiry will contribute to the learning in the multiple identities that characterize 'I and I'.

Self as Researcher

I am no stranger to research. In fact, it was my love of research that led me to select an undergraduate science major. During high school, my biology teacher, who was the president of the Association of Science Teachers in Jamaica at the time, encouraged me to pursue research in an area of personal interest, and to present my findings at the National Science Exhibition held annually to attract science students to the field. My very first independent research in science was conducted at age fourteen and I explored the incidence of a skin condition called *Tinea versicolor* (locally called liver spots) that seemed to be affecting several students of the school population, myself included. The gratification of pursuing a question from the beginning to the point where several other questions were spawned as a result was very gratifying, and led to several other research experiences in science later in my life. My final independent research in the field of science was conducted as a requirement for the masters of philosophy (MPhil) in botany I obtained in the early nineties. The MPhil is an advanced postgraduate research degree granted after several years of original research. For this research, I conducted environmental impact assessments of biofuel production in Jamaica so my data were derived from soil, water, and atmospheric samples. My analysis followed a linear script and in the end I had a research report with many pages of data tables, graphs, statistical printouts, and the rhetoric that characterize scientific prose. I was informed early in my data analysis and representation classes not to use the first person and to always refer to Self as 'the author' if I needed to make such a reference. Self was not important to research in science. She was secondary to the numbers generated from standardized analyses and statistical manipulations. Having

no experience with any other research paradigms, Self became accustomed to being invisible for many years. Then she was introduced to another way of knowing.

After many years of allegiance to the venerable tradition of science research, I had the opportunity to study the interactions of biology teachers with their students in a large urban school in New York. I was quite enamored by the possibilities offered by qualitative investigations of human behavior in various academic settings. More importantly, I was fascinated by the prospect of making Self visible during the research processes. My transfer from the domain of science to that of science education resulted in my immersion in another research paradigm that I decidedly embraced, at first try. However, my commitment issues prevent me from eschewing one in favor of the other, and my contradictory ambitions leave me in a quandary especially since one conforms to 'Babylon system' while the other criticizes it. What is Self to do? Does she perpetuate the very system she ostensibly rejects? Does she assume the identity associated with the paradigm she selects for subsequent research? Would that make her disingenuous, unreliable, or phony? She did confess to the multiple identities subsumed in Self. She did indicate that her past and present research experiences contributed to the lens of Self. Perhaps we should observe the way she appropriates this lens before we rush to judgment.

About Chapters Five and Six

Chapters 5 and 6 present the reconstructions resulting from my data analysis. The two interactions were selected for analysis based on their relevance to my research questions, and were presented in two separate chapters. For the most part, both interactions involved different middle school science teachers but there were two teachers who participated in both. This was purely coincidental as interactions were

selected based on the nature of discussions rather than the composition of the group. The reconstructions presented the interactions as they unfolded on a moment-by-moment basis, and highlighted those incidents that were considered significant to the exercise of power and the construction of knowledge. In some cases there were notable overlaps, which confirmed Foucault's view that power and knowledge are inextricably linked. In keeping with the methodological framework adopted for this composition, I have indicated the tools employed for deconstruction of each of the reconstructed segment. Additionally, the lenses appropriated during the reconstructions were explicitly named in summaries at the end of each chapter in order to provide a clearer understanding of the method embedded in my madness.

Table 4-1. Profile of PLC participants

Names*	Age	Grade(s)/Subjects Taught	Years Experience	Education	Certification
Nina	Early 30s	5 th /Math and Science	8	BA (Elementary Education)	Middle grades integrated
Jenna	Late 40s	6 th , 7 th , & 8 th /Science	10	BA (German, minor in Education & Humanities)	Middle grades integrated
Sue	Early 50s	1 st to 8 th /Science	13	BA (Education)	-
Megan	Late 40s	6 th /Science	10	BSc (Chemistry) PhD (Pharmacology)	Middle grades integrated
Erin	Mid 40s	6 th /Earth and Space Science (advanced & regular)	9	BA (Music Therapy)	Middle grades integrated
Drew	Late 40s	6 th & 7 th /Math and Science	15	BA (Business Administration)	Middle grades integrated
Jessica	Mid 30s	8 th /Science 9 th /Agriculture & Intensive Reading	8	BS (Environmental Horticulture)	Middle grades integrated
Rob	Late 30s	7 th /Science	11	BS (Physical Education)	Middle grades integrated

*Pseudonyms

Table 4-2. Data sources and analyses

		Data Analysis
Primary Data Source	Audiotaped transcriptions of interactions	<p>First reading of transcript identified individuals, events, or institutions that were referenced during the interaction, and also guided the collection of supplementary data sources.</p> <ol style="list-style-type: none"> 1. Transcript divided into segments that reflected significance or relevance to my research question 2. Segments further divided into statements (interrelated units), which were interrogated using relevant questions from the analysis tools designed for this inquiry. 3. Segments reconstructed through the multiple lenses that were appropriated during the research 4. Reconstructions used to determine opportunities for learning as well as exercise of power during interactions.
Supplementary Data Sources	<p>Videotaped footage of interactions</p> <p>Archival documents related to master's program</p> <p>Researcher notes during and after interactions</p>	<p>Non-verbal communication, such as facial expressions or hand gestures viewed from these recordings, were used to enhance the interpretation of verbal statements.</p> <p>These documents were collected from the UFUTuRES project directors and provided context and clarification for specific episodes that were discussed during the interaction</p> <p>Researcher's notes captured relevant events that took place outside of the video camera's field of view</p>

Table 4-3. Foucauldian-inspired discourse analysis tool

Analytical Tool	Representative Questions
Knowledge	What meaning (<i>connaissance</i>) did the group negotiate as a result of the discourse? What were some of the points of contention, disagreements, and coercions (<i>savoir</i>) that led to the formalization of <i>connaissance</i> ? Which form of knowledge was legitimized and which was disregarded? What specific knowledge emerged from what was said? What can we interpret from what was 'not-said'? What is the relationship between the various opinions (<i>savoir</i>) generated during the discourse? What knowledge was believed or accepted to be true? Is the knowledge generated casually accepted as true? How does this new knowledge relate to that already generated in the past? How do historical events influence the construction of knowledge within such communities?
Author	What was said and what was meant? What is the meaning of what is said? What can be read between the lines? What did the author leave unsaid? What unconscious or subconscious activity preceded or ensued what was said? What is the intention of the author? What identity was the author intending to enact? What identity does the author attribute to others as a result of what was said? What frame of mind was the author in? How thorough or rational was the author's contribution to the discourse? What qualifies the author to create the statements contributed to the discourse?
Politics	What are some of the constraints that institutional practices place on the generation of the discourse? Does the institution value the knowledge constructed in such learning communities? Do individuals use their positions of power to subtly manipulate the outcome of the discourse? How are power struggles demonstrated during exchanges? How do related statements reflect the authors' notion of authority?
Context	What is the purpose of this particular discourse? What are some of the events or interactions that were referenced during this discourse? What is the significance of such events to the discourse? What past event or interactions contributed to underlying tensions in the discourse?

CHAPTER 5 FINDINGS I: THE POT OF GOLD

Reporting Findings

In Chapter 5, I report findings from the analysis of the data derived from one of the interactions of middle school science teachers within a PLC. My analysis was guided by the following question and sub-questions:

- 1 How can professional learning communities (PLCs) operate as a site for learning and development of middle school science teachers in the process of implementing an inquiry curriculum?
 - a) How do middle school science teachers negotiate meaning and construct knowledge about their practice during interactions within a PLC?
 - b) How does the exercise of power influence the process and outcome of consensus making among middle school science teachers within the PLC?

These findings are the result of complementary processes of deconstruction of data using Foucauldian-inspired discourse analysis tools, and subsequent reconstruction using an eclectic blend of theoretical constructs outlined in Chapter 3. In this composition, each interaction was addressed separately and in a sequential manner as I examined shifts and transformations in power relations as science teachers negotiated meaning within the PLC.

The analysis of collected data signaled an important milestone in my journey toward Enlightenment. Although the process addressed many of the wonderings I had at the onset of my inquiry, it challenged taken for granted notions regarding truth, knowledge, and intellect. Multiple truths, multiple ways of knowing, multiple understandings gleaned from a single occurrence dispute the existence of a single place or state called Enlightenment. Yet for many years, I have nurtured the misconception that all graduate students pursuing the same program of study somehow

share a common journey, with common experiences, and a common destination. I bought into the notion that a group of individuals when exposed to the same information would derive the same set of understandings, and therefore achieve the same degree of enlightenment.

As I delved through the various layers of my data, and as I swapped analytical lenses to examine and interrogate the data, I resisted the temptation to accommodate preexisting ideas of what I would find at the end of the rainbow. Rather I kept an open mind, and ignored the promises of leprechauns, pots of gold, and eternal bliss that permeate popular cultural systems of truth. Needless to say, I have become quite skeptical of where my journey to Enlightenment will take me. In fact, at this point in my inquiry, I consider Enlightenment to be as actual and factual as Rainbow's End. As such, my Enlightenment is a matter of perception, not a matter of fact. The findings I report below reflect one of the many realities that constitute interactions of science teachers in a PLC. Again, these findings reflect my interpretation of selected episodes of teacher interaction that addressed my established line of inquiry, and should not be considered universal truth.

Exploring Discourse Types in the Science Classroom

The interaction reported below took place as teachers worked in groups to redesign a physical science lesson segment in a way that integrates some of the discourse types associated with the reform curriculum they were currently implementing. This particular interaction was selected because of the overwhelming demonstration of power strategies by one or more teachers, and aimed at influencing the outcome of deliberations. Additionally, there were numerous shifts in positions as teachers attempted to arrive at a consensus that reflects the views of all participants.

The teachers were instructed to view the lesson segment on the YouTube website <http://www.youtube.com/watch?v=eG5Odw91Klw> before collectively responding to the following prompts (excerpted from U-FUTuRES document in Appendix A):

- 1 Summarize the science content presented in the lesson segment
- 2 Identify two IQWST discourse type that your group wants to incorporate into the (redesigned) lesson segment. Identify the purpose of incorporating each discourse type in terms of what students will be able to do or know (emphasis in original document).
- 3 Develop a list of at least 3 teacher questions to promote the two discourse types you identified in step 2. Identify possible student response for each of the questions you listed.

Teachers were also provided with an additional document (U-FUTuRES document in Appendix B) that recapped the discourse types associated with the inquiry curriculum as well as a list of teacher questions corresponding to each. According to the front matter of the reform curriculum, the discourse types include:

- 1 Brainstorming – involving sharing ideas without evaluating the validity.
- 2 Synthesizing – involving putting ideas together, or assembling multiple activities into a coherent whole.
- 3 Pressing for Understanding – involving figuring things out or making sense of readings or activities.

In addition to responding to the prompts outlined above, teachers were instructed by the facilitator to, 1) make two claims about the discourse types observed in the video clip, and 2) support each claim with evidence/observations from the video clip (U-FUTuRES document in Appendix C).

Summarizing the Lesson Segment

The lesson segment viewed by the teachers was a 6:35 minute video clip of physical science teacher's attempt to reinforce to his students the importance of experimentation (see annotations on the video clip <http://www.youtube.com/watch?v=eG5Odw91Klw>). The teacher asked students "in your experience, do heavier objects fall faster than light ones?" He probed students' affirmative responses with questions such as "what are some examples?" "Is that true?" and "how do you know?" He showed the students a 10g weight and a 200g weight and asked which weight they believed would fall first. Classroom consensus was that the 200g weight would fall first. On several occasions, he unsystematically dropped both weights to determine whether the rate at which they fell was directly proportional to the mass. He then asked students to indicate whether or not the experiment was a good or valid experiment. Students suggested that both weights would have had to be dropped from the same height at the same time in order to ensure validity of the experiment. Furthermore they indicated that a timer would be necessary to accurately record the time.

After noting students' responses to his questions he asked, "why do we have to do this?" "can we just talk about this and figure it out?" "why do we need to experiment?" After testing several masses in a similar unsystematic manner, which resulted in the heavier object falling first, the teacher took the students outside to test their hypothesis in a more methodical way. The teacher used a bowling ball and a marble, and dropped them from the same heights onto a board so that students could clearly hear when the objects hit the ground. The outdoor demonstration revealed that

both the bowling ball and the marble fell at approximately the same time. The video clip stopped immediately after the objects fell.

Introducing the Teacher Participants

The PLC under investigation comprised four middle school science teachers: Nina, Jenna, Drew, and Erin. Nina is a 5th grade math and science teacher with eight years teaching experience; Jenna has taught science to 6th, 7th, and 8th graders for the last ten years; Drew has had fifteen years experience teaching life sciences to 7th graders; and Erin is a 6th grade earth/space science teacher with nine years teaching experience. These four teachers were expected to collectively redesign the lesson segment viewed in the video clip by integrating discourse types learned in a course they had completed from their prescribed program of study. They were required, as a group, to conceptualize and negotiate their understandings of discourse types associated with the reform curriculum IQWST, and to integrate consensus ideas in a revised lesson plan. The sections below explore, in a sequential manner, the process of meaning negotiation as teachers addressed the required prompts.

From Battleground to Common Ground

As middle school science teachers attempted to negotiate their understanding of the discourse types associated with the inquiry curriculum, there were numerous shifts in individual conceptualizations as each teacher struggled to construct meaning that would gain the approval of the group. The forum provided an opportunity for teachers to share their developing ideas, reexamine them in the face of conflicting suggestions, and make modifications based on new understandings. An analysis of the discourse generated by the interaction highlights these shifts and transformations while surfacing power strategies employed by individual members to ensure unanimous acceptance of

their negotiated meaning. The reconstructions below were guided primarily by Foucault's theories on power and knowledge as well as the tenets of social constructivism, perceived in my composition as a learning theory. Each segment was subtitled based on the specific incident highlighted.

Anticipating thoughts

Context/Politics. Erin began the conversation by trying to get consensus as to how to proceed with their deliberations. Nina interrupted her comments by indicating that she wanted to "drop a bowling ball on a board now" (line 2). At this point Jenna, who was feverishly taking notes during the viewing of the video, redirected one of the prompts included in the assigned instructions to the rest of the group. She asked, "what are our two claims about discourse types observing the video?" (line 4). To this Erin responded "pressing for understanding" while Jenna suggested "brainstorming". Erin agreed with Jenna's choice, and eliminated the third discourse type, synthesizing, as a possible choice. Nina declared total agreement even before Erin completed the statement. Nina claimed that she "anticipated" Erin's thoughts and was able to respond in agreement even before the statement was completed (lines 7-14).

7 Erin: I definitely do not think it was...

8 Nina: I agree

9 Erin: ... synthesizing

10 Nina: I agree

11 Erin: Are you anticipating my thoughts?

12 Nina: I did, I did anticipate your thoughts because you were going to do one of

13 the other two and I knew that it wasn't one of the other two so whichever one

14 you picked I was going to agree with you

Author/Politics. Nina took a very bold action when she resolutely agreed with Erin even before Erin made her position known to the group. This action demonstrated the high level of trust and confidence that Nina has in Erin. She confirmed this by asserting that she was anticipating Erin's thoughts. Why didn't she anticipate Jenna's thoughts? Why didn't she agree with Jenna? She certainly did not voice an agreement when Jenna indicated brainstorming as her choice for a discourse type. She did not nod in agreement or otherwise demonstrate concurrence with Jenna's selection. Nina explicitly indicated that she was going to agree with any discourse type selected by Erin. What was her intention in doing so? What did she achieve by making this declaration? Nina made it absolutely clear that she valued Erin's ideas and would firmly and unconditionally support her responses.

By demonstrating this unwavering support, Nina suggested that a rejection of Erin's position equates to a rejection of Nina's position. This preemptive declaration revealed a united front between Nina and Erin that the other two participants would have to reckon with. At this point in the discussion, it is not clear why Nina took sides with Erin and not the others. It is also not clear at this juncture whether the statement was meant to inform or intimidate the other participants. What is evident, however, is that the close friendship Nina and Erin have developed over the course of the program activities may have contributed to this overwhelming demonstration of support. I believe that the notion of anticipating the thoughts of others is an important aspect of social interaction. What makes this case of anticipating thoughts significant is the explicit declaration of such, as well as the commitment to consensus even before the thoughts were translated into text.

Knowledge. Within the first several minutes of deliberating, the group achieved a consensus as to the two discourse types observed in the video clip. They were selecting from three possible options, and through a process of elimination, Erin and Jenna were able to make selections that met the approval of the others. The consensus was quick and easy for two reasons. First, the number of individuals involved in the process of negotiation was relatively small. Second, the participants were selecting from a small pool of options. Despite this, the teachers were able to make sense of the discourse types that they had read about in a previous course. The prompt provided teachers with an opportunity to make associations between formalized codified knowledge related to the reform curriculum, and practical classroom strategies observed on the video clip. The quick consensus achieved during this segment indicated that there was a shared understanding among all group members regarding the features of the discourse types associated with the curriculum they are being prepared to implement. From a constructivist viewpoint, observations made from the lesson segment aligned with codified understandings articulated in the front matter of the reform curriculum, and as such were accepted within the PLC as valid.

It appeared that teachers prefer not to resist codified information. The general assumption is that the knowledge of experts is superior, and as such codified knowledge can have a powerful effect on the outcome of meaning negotiation in PLCs. The underlying discourse that permeates the group's discussion is the 'preferred' form that classroom discussions must take during the implementation of the reform curriculum. This discourse operates in silence and restricts teachers' meaning negotiation within the confines of the three formats of discussion acknowledged by the

curriculum, namely, brainstorming, pressing for understanding, and synthesizing. Although the decision to limit teachers' responses to the three discourse types associated with the curriculum may be reasonably argued, one cannot ignore the influence of codified knowledge on this group consensus. The regime of power established through the expertise of curriculum developers is ostensibly reproduced when teachers' creativity and thought processes are restricted to the discourses imposed on the learning community.

Evidence is everything

Context/Knowledge. The interaction continued as teachers addressed the second prompt of presenting evidence in support of the claims made about the discourse types selected by the group. As each teacher advanced a claim, the rest of the group responded affirmatively using identifiers including "right", "I agree", "yea", and "hmm hmm". During this segment, there was an eleven-second pause as teachers documented the suggestions made by the other group members. The suggestions included were quotes from teacher dialogue during the lesson segment such as "give an example", "have you tested this?" "Is this true?" "So what do we know?" The eleven-second pause was interrupted by more quotes and more affirmative responses from group members.

After the quick consensus was reached, teachers worked toward identifying claims to support the selections made. The design of this task by facilitators was influenced by discourses associated with the reform curriculum that the teachers were preparing to implement. This inquiry curriculum is based on the notion that scientists, in the construction of scientific knowledge, provide evidence of the validity of their claims (McNeil & Krajcik 2007). Experts in the field of science education believe that students

should be engaged in similar inquiry practices, which promotes the use of evidence and reasons for ideas or claims (Driver, Newton, & Osborne 2000; Minner, Levy, & Century 2010; Sandoval & Reiser 2004). In an effort to prepare teachers to implement inquiry-based instruction, facilitators created prompts that reflect the basic principle that undergirds the design of the curriculum. The use of evidence to support claims is, therefore, part of a larger discourse within science education, which influenced the design of the prompts by facilitators, and hence the activities of teacher participants in the PLC. This demonstrates the power of formalized discourses in controlling the professional development activities of middle school science teachers.

The nature of the discussion that followed the consensus was guided by knowledge constructed in the field of science education regarding the use of evidence to support claims. Teachers provided evidence from the lesson segment to support their claim that two discourse types observed were brainstorming and pressing for understanding. The evidence cited reflected the meanings each teacher negotiated regarding the discourse types. Erin indicated that the teacher question “what do we know?” could be considered evidence but did not indicate which discourse type the evidence supports. Drew pointed out that the question suggests the elicitation of “background knowledge”. The other participants agreed with this characterization, and Jenna affirmed that the evidence advanced was in support of the discourse type brainstorming. No one opposed this statement so it appeared to be a consensus. Jenna’s follow-up statement provided an indication of her understanding of the concept of brainstorming (lines 26-28):

26 Jenna: Yea, how many times have you tested this? Is this true? Is this true?

27 So he was asking all those things that would pull out prior knowledge...what they

28 knew.

Jenna, in making this statement, articulated the associations she made between brainstorming and prior knowledge. She believed that brainstorming sessions that involve the sharing of student ideas would encourage students to share what they already knew about a given concept. Brainstorming, as far as Jenna was concerned, is an effective means of eliciting background knowledge.

Curiously, the group was involved in a brainstorming session of their own when Jenna conceptualized her understanding of brainstorming. According to the front matter of the inquiry curriculum the teachers were preparing to implement, brainstorming involves the sharing of ideas without evaluating their validity. Jenna, Drew, and Erin shared possible pieces of evidence for the selected discourse types without being challenged or questioned regarding the accuracy of their response. The lack of a critical assessment of the advanced responses could have been due to whole group consensus indicating that all members held similar understandings with respect to brainstorming. It could also be an indication that the teachers were so engrossed in the documentation of the ideas (they were all writing down the ideas that were advanced) that they didn't care too much about challenging each other's responses. By all indications, Jenna's views on brainstorming reflected the understandings of those within the group.

On a personal note

Context/Author. As teachers deliberated on evidence in support of claims regarding discourse types observed in the lesson segment, the conversation became slightly personal. Without being prompted or questioned, Jenna indicated that her learning is highly dependent on the documentation of ideas. In her own words, "I don't

learn unless I write” (line 37). Before Jenna had a chance to elaborate, Drew abruptly redirected the discussion to the prompts they were required to address.

The fact that Jenna commented on her learning style is not unusual in this situation. It is the language used that raises some questions. She indicated, “I am the note-taking crazy person I guess” (line 33). This statement not only discloses her learning style but also exposes her as a self-admitted crazy person albeit with an element of uncertainty. Does she believe that she appears crazy to the rest of the participants because of her fixation on taking notes? Was the statement made to justify or explain her consistent documentation of ideas? Why did she even consider it important to make the statement bearing in mind that they were all writing during the eleven-second break in conversation mentioned in the previous segment? Nina and Erin laughed when Jenna confessed to being a note-taking crazy person. Were they laughing at or with her? The laugh did not sound derisive. Jenna responded to the laugh by explaining that she doesn’t learn unless she writes.

This explanation also provides confirmation that teachers used interactive moments in PLCs as an opportunity to learn. By making these statements, Jenna placed herself in a vulnerable position by identifying herself with undignified descriptors such as crazy person. I would like to point out that I do not think that Jenna believes that she is crazy. She was just making an “off the cuff” statement about herself at a point during the interaction where writing was the main activity. In so doing, she lightened the atmosphere as she shared personal information with other teacher participants with whom she was interacting. Discussing personal information is also important for establishing an atmosphere of trust among group members as they negotiate their

understanding of features associated with the curriculum they are preparing to implement. Was Jenna successful in creating a breakthrough for the group in this regard? Perhaps not.

Politics/Author. Drew abruptly interrupted Jenna's justification of her feverish writing during deliberations by redirecting the conversation to the prompts they were required to address. Curiously, Drew did not share in the light moment Jenna attempted to create. Drew did not laugh with Erin and Nina after Jenna's candid confession. Drew did not participate in the discussions about personal learning styles; neither did she encourage prolongation of a conversation that she did not deem relevant to the prompts to be addressed. Drew's action here can be viewed as an exercise of power, the consequence of which influenced the process of meaning negotiation among the teachers. The interruption of this personal conversation changed the trajectory of what could have been a protracted discussion contributing very little to the working objectives of the group. The manner in which she executed this motion also had some bearing on the outcome. Drew did not rudely suggest that she was not interested in hearing what Jenna had to say about her learning style; neither did she comment on the need for the group to change the focus of the discussion. She diplomatically continued the discussion of discourse types by stating the evidence in support of claims regarding pressing for understanding. In so doing, no one had reason to become offended. The group's compliance resulted in more productive interactions.

Pressing for understanding

Context/Knowledge. For the next several minutes, group members provided evidence that supported their selection of pressing for understanding as one of the

discourse types observed in the lesson segment. They also made value judgments regarding the pedagogical strategies they identified (lines 46-53):

46 Jenna: and then he asked them, 'Is that a good experiment?

47 Why?' I think that asking that why question...

48 Nina: or why not?

49 Jenna: Right...or why not?

50 Nina: That was good

51 Jenna: And then he asked 'what could I do to make this a valid experiment,

52 I thought, was a thoughtful, good question...you know

53 Nina: He's taking it to the next level

According to Jenna, asking "why or why not questions" encourages students to think about an explanation for their idea or observations, and pushes them to articulate their understanding of a given concept. Their favorable assessment of this strategy is an indication that teachers perceive the 'pressing for understanding' discourse type as effective for promoting higher-level thinking among their students.

Discussions regarding the pressing for understanding discourse type and evidence as to the practical applications led Nina and Jenna to thinking about why the teacher elected to use that particular strategy during the brief lesson segment viewed (lines 55-61):

55 Jenna: Cause that's part of testing to make sure they are understanding the

56 concepts and I break down the science content knowledge to put that it is the

57 importance of experimentation ...so I thought it was really reinforcing what he

58 was trying to teach within the...

59 Nina: but I think also...I mean he...the purpose of the lesson being the

60 importance of experimentation. I think that a big part of pressing for
61 understanding was...was...can we figure this out by just talking about it
Both Nina and Jenna agreed that the purpose of the physical science lesson was to
impress upon students the importance of investigating phenomena in order to obtain
evidence to support claims. However, Jenna believed that in pressing for understanding
the teacher was reinforcing these ideas for greater emphasis. The tone of Nina's
response suggested a slight difference in opinion. However, examination of the
transcript revealed that Nina's ideas were quite similar to those expressed by Jenna.
The teacher was reinforcing the idea that scientists carry out investigations rather than
just talking about the phenomenon.

Politics/Knowledge. It is important to highlight this incident because differences
in the way individuals articulate their ideas contribute to pseudo-conflicts. I define
pseudo-conflicts, as misunderstandings due to poor communication of ideas. One party
misses the point of the discussion or miscommunicates ideas in a way that creates
discord rather than consensus. In this case, Nina began her response to Jenna with the
word "but" (line 59). The word but is typically used to introduce an idea that is seemingly
contrary to what has just been said. It may also be used to introduce further information
that is different from what was previously articulated. Nina's defensive tone suggests
that she believed her idea to be dissimilar to that proposed by Jenna. However, Jenna's
good-natured response, "I wrote that down..." (line 62) diffused possible deliberations
on what was already a consensus.

Jenna also pointed out that the teacher in the lesson segment used the pressing
for understanding discourse as a means of connecting scientific ideas "to the kids
personal life" (line 72), which she believed promotes engagement in the science

classroom. Again, this was a favorable assessment of the integration of this particular discourse type in their instruction. Observing genuine student engagement in an unedited video of a real science classroom made instructional strategies appear more adaptable to the participants' own classrooms. Teachers identified teaching strategies that they believed to be practicable and effective, and shared their assessment of such with other group members. Nina began the trend when she stated her first impressions of the instructional strategies employed by the teacher in the video (see line 50).

Although the evaluation of teaching strategies was not a requirement of the prompt, Nina's action inspired a similar action in Jenna. In keeping with Foucault's characterization of the exercise of power, the outcome of this discussion was productive, positive, and provided valuable opportunities for teacher learning. Both Nina and Jenna articulated understandings they negotiated regarding the selected discourse type. Specifically, knowledge constructed from their dialogue seems to suggest an understanding that fostering classroom discussions encouraging students to verbally make sense of given concepts or activities 1) promotes higher order thinking, 2) reinforces scientific concepts, and 3) facilitates connections with the real world.

Making sense of the prompts

Context/Knowledge. After advancing several pieces of evidence to support the discourse types selected, the group members revisited the prompts to ensure that there was consensus regarding the tasks they were expected to complete. In order to do this they reread the prompts aloud, checked to see what they had already completed, replayed portions of the video to confirm previous findings, and made decisions as to what to do next. These activities enabled teachers to articulate individual understandings as they collectively made sense of prompts. Conventional wisdom

dictates that individuals make sense of given assignments before beginning them. Our teacher participants, however, used a different approach to addressing the prompts. They began deliberations then interrupted the proceedings to check their understanding of procedural and propositional information related to the task. In so doing, they either intentionally or inadvertently resisted 'Babylon system' to employ strategies that came naturally to them.

As teachers checked on the prompts they had already completed, Erin and Nina indicated that they had not written down the ideas they had achieved consensus on. Jenna's confession of being the "note-taking crazy person" (line 33) led to an appreciation of her expertise in documenting information. As teachers checked their progress, they relied on Jenna to report on the meanings already negotiated. If Jenna really believed that she was crazy because she was a prolific note taker, the action of her peers in valuing her talents will likely contribute to a positive feeling about her participation in the activities of the PLC. This action is not unique to this PLC. There is a general tendency to rely on the individual expertise of others during collaborative activities toward a common goal (Webster-Wright 2009).

Knowledge. Rereading the prompts and replaying parts of the video enabled teachers to refocus their attention on the requirements of the group. Erin, after replaying portions of the video for approximately 2.2 minutes continued the discussion by putting things in perspective (lines 96-101):

96 Erin: Ok, so I like what he is doing. I like that they are focusing on gravity and
97 and mass and the relationship between gravity and mass and the falling
98 pennies also really focusing on experimentation and carrying it out, so he is
99 really tying in two things. Alright, so...[reading]...as a group make two

100 claims. So we have done that, we have supported them with evidence...you
101 have your four pieces for each one.

Erin's interpretation of the purpose of the lesson segment was slightly different from those articulated previously by Jenna and Nina. Although Erin agreed that the focus of the lesson was experimentation, she also thought that there was a corresponding emphasis on the relationship between gravity and mass. This understanding was communicated after a more focused observation of the video clip.

Now that teachers had reviewed the portions of the prompts they had already addressed, they were ready to move on to the next prompt. Erin continued to lead the process of sense making by rereading the prompts and sharing her personal interpretation (lines 105-111).

105 Erin: Next, we are going to develop a discourse plan so select any two
106 discourse types. So brainstorming, synthesizing, pressing for understanding.
107 redesign...[14s pause]

108 Erin: So...redo the questions. [Nina laughs]

110 Drew: Rewrite questions for him?

111 Nina: I know...it says to extend so perhaps we are adding something to it.

The teachers were asked to develop a discourse plan to “extend the teaching activity to represent the two IQWST discourse types” (see U-FUTuRES document in Appendix C) they selected through deliberations. Erin and Drew interpreted this prompt as redoing and rewriting teacher questions respectively while Nina understood the instruction as adding to the existing questions. Nina rationalizes her interpretation by referring to the word “extend”, which was included in the prompt. Nina, in negotiating an understanding of the required prompt, considered the meaning of key terms as well as the context

within which the terms were used. Again teachers appear to have made associations with codified knowledge as they negotiate meanings of their own. Although the three teachers shared their individual understanding of the prompts, there was no consensus as to how to approach the development of the discourse plan. Nevertheless, Erin proposed a discourse type.

A focus on synthesizing

Context. Erin proposed focusing on the synthesizing discourse for the redesign of the lesson segment viewed. In rationalizing her choice, she indicated that based on her assessment of the video clip, the synthesizing discourse type was absent. Erin also admitted that she rarely integrated this discussion type into her science lessons. Nina responded by assuring her that she was not unique in that regard (lines 118-120)

118 Nina: Well the lesson are such tiny baby steps that you have to get through
119 about three before there is even a place for synthesis to actually happen
120 really, so yea you're right. It doesn't happen as frequently as the others.

This brief segment revealed both Erin's and Nina's interpretation of synthesizing and how it related to their practice. The discussion also prompted a reflection of practice, and a critical examination of current instructional strategies.

Author/Knowledge. In reflecting on her practice, Erin admitted that while she integrated "a lot of brainstorming" (line 114) and "a lot of pressing for understanding" (line 116), she was not satisfied with her use of synthesizing as a discourse type in her science lessons. In her mind, this discourse type involves having students "extend" (line 117) their ideas beyond that which they have experienced in classroom activities.

Curiously, this interpretation aligns with the 'pressing for understanding' rather than the 'synthesizing' information presented in the front matter of the reform curriculum (see U-

FUTuRES document in Appendix B). Erin's interpretation of the synthesizing discourse type appeared to contradict the codified information associated with the curriculum, which conveyed the idea of assembling classroom activities or understandings into a coherent whole. While it is a bit premature to suggest that Erin's understanding of the synthesizing discourse type is misinformed, it appears that her ideas are still being developed and that further group interactions may contribute to a refinement of such.

Nina's response suggested an understanding slightly different from that of Erin. She believed that synthesis of ideas take place after "about three" (line 119) lessons, and as such does not occur as frequently in the science classroom as the other two. Nina made a bold statement regarding the general use of a particular discourse type in the science classroom (lines 118-120). Furthermore, she rationalized and justified Erin's self-confessed shortcoming regarding her teaching practice. Erin, in making a confession about her practice, placed herself in a vulnerable position where she became subject to the critique of her peers. Nina, on the other hand, did not personalize her responding statement. Rather than opening up her practice to critique from her peers, she elected to make a sweeping statement that tacitly excused the integration of synthesizing in science classroom discussions.

Extending the teaching activity

Context. Although Erin suggested the use of synthesizing as one of the discourse types that would form the basis of the redesign of the lesson segment, consensus was not achieved immediately. There was still some confusion regarding how to proceed. Erin tried to facilitate clarity by rereading the prompts, while Drew sought the interpretation of others as she tried to negotiate her own understanding of the requirement of the prompt. Another brief replay of the video clip shifted the

deliberations from the next steps to the focus of the lesson segment. This, after Drew's suggestion of a way forward reflected conflict with prevailing ideas that the focus of the lesson was on the importance of experimentation.

Knowledge. In a previous segment, Drew, Erin and Nina articulated their understanding of the prompt requiring a redesign of the lesson in a way that extends "the teaching activity to represent the two discourse types" (lines 121-122) selected by the group. So far, Erin suggested the synthesizing discourse type without opposition from the other participants. Achieving a consensus on how to extend the teaching activity, however, would require a common understanding of the focus of the lesson segment under study. Erin and Jenna had suggested previously that the lesson segment integrated concepts of mass and gravity with the importance of experimentation. Nina believed that the sole focus of the lesson was "why do we have to do the experiment" (line 142). While Drew did not advance her views regarding this issue, her proposal to extend the teaching activities to incorporate the concept of air resistance was a clear indication that she did not share Nina's opinion. Nina was quick to defend her lone position (lines 141-153):

141 Nina: Well I feel like though the focus of the lesson is not the idea of gravity
142 and falling. The focus is on why do we have to do the experiment. So I felt li
143 like the point of the lesson was...alright, so for 2000 years this is what we
144 thought and this is what we expected as being the norm but no one has ever
145 tested it to find out for sure so we need to try it. I feel like that was the
146 focus...was trying it and proving that your belief is true and not true. So I
147 mean, in my mind, if we are going to extend this I feel that perhaps taking
148 another activity where you are giving them something such as a situation

149 where it is understood that this is going to happen and perhaps it doesn't...

150 Drew: And devise a way to test it?

151 Nina: And perhaps it doesn't and testing it proves that what's understood

152 or what is accepted is not accurate. Like the heavier ball will fall faster...that

153 is accepted but we know it is not true. I mean that's what I got from it so I

153 could be way over in left field...

This statement was a clear expression of Nina's understanding of the focus of the segment and, hence, a suggestion for extending the teaching activity.

Nina stated her position regarding the focus of the lesson despite the fact that it was at variance with that assumed by the rest of the group. The other group members were now forced to re-evaluate their interpretation of the focus of the lesson in light of the dissonance created by Nina's well-communicated ideas. Again, a consensus regarding the focus of the lesson is necessary as teachers determined ways to extend the lesson segment. Drew's response to Nina's proposal appeared supportive (line 154):

154 Drew: So if they were going to synthesize, would they have to think of that

154 activity?

Rather than disregarding Nina's ideas, Drew sought clarification and attempted to negotiate her own understanding by using probing questions aimed at eliciting additional information. Nina's action, therefore, stimulated cognitive dissonance on the part of the other members while Drew's probing reaction contributed to an elucidation of how to proceed with the redesign of the lesson segment. The reaction of Erin and Jenna to Nina's bold position "over in left field" (lines 152-153) would prove critical to the outcome of the interactions.

About the science content

Author. Erin acknowledged a difference in opinion between herself and Nina. Indicating that she understood the point of view advanced by Nina, she went on to rationalize her position that the focus of the lesson was not merely about the importance of experimentation but that some science content knowledge was addressed. According to Erin, the prompt required them to ensure that “everybody understands the science content” (line 166) and as such there must be a focus on content knowledge. Jenna, the “note-taking crazy person” (line 33), mentioned that her notes indicated that the teacher in the lesson segment made reference to pendulums, which may be the science content around which the lesson was designed. The teacher participants attempted to address this point of divergence before moving on to the next step.

Knowledge/Politics. In making sense of the focus of the lesson segment, Erin consulted the prompt and reasoned that if the prompt required teacher participants to understand the science content knowledge then this requirement reflects an additional focus on content. Here, her claim is supported not by her observations of the video or the case presented by Nina, but rather by the prompt provided by the U-FUTuRES facilitators. Erin accepted the Information in the prompt as true and summarily disregarded understandings negotiated by Nina. Jenna, who was the first to indicate a science content focus in the lesson segment, supported Erin’s argument by referring to notes she had made while watching the video clip. However, she appeared unconvinced about the strength of her argument (line 171).

171 Jenna: Actually at the beginning, I think he mentioned something about
171 pendulums.

Even after replaying the video, there was an element of uncertainty in Jenna's line of reasoning (lines 180-181).

180 Jenna: So maybe they studied pendulums...and now we are trying to reason
181 why the heavier one does not swing faster.

This suggests the possibility that Jenna was clutching at straws in her attempt to provide justification for her idea that the focus of the lesson segment included science content knowledge rather than solely the nature of science. In other words, it was more important for Jenna to justify the selection of codified ideas rather than consider the view of another group member, despite the uncertainty regarding her rationalization.

This is a reflection of the power of formalized discourses in influencing the negotiation of understanding among the teachers. There is a lack of confidence in the knowledge constructed by a group member as demonstrated by teachers' disregard of Nina's articulated understandings in favor of those implied in a formal document.

Politics. Nina's response did not immediately suggest agreement with Jenna and Erin. In fact, she shifted the subject of the conversation during the replay of the video clip. Commenting on the age and experience of the teacher in the lesson segment was perhaps her way of redirecting attention from her reluctance to concede. Drew chose not to contribute to the deliberations so it was unclear whether she had shifted from her original position in support of Jenna and Erin. In any case, Nina stood by her interpretation of the focus of the lesson segment, showing no immediate intention to change her views.

Flip-flopped

Context. Erin made several suggestions as to how to proceed with the redesign of the lesson with support from Jenna, who used her copious notes to both validate and

challenge the statements of her peers. The proposals advanced were based on the understanding that the focus of the lesson was on a science content area rather than on the nature of science. Nina seemed to be disconcerted by Erin's contradictory position regarding the focus of the lesson segment. Drew, who was noncommittal, did not initially participate in discussions on the redesign of the lesson.

Knowledge. Erin's plan for redesign reflected her understanding that the teacher in the lesson segment was attempting to explain why the bowling ball fell at the same time as the marble despite differences in the mass. According to Jenna, students could be asked to consider the results of their class experiment with the marble and bowling ball, and to provide an explanation as to why a heavy pendulum would not swing as fast as a lighter pendulum.

182 Erin: Okay, so the next logical step would be tying in...

183 Nina (to Erin): So you and I have flip flopped

184 Erin: Well tying in the fact that the weight...so he was showing that the

185 bowling ball and the marble fell and hit at the same time...

186 Nina/Jenna/Drew: Hmm hmm

187 Erin: So then how do we reason why the heavier one does not swing as fast.

188 So they saw that the heavier one does not swing as fast but then when they

189 dropped the two objects they saw that they both fall at the same time. So

190 now they need to come up with the reasoning...

Jenna, the "note-taking crazy person" (line 33), was quick to identify the misconception in Erin's explanation, and tentatively modified the statement. According to Jenna's notes, both pendulums swung at the same rate.

191 Jenna: Well, he's saying that the heavier one does not swing faster. I think

192 they are swinging at the same rate...

Interestingly, Erin did not acknowledge the error until she consulted with Nina. This action reinforced a lack of confidence exhibited by Jenna during previous portions of the interaction.

193 Erin [after whispering with Nina]: Oh it doesn't? Sorry, I didn't...

194 Jenna: So I am right on that though? I mean they would swing at the same
194 rate...?

195 Nina: Sorry Jenna

196 Jenna: No that's okay. I just wanna make sure I'm...I'm

Although Jenna was restating ideas documented from the video clip, she demonstrated a level of uncertainty and sought validation from the rest of the group.

Author/Politics. The camaraderie demonstrated between Nina and Erin throughout the course of interactions within the PLC had not gone unnoticed by Jenna. Recognizing that both Nina and Erin were key to the decision making process, she was very cautious about the way she contradicted them. She strategically used her notes to defend her position while making a concerted effort to be compliant rather than defiant. Nevertheless, she was not intimidated by their actions. Erin adjusted her proposal to reflect Jenna's clarification, and suggested that students could be asked to "synthesize and connect and draw the connections between the two" (lines 204-205) scenarios involving the pendulums and balls. Erin's communication of this plan reflected a more developed understanding of the synthesizing discourse type. Her previous articulations did not align with the ideas presented on the U-FUTuRES document provided to support their deliberations. As Erin devised a practical solution to extend the lesson segment, she had the opportunity to think and talk about potential classroom activities that would

reflect a specific discourse type. This process of meaning negotiation allowed Erin to further develop her conceptualization of synthesizing as a discourse type. Jenna, however, believed that the classroom activities Erin described better reflected the pressing for understanding discourse type. Again, she cautiously advanced her view:

206 Jenna: That to me seems pretty logical as far as pressing for

206 understanding...right?

Jenna's perpetual uncertainty made her argument unconvincing and as such was summarily dismissed by her peers. At this point in the interaction, her strongest claims were those supported by the notes she made during observation of the video clip. These were the claims that had the strongest influence on the outcome of the discussions. Again, codified knowledge was considered of greater value than the understandings negotiated by individual group members.

Nina's unsettled feeling about Erin's conflicting position was palpable. She first acknowledged their differences when Erin began sharing her proposal to move forward:

182 Erin: Okay, so the next logical step would be tying in...

183 Nina [to Erin]: So you and I have flip-flopped

Erin ignored her comments, and continued with her explanation. Nina was not satisfied with the lack of response, and later ventured to interrupt Erin's explanation in a bid to restate her point:

207 Erin: But I do see your point about what you...

208 Nina: You and I are just flip flopped...and I thought the focus was on the

209 experimentation as opposed to the disciplinary...

210 Erin: Yea

211 Nina: So I was flip-flopped.

Why is it so important to Nina to highlight her difference of opinion with Erin? Nina was actually at variance with all the other group members but she appeared more concerned about the fact that she was at odds with Erin. At the beginning of the interaction, Nina had declared her unconditional support for Erin by anticipating her thoughts. Clearly this support was unrequited, reflecting as far as Nina was concerned a weakness in the 'coalition of two' she had established and declared at the beginning of the discussion. Although Nina attempted to provoke a response from Erin, none was offered and deliberations resumed.

Selecting two discourse types

Context. Erin continued to take the lead in the discussions regarding the redesign of the lesson. She repeated the scenario that involved students making connections between the pendulum experiment in which both heavy and light bobs swung at the same rate, and the class demonstration involving the bowling ball and the marble falling at the same rate. Nina suggested that rather than having them focus on the science content knowledge embedded in both activities, students could devise an experiment to reflect "different rates of dropping" (lines 224). Erin disregarded this suggestion, and continued to express her ideas about connecting both science activities. Drew disagreed with the use of the synthesizing discourse type for the redesign Erin proposed. Erin chose not to defend her position to use synthesizing and then suggested that perhaps the pressing for understanding discourse type could be used instead.

226 Erin: Well, but it says pick two discourses. So maybe press for

227 understanding about pendulums and then...

Jenna, who previously characterized Erin's redesign plan as pressing for understanding rather than synthesizing (line 206), indicated willingness to compromise provided that brainstorming is used as a complement to synthesizing.

228 Jenna: Do we want to continue on with synthesizing since they seem to be
229 logically...I mean you start with brainstorming, then the synthesizing, maybe
230 we can move from synthesizing to...

Erin immediately rejected the idea of including brainstorming in the design of the lesson. On the other hand, Drew and Nina expressed agreement with Jenna regarding the use of synthesizing and brainstorming as the discourse types to be integrated.

Politics/Knowledge. At this point, Erin was the dominant voice in the redesign of the lesson. The science activities she proposed reflected her understanding of the synthesizing discourse type. Her understanding of synthesis developed from the initial notion of expanding students' cognitive processes to one that involves them making connections. Her redesign also reflected her opinion that the focus of the original lesson segment was knowledge of specific science concepts rather than about the nature of science. As such, her new plan required students to provide an explanation for why an object's rate of fall is independent of its mass. As the only proposal advanced and with no presentation of an opposing view, this redesign plan appeared to be accepted by the group members. Nina, however, decided to persist with her original call for a focus on experimentation rather than science content (lines 218-219).

218 Nina: And then you can...I am sorry to interrupt you...but then you could get
219 to say now let's come up with scenarios where they wouldn't fall at the same
220 rate.

Nina's interjection was strategic. She was quite convinced that her ideas were correct, and that the redesign of the lesson should reflect a nature of science component. Her follow-up statement suggested inclusion of an activity where students would design investigations "where they would have different rates of dropping" (lines 221-222). It is important to point out that Nina's suggestion did not directly oppose Erin's plan. What it did was to circumvent previous disagreement regarding the focus of the lesson in a way that would allow the redesign to reflect nature of science rather than a science concept. As far as Nina was concerned, the prompt required a consensus on the activities for the redesigned lesson segment, not on the focus of the lesson segment. If she could not get the support of her peers in that regard, she would attempt to sway their opinion on the subject that mattered most to her. Nina's persistence reflected her belief that her truth was the most logical, and as such should be accepted by the other three group members. Despite the gentle coercion, she did not receive the buy-in required to influence the outcome of the discussion.

As teachers mulled over possibilities for the redesign of the lesson segment, the decision regarding the two discourse types to be considered became crucial to the discussion. Earlier in the interaction, Erin indicated that she wanted to include synthesizing as it was missing from the lesson segment they viewed as well as from her own teaching practice. There was no consensus at the time. The teachers chose to plan science activities then identify the discourse types present in the plan rather than plan the activities based on the discourse types selected. The decision to pursue this line of reasoning ostensibly resulted in conflict regarding the two discourse types to be used. Discussion emerging from this dissonance provided teachers with the opportunity to

negotiate individual understandings of the discourse types associated with inquiry instruction.

Jenna's contribution to the discussion suggests the idea of discourse continuum, which starts "with brainstorming, then the synthesizing" (line 229) and finally pressing for understanding. Drew's recommendation to "brainstorm ways the pendulum and the ball experiment are alike" (lines 234-235) indicated an understanding that regardless of the subject being discussed, as long as students are sharing ideas then they are involved in brainstorming. Nina's response to Drew suggested that as long as students are making connections, even if they are sharing ideas about these connections, they are synthesizing.

236 Nina: Well that would be synthesis. That would be connecting the
237 connections between the two.

Both Nina and Drew's conceptualizations aligned with the ideas presented in the U-FUTuRES document (Appendix B) that was provided for the teachers. The defensive tone of Nina's response revealed that she considered Drew's interpretation erroneous, and counteracted by 'correcting' her statements. Drew did not respond to Nina, averting for the second time since the start of the interaction, the possibility of a pseudo-conflict. Nevertheless, Nina's tendency to initiate these pseudo-conflicts may be due to a lack of attention to the details of her peers' responses. Her loaded responses based on a pre-supposition of discrepancy, appeared to have intimidated her peers, who on two occasions, ignored rather than engaged her arguments. On the other hand, ignoring her actions hindered a process of clarification, which could have contributed to a greater understanding of the varieties of 'truths' embedded within their ongoing discussions.

Author/Politics. In discussing her view of Erin's plan, Nina disagreed with the notion that pressing for understanding was the appropriate discourse type for the activities proposed. Erin had indicated that she would not want to include brainstorming in the design of the lesson. Nina, however, explained brainstorming would better align with Erin's plan.

237 Nina: If you are going with what Erin says and you are moving on to
238, okay, this is the same...you know it's falling at the same rate, and move
239 on to what would cause them to fall at different rates...that could be a
240 brainstorming session of what could adjust the rate at which something falls.

Nina was careful not to commit to Erin's proposal that focused on the science content knowledge rather than the nature of science. She simply repeated her own understanding of Erin's plan (If you are going with what Erin says...line 237) while pointing out that the decision to disregard brainstorming as a possible discourse type was misguided. Although this action could have encouraged Erin to reconsider the decision to disregard brainstorming, one could question the timing of Nina's contradiction. Is it possible that the contradiction was in retaliation to Erin's lack of solidarity with Nina's idea on the focus of the lesson segment? Did she disagree just for the sake of disagreeing? Certainly her tendency to initiate pseudo-conflicts suggests that possibility. Furthermore, joining forces with Jenna and Drew regarding the inclusion of brainstorming in the redesigned lesson turned the tables on Erin, who had previously carried out similar actions concerning the science content focus of the original lesson segment. In other words, Nina resorted to an equivalent retaliation in response to Erin's apparent deviation from the 'anticipating thoughts' script that had threatened to influence the outcome of meaning negotiation among the teachers. This 'tit for tat'

strategy signaled a power struggle between ‘the coalition of two’ established by Nina earlier in the interactions, and shifted the balance of power in a way that emboldened Drew and Jenna to become more assertive.

That would be synthesizing

Context/Politics. The lack of consensus on the discourse types to include in the lesson became a hindrance to the redesign of the lesson segment. Erin rejected the idea of brainstorming and suggested the integration of synthesizing and pressing for understanding. Drew, Jenna, and Nina, however, agreed on synthesizing and brainstorming. Erin reframed her proposal to include a suggestion made previously by Nina.

243 Erin: So they could put together with the pendulum and what they saw with t
244 the bowling ball and the marble. Put that together and see the connections there
245 Jenna: That would still be synthesizing.
246 Erin: Right, and then follow up with so how could we adjust or alter the rate
247 with which...you know...the thing falls.

There was a twenty-seven second pause during which teachers wrote notes. Erin left the group for several minutes, presumably for a restroom break. Nina appeared distant and distracted as she fiddled with her phone and iPad. Jenna and Drew continued talking among themselves as they attempted to make sense of Erin’s proposal. Jenna indicated that including a wrap-up discussion to address the key question of “why are they (the bowling ball and the marble) falling at the same rate?” (lines 249-250) would enhance Erin’s lesson plan. She thought that this discussion would be characterized as synthesizing because the students’ would still be making connections. Drew disagreed with this characterization, and stated that ‘why’ questions

are indicative of pressing for understanding. She added that the redesigned lesson should start with a discussion where students are given the opportunity to make sense of the bowling ball activity, that is a pressing for understanding discourse. After it has been established that students understand why the ball and the marble fell at the same rate “then you would be able to synthesize and brainstorm beyond that” (lines 267-268).

Knowledge/Politics. For the first time since the interactions began, Drew eloquently expressed her understanding of the discourse types and how they may be integrated in a science lesson. Was it pure coincidence that she did this in Erin’s absence? Does she somehow feel inhibited or intimidated by Erin’s presence? Did she feel more comfortable debating Jenna rather than Erin or Nina? Given that Erin had been dominating the discussion on the redesign of the lesson, it is reasonable to assume that Drew took advantage of Erin’s temporary absence to voice her views. Furthermore, given that Nina who had a penchant for initiating pseudo-conflicts had temporarily checked out of the discussions, Drew had an added opportunity to comfortably share her ideas. The passive aggressive actions of group members including, checking out of conversations or deliberately stalling consensus with pseudo-conflicts, appeared to influence the outcome of meaning negotiation in the PLC. The response of other group members to these subtle, non-verbal actions determines if the outcome is constructive or disruptive. In this case, Drew shared the meanings she negotiated regarding the pressing for understanding discourse type, creating an opportunity to deepen her understanding of the concept.

We also cannot ignore the pervasive power of the codified information regarding discourse types in influencing the process of meaning negotiation among teachers.

Teachers were fixated on categorizing the discourse types rather than on negotiating appropriate activities for the redesign of the lesson segment. This fixation detracted from the actual requirement of the prompt, which instructed them to negotiate with (your) group members and redesign (the lesson segment) to reflect teacher questions and possible student responses consistent with the discourse type (U-FUTuRES document, Appendix C). As a result, teachers reworked their proposals to fit with their perceptions of a given discourse type rather than collectively designing a lesson activity that would meaningfully engage students.

Instruction as opposed to discourse

Context/Knowledge. Drew's suggestion to integrate the pressing for understanding and synthesizing discourse types was not initially met by resistance. Erin was physically absent when the proposal was advanced, and Nina had mentally checked out of the discussion. Jenna volunteered to document an outline of the redesigned lesson, while Drew sought unanimity on the idea proposed.

273 Drew: You guys agree? Press for understanding first? To make sure they
274 understand why they are falling...

Nina's response was noncommittal.

275 Nina: I don't know...yes and no. I agree that yes if you want to go that route
276 then you should make sure they have that before you move on. But it seems
277 as if they don't have the content down to be able to figure that out just from
278 pressing for understanding. That would be additional instruction as opposed
279 to...another round of discourse.

Nina indicated that if students had good grasp of the science content knowledge, Drew's idea would be appropriate. She surmised, however, that the students in the

video clip did not have the requisite content knowledge hence, engaging them in a pressing for understanding discourse would be an inappropriate course of action. According to Nina, additional instruction would be necessary, not “another round of discourse” (lines 278-279). This response was arguably circumstantial, conjectural, and beyond the scope of the required prompt. Rather than bringing the group closer to consensus, it confounded the issue by introducing unnecessary variables and conditions based on faulty assumptions.

Author. Jenna and Drew responded using affirmative responses “right” and “hmm hmm” (lines 280 & 282) respectively. At this point, Erin returned to the group and Nina attempted to provide an update of the dialogue that took place in her absence. Interestingly, Nina began her report by repeating the comments she made (lines 275-279 above) in response to Drew’s suggestion rather than informing Erin of the entire discussion that had ensued. Jenna interrupted Nina’s report with a quick summary of current understandings of the group.

285 Jenna: We were looking at whether we want to start with synthesizing where
286 we are looking at the connections or pressing for understanding first. Do we
287 want to make sure they understand why the bigger mass and the smaller
288 mass fall at the same rate.

Erin reiterated her idea of revisiting the pendulum activity with the students. She indicated that she was unsure of the discourse type that aligned with her idea but felt pretty strongly about its inclusion. Nina used this opportunity to restate her case for instruction rather than discussion, a plan that contradicted Erin’s vision for redesign. Rather than owning the idea, however, she used Jenna’s comments (lines 285-288) as a platform for the proposal.

295 Nina: Now I might be misunderstanding, but I think what I am hearing from
296 Jenna is not that reminding them of the pattern and how they were similar
297 but rather they need to know why it happened...the scientific concept behind
298 why it happened.

This response was couched in a way that would lead Erin to believe that the source of contradiction was Jenna rather than Nina. Nina unexpectedly assumed a new position that reflected a focus on the scientific knowledge behind the lesson segment. This conflicted with her original views of a focus on the nature of science.

Politics. Nina again employed subtle power strategies that temporarily delayed a possible consensus regarding the redesign of the lesson segment. She casted doubt on a plan proposed by Drew based on the assumption that students in the video clip did not have the requisite content knowledge for the pressing for understanding discourse. Nina did not present evidence in support of this conjecture; neither did she rationalize her suggestion to reject discourse in favor of instruction. Since there was no basis for her reservations, it is reasonable to assume that Nina was initiating, yet again, another pseudo-conflict that effectively and needlessly delayed a group consensus. Jenna and Drew's passive and affirmative responses demonstrate several possibilities: their reluctance to dispute assertions made by Nina; the tendency of the two to defer to Nina or Erin where decision-making is concerned; indifference toward Nina's passive aggressive antics (Harrn 2011); or a lack of confidence in their own abilities to make an acceptable suggestion. Whether or not Nina's actions were conscious is debatable. What seems clear, however, is that these actions affected the process of meaning negotiation by silencing the voices of would be knowledge generators, and reducing them to passive receptacles who simply acquiesce to avoid unnecessary confrontation

and conflict. These actions are not constructive and do not contribute positively to the learning process.

To me that's synthesis

Context. After approximately thirty-five minutes of negotiation, the group appeared to be no closer to a consensus than they were at the beginning of the interaction. The group quickly agreed on the two discourse types observed in the video clip and also the evidence to support their claims. Arriving at a consensus for the redesign of the lesson, and the discourse types to be used as a basis for this redesign became a formidable challenge for teachers who were struggling with their own understanding of classroom discourse. Erin, who had taken charge of the discussion, appeared determined to have her suggestion ratified by the other group members. As a result, possible modifications to Erin's ideas as suggested by Drew and Jenna were summarily dismissed. Nina, who had been shifting her position regarding the focus of the redesign, advanced a radical idea that was a grand departure from the requirement of the prompts provided to guide the group's discussion. She suggested that rather than integrating a discourse type as required by the prompt, the lesson should focus on direct instruction of the science content because "it seems as if they (students in the video clip) don't have the scientific content down" (line 276-277). This suggestion was based on unsubstantiated assumptions that the students for whom the lesson was being designed did not have adequate background knowledge to engage in classroom discourse. She did not view classroom discourse as a medium for instruction, or vice versa. As far as the meaning Nina negotiated regarding instruction and classroom discourse is concerned, they are two separate and unrelated activities.

Knowledge. Nina shared her plan with Drew and Jenna who passively and uncritically accepted such. Erin, who was absent from the discussions when Nina initially expressed her views, challenged the legitimacy of using “instruction as opposed to discourse” (line 303) and redirected attention to the prompts that had been guiding the discussion so far.

308 Erin: So I would say since we are focusing on discourse, we probably should
309 go ahead and assume that they gained some type of science content
310 understanding.

Nina’s response did not reflect any resistance. She seamlessly adjusted her previous argument of having students learn the content “before you move on” (line 276) to having them “figure the content out later” (line 313). This was not the first unexpected and unexplained shift in Nina’s position, and again the rest of the team chose to move the discussion forward rather than insist on clarification.

Erin was satisfied that Nina had abandoned her radical thoughts of instruction, and proceeded to seek new support for her plan. To drum up support, she made associations between typical classroom practice and the plan she designed (lines 318-320).

318 Erin: So think about what we do. So let’s say this was one of the lessons
319 on one day, then we come in the next day, what do we always do...we
320 always prompt them...”so what did we do yesterday?”

This strategy to get her point across to group members was very effective. Teachers had a practical point of reference to guide their thoughts about a redesigned lesson. Erin continued by explaining that when students discuss their prior knowledge and make comparisons with the outlined activity for the day’s lesson, the discourse type

involved would be synthesis. Using the scenario described by Erin, teachers were able to articulate their understanding of the discourse types (lines 327-336)

327 Erin: And I think that would be synthesis right? But we would take a
328 moment to go back and say “how is the dropping like the pendulum? Lets
329 talk about what they have in common. Let’s talk about how they were
330 different. How they are connected and then...

331 Nina: So, that to me is brainstorming.

332 Erin: See that to me is synthesis. That’s putting together.

333 Jenna: See, I’m thinking of...I guess I wrote that down as synthesize
334 connecting them all to the pendulum

335 Erin: Yes, to me that’s synthesis...

336 Drew: I think so too...

Erin, Drew, and Jenna perceived any activity in which students are asked to make connections as synthesis. Nina, on the other hand, appeared to believe that any activity in which students are sharing ideas involve brainstorming regardless of the topic being discussed. These articulations reflect, yet another shift in science teachers’ understanding of these discourse types.

Erin and Jenna have been unwavering in their interpretation of the synthesizing discourse types. Drew and Nina have flip-flopped. Previously during the interactions, Drew suggested that students “brainstorm ways the pendulum and the ball experiment are alike” (lines 234-235) indicating that she understood brainstorming as the sharing of ideas. Nina had ‘corrected’ Drew earlier when she stated her original view of brainstorming, indicating that any discussion involving a comparison would be synthesis.

236 Nina: Well that would be synthesis. That would be connecting the
237 connections between the two.

At this point in the discussion, however, Drew expressed an agreement with Erin and Jenna that discussions in which students are asked to identify commonalities may be classified as synthesis. Nina, on the other hand, shifted her position and argued brainstorming rather than synthesizing. Needless to say, the U-FUTuRES document (Appendix B) provided for teachers to guide their redesign of the lesson segment maintains that the argument could go either way. This persistent deadlock was decidedly unwarranted and unproductive, and could have arguably been avoided if the teachers had read rather than skimmed the document they were given.

Politics. Nina's tendency to create pseudo-conflicts is again brought into question when she once again shifted her position from brainstorming back to synthesis. Nina indicated that if students are asked to compare a past and present class activity during a class discussion, they are involved in the synthesis discourse. In other words, she agreed with conceptualizations advanced by Erin, Drew, and Jenna.

338 Nina: I think if you ask them to connect it, then I

339 agree completely. Now tell me how this and this is the same...

Nina shifted her position without any modification of the original proposal made by Erin. Neither did she adjust her argument for disagreeing in the first place. Was she disagreeing for argument sake? Her claims were not consistent and often questionably derived. In other words, Nina appeared to be obstructing the process of consensus making by repeatedly contradicting her peers and herself. This action continued when Nina indicated that she typically gets her students "immersed" (line 342), presumably in the content, prior to engaging them in class discussions. This aligned with her latest

proposal of “instruction as opposed to discourse” (line 303), and also a suggestion by Drew to press for understanding prior to synthesizing. This was a proposal that Nina had not previously committed to (lines 275-279). Drew, realizing that Nina was leaning toward the idea of reinforcing content, restated her idea in the hope of gaining support.

344 Drew: But wouldn't that be then if you did that first what you were saying,

345 that would be pressing for understanding to make sure that they...

346 Nina: To me it's still the synthesis. It is just setting the stage for it. It's just

347 prefacing...it's still synthesis.

Nina replied before Drew completed her sentence, with a dismissive tone that suggested unreserved disagreement.

Author. Nina's response, although confidently stated, reflected lack of a clear understanding regarding the discourse types and their application to practice. She alluded to the notion that discussions aimed at reinforcing content may be considered as a synthesizing discourse type. According to Nina, not only does reinforcing content set the stage for synthesizing it also accomplishes the same objectives as the synthesizing discourse. Prefacing or introducing a topic, according to Nina's response, is still synthesizing. This interpretation, is strikingly different from her previous characterizations, and represents yet another shift in her conceptualization of the discourse type. The quick succession with which she experienced these shifts, the erratic and arbitrary nature of the shifts, and the unsubstantiated explanation provided in support of these shifts all point to the questionable circumstances that surround Nina's actions. These actions have the potential to derail ongoing deliberations as science teachers negotiate their understanding of discourse types related to an inquiry curriculum they are preparing to implement.

We could argue anything

Context/Knowledge. As Erin re-evaluated the proposal she presented to the group, she shared her developing thoughts on the brainstorming discourse type. She indicated that her plan to ask students “What do we know about the pendulum so far? What do we know about dropping the different weights so far?” (lines 350-351) would be brainstorming rather than synthesizing. Jenna referred to the U-FUTuRES document (Appendix B) and read aloud the definition provided for synthesizing. She was attempting to justify the use of synthesis even though brainstorming was the more appropriate selection.

356 Jenna: I mean we could argue

357 brainstorming but we are really wanting to hit the synthesizing right?

Jenna made this suggestion to show her support for Erin, who had wanted to use the synthesizing discourse because it was missing from the lesson segment and from her own practice (line 112). In so doing, Jenna rejected associations the group previously made between prior knowledge and brainstorming (lines 19-27). Had she forgotten that the evidence the group advanced in support of the discourse type brainstorming all related to prior knowledge? Was she a bit unconvinced about this association? Was she backtracking from her original position? Did she tweak her argument to earn social capital from Erin, who was a dominant voice in the discussion? Jenna, over the course of the interaction, had demonstrated uncertainty in most of the ideas she contributed to the discussion. She had been using her notes as a crutch to strengthen her arguments, and to justify her position. Demonstrating support for Erin would likely garner reciprocal support that could bolster her confidence as she contributed ideas to the group.

Author/Knowledge. Erin's response to Jenna's show of support was inexplicably one of exasperation. The length of the deliberation coupled with the dwindling chance of a group consensus began to take its toll.

358 Erin: I don't care, I don't care...Let's make a decision and go with it. I'm
359 fine. I can see both sides...I can see so it really doesn't matter.

Erin continued by outlining her understanding of the application of the discourse types to her practice. She indicated that the teacher questions associated with the various discourse types should be used in an integrated rather than isolated manner. According to Erin, there may be scenarios where teachers use "brainstorming questions and then that leads into, depending on your students' responses, that could lead you into synthesis" (lines 364-365). Erin made associations between ideas advanced by her peers and her own practice (lines 318-330) to negotiate meaning. As expected, Jenna demonstrated her unwavering support for Erin by suggesting the possibility of "brainstorming and synthesizing at the same time" (line 363).

Nina, on the other hand, made another radical remark. She stated that the brainstorming discourse type could not be carried out without the synthesizing discourse, and vice versa.

366 Nina: I don't know that you can have one without the other...

This statement is significant for two reasons. First, it came as a subtly conflicting response to Erin's understanding that both brainstorming and synthesizing can occur simultaneously during a class discussion. Nina, in making this comment, was not explicitly disagreeing that both can occur simultaneously. She was declaring that they always occur simultaneously. Second, this comment represented yet another shift in her position and or understanding of the discourse types. Her most recent announcement

indicated that brainstorming and synthesizing took place independently of each other. According to Nina, “if you asked them (students) okay what did we do yesterday” (lines 337-338) then you are engaging them in a brainstorming session. If students are, thereafter, asked to make connections between what they did in a prior class and the activities they are preparing to implement in a lesson, they are engaged in the synthesizing discourse. Her new idea that neither can occur without the other cast doubt on her understanding of the discourse types.

Politics/Knowledge. Drew sensed the indecision among her peers and decided to, once again, advance her proposal for pressing for understanding before synthesizing. This time, she used the U-FUTuRES document to support her claim.

369 Drew: I’m really thinking you need to start with pressing for understanding to
370 make sure they are understanding the whole...the concept. It involves
371 figuring things out...making sense, going deeper beyond the surface
372 answers. And then after that you synthesize.

The first time Drew articulated this idea, Erin was physically absent from the group and Nina had mentally checked out. Erin was hearing Drew’s proposal in its entirety for the first time. There was a pregnant seven-second pause before Jenna broke the silence.

374 Jenna: We could argue that too

375 Erin: I agree...I agree with what Drew says...

376 Jenna: We could argue anything

377 Erin: Okay...so let’s just pick. So we’re fifty-fifty

Erin agreed with Drew creating another shift in the plans for redesign of the lesson. For much of the discussion, Erin’s proposal to brainstorm and synthesize had held ground despite the back and forth over the discourse categories. Her sudden agreement with

Drew could be associated with a previous outburst during which Erin indicated that the group should “just make a decision and go with it” (line 358). She appeared to be very eager for the group to come to a decision. Nina and Erin had just found common ground regarding brainstorming and synthesizing while Erin and Drew agreed to press for understanding then synthesize. If one team conceded to the other, a consensus could be reached. In any case, unanimity appeared to be on the horizon.

The big picture

Context. Erin suggested that the group make a selection between the two options that were under consideration, but Nina had other ideas. She proposed an option that included all three discourse types rather than the two required by the prompt. According to Nina, this proposal focuses on the big picture.

381 Nina: So if the big picture is we need the kids to make a connection between
382 the pendulum and the ball drop. Making connections is synthesis.

383 Erin: Correct

384 Nina: So we will go with that

385 Erin: Hmm...hmm

386 Nina: And if we need to extend beyond that maybe we want to press for
387 understanding as to how they are related. That could be pressing for
388 understanding or maybe we want them to extend it to maybe trying different
388 shaped objects fall, or to
389 make them different. And then that would be a brainstorming session.

This represented another shift in Nina’s position. This new plan involved the initial use of the synthesizing discourse type then pressing for understanding then brainstorming.

Erin, who had agreed with Drew's plan to press for understanding before synthesis, modified the idea to reflect this understanding.

390 Erin: I agree but I still think you have to press

391 Nina: Right...

392 Erin: before you synthesize

393 Nina: No, I'm not saying don't do that. I am just saying that if you are thinking

394 big picture as opposed to...

395 Erin: I would press, synthesize, extend...and brainstorm and extend...yes

396 Nina: Yes [laughs]

397 Erin: Yes

Although her plan clearly stated that the lesson redesign should begin with the synthesizing discourse (lines 381-382), Nina almost immediately rejected her own position (lines 393-394) in order to wholeheartedly accept Erin's modification. Despite the shift, a consensus was reached.

Author/Politics. Two specific episodes are of significance here. First, is that a consensus was finally reached during dialogue between only two members of the group: Nina and Erin (lines 378-397). Erin had been a dominant voice in planning the redesign of the lesson, and had initially received unconditional support from Nina (lines 11-14). Nina had, on several occasions, shifted her position in a bid to influence the outcome of the deliberations. Erin and Nina, whether consciously, semiconsciously or subconsciously, used different techniques or strategies that effectively directed the trajectory of the deliberations. Although Erin accepted a proposal by Drew, she appeared to have done so out of exasperation due to a lengthy process of deliberation. Despite a suggestion for a selection based on a fifty-fifty decision split, Nina wanted to

have the last word. As a result, she advanced an idea that was as distinct from the others as possible. It was an idea that even contradicted the requirements of the prompts. The second significant episode is somewhat linked to the first. Nina explicitly rejected her own stated position in order to demonstrate solidarity with Erin. This action represents a shift in Nina's tendency to flippantly contradict the ideas of others with poorly developed and supported claims. Nina's readiness to reject her own position, however, calls into question the meaning she negotiated regarding discourse types as a result of the interactions.

Author. Nina's most recent articulation suggested that the synthesizing discourse involves making connections (line 382), and that pressing for understanding means extending beyond the connections students make (lines 386-387). Brainstorming, based on Nina's conceptualization, involves the sharing of students' ideas. These understandings align seamlessly with the U-FUTuRES document (Appendix B) provided for the teachers at the beginning of the interaction. If the meanings Nina negotiated are within the framework of that promoted by the inquiry curriculum, why were there so many shifts in her position regarding the redesign of the lesson? Why was she in disagreement with some of her peers who articulated similar views? Did she stall the process of consensus making in order to have the final word? Nina's actions, for the most part, were met with passive resistance in the form of pseudo acceptance from her peers. The passive reaction from her peers averted a possible confrontation that could have derailed meaning negotiation among these middle school science teachers.

We are overachievers

Context/Knowledge. During a brief dialogue between Nina and Erin, a consensus was achieved regarding the redesign of the lesson. They both agreed to integrate the three discourse types in the following order: pressing for understanding, synthesizing, and brainstorming. Although Drew and Jenna did not participate in the discussion at the point that the decision was taken, their silence signaled consent. The persistent indecisiveness that has plagued the group's deliberations resulted in mental exhaustion, and individuals appeared more interested in avoiding confrontations than making proposals that were likely to be rejected in mid sentence.

After the consensus, Jenna attempted to take the lead on further discussions by bringing the group's attention back to the third prompt on the U-FUTuRES document (Appendix A). Teachers were instructed to identify the purpose of the redesigned lesson, to outline what students were expected to learn from the lesson, and to identify teacher questions and possible student answers. Jenna suggested that the purpose of the redesign could be to ensure that "the students would understand the connections" (lines 406-407). Erin agreed almost immediately but Nina indicated that she was "having trouble with this" (line 409) proposal because the discourse types are not discrete and are interconnected in ways that are extremely complex. This, despite her consensus idea, which reflected three discourse types being used in three distinct phases of the lesson. Nina's explanation of the trouble she was having was a bit incoherent, so it was unclear why she opposed Jenna's suggestion.

409 Nina: And see I'm having trouble with this because to me it's all a big
410 mishmash anyway...I mean it's not like...like you said there isn't 5 minutes
411 of this and then 3 minutes of this. It's all mashed in together...and you...

Nina's explanation did not address the problem she was having with Jenna's suggestion for the purpose of the lesson. Nina was continuing the trend of dismissing others' opinion without clear justification, and silencing the voices of her peers as they attempt to make sense of the inquiry curriculum.

Knowledge/Politics. While Nina's explanation did not justify her rebuttal of Jenna's suggestion, it prompted a response from Erin that encouraged reflection on practice. For a brief moment Erin and Nina made associations between their understandings of discourse types with the discussions they accommodate in their science classrooms. This brief discussion allowed teachers to consider practical applications of the discourse types, and ways in which they could improve instruction. Unfortunately, only Erin and Nina participated in this reflective discussion. Drew and Jenna were engaged in another discussion of their own. They were both sharing ideas of ways to document the group's understanding of the discourse types within the context of the prompts. Again, Jenna tried to redirect the conversation to the required prompts.

Jenna suggested the use of a two-column chart to represent the two discourse types and the associated teacher questions. Based on this suggestion, it was clear that Jenna had not accepted Nina's proposal to integrate three rather than two discourse types. Nina interjected in order to restate the consensus idea.

423 Nina: I think we'll just go with the three and say...

424 Jenna: We are only doing two...

425 Nina: Yea, we're three because we are overachievers...and (laugh), we're gonna...

426 Jenna: We're not...we're not...

Jenna clearly resisted the idea to disregard the requirements of the prompt but Nina cited they could because they were overachievers. So far, this was the only justification Nina presented for going off-script. Was this a psychological ploy to make her peers feel good about going with her decision? Does she perceive herself as an overachiever? Was she attempting to project this perception of herself on to her colleagues? By all indications, Nina is highly competitive and motivated individual who thrives on control. Most of her actions during this interaction pointed to a need to influence group decisions. Evidently, the use of platitudes and trite flattery is included in her arsenal of power strategies. Nevertheless, her comments garnered several chuckles and grins that relaxed an otherwise tense atmosphere.

One of the facilitators stopped by to inform group members that they had just several minutes left for deliberations. Drew and Erin redirected the group's focus on addressing the prompt. They supported each other as they attempted to articulate a way forward. Erin indicated using "quick press for understanding to get them back to where they need to be..." (lines 430-431). Not only did she restate the use of her selected discourse she also indicated the purpose of integrating the particular discourse in the redesigned lesson. Drew, who was the first to propose pressing for understanding as the starting discourse, shared her understanding of what she thought students should be able to do and know as a result of being engaged in the discourse. Erin was mindful of Nina's assertion that the discourse types were "all mashed in together" (line 411). She indicated that although the lesson redesign started with pressing for understanding, then synthesizing and brainstorming, there is an understanding that "there might be some paths connecting them periodically" (line 438). Although one could

be tempted to think that Erin was simply trying to appease Nina, reflective dialogue contributed to the negotiation of an understanding of the practical application of discourse types in the science classroom (lines 412-414).

412 Erin: And I don't know about you but I switch between the two...

413 Nina: Yes and I do too, it's constant

414 Erin: And like I do only pressing for understanding and then I move into this next...

By reflecting on practice, Erin made associations with the discourse types and actual classroom scenarios thus facilitating the negotiation of meaning.

Group conclusions

Context/Author. One of the facilitators stopped by the group in order to listen to the deliberations, and to determine their progress. Nina exchanged pleasantries with the facilitator and engaged her in a conversation about the process and product of the interaction. According to Nina, the group was unable to complete the prompt within the required time because "some of us are big picture thinkers and some of us are detailed picture thinkers" (line 441). Was this her justification to the group for delaying the consensus making process? She went on to inform the facilitator, "we all agreed...we could all see each other's perspective" (line 453). Was this her perspective of the nature of the group's meaning negotiation? A group in one accord? A harmonious process where each person's ideas were valued? Was she painting a picture of constructive deliberations in the absence of such? Nina had disagreed with just about everyone in the group for no apparent reason. She had initiated pseudo-conflicts with individuals whose views were similar to the ones she declared. She had mentally and verbally checked out of the discussion when it was heading in a trajectory she did not approve of. She had shifted her position numerous times demonstrating a lack of commitment to

her vacillating perspectives. Despite her actions and the consequences thereof, Nina reported a constructive process of meaning negotiation that yielded the following conclusions.

Author. Nina reported to the facilitator that the group concluded that there is no predetermined direction that guides the integration of the discourse types.

449 Nina: Yea that was our overall conclusion. Is that there is no direct path from
450 A through to Z. It's like A to D then back over to C then jump over to F and
451 then come back over here.

She also added that the discourse types were “not mutually exclusive” (line 456), a position she took when she stated that she was unsure whether “you can have one without the other” (line 366). There are two significant points to highlight from this incident. The first relates to the clear contradiction inherent in the group conclusion. One segment suggested that the discourse types are distinct but may be used in an integrated manner depending on the nature and direction of the classroom discussion. In other words, a single lesson may integrate several discourse types that are guided by students’ responses to teacher questions. A teacher may ask a question that presses for understanding before asking another question that requires students to synthesize ideas, and then go back to pressing for understanding. There is, therefore, no predictable order for the integration of the discourse types. The other segment suggests that while they can occur at the same time, one discourse cannot be integrated without the other. In other words, science lessons should include all three types because a brainstorming session cannot occur without the synthesizing discourse. According to Nina, they are not distinct but rather “all mashed in together” (line 411) as reflected in her decision to include all three discourse types rather than the two required by the

prompt. Jenna rebutted this decision (lines 424 & 426) but Nina overruled objections to her idea (line 425).

The second point of significance questions whether or not Nina spoke for the entire group when she reported these conclusions. To what extent do these conclusions reflect the ideas proposed by the group? The decision to use all three discourse types emerged from a discussion that involved only Erin and Nina. There was no input or feedback from the other two members of the team. Furthermore, discussions regarding the stated group conclusion did not involve Jenna and Drew. They may have voluntarily declined comment or were silenced by the actions of the others. In any case, there were no comments by either Drew or Jenna to indicate an agreement with the group conclusions reported by Nina.

Documenting consensus ideas

Context/Politics. Erin took charge of the writing process and documented the ideas discussed on a pre-prepared response sheet provided by the facilitators (Appendix D). As she wrote she was whispering and laughing with Nina, demonstrating the camaraderie that was alluded to at the beginning of the interactions when Nina anticipated her thoughts. Within the context of group interactions, however, the whispering and laughing excluded both Drew and Jenna who were sitting across the table from Nina and Erin. What were they whispering and laughing about? Was the conversation about discourse types? Was it about a personal subject? Were they talking about Drew or Jenna? The previous discussion indicates that Jenna disagreed with Nina's idea to use all three rather than two discourse types (line 424 & 426). Was Nina a bit irritated that Jenna challenged her idea? Was she also annoyed that Drew's idea was selected as the group consensus? Could these actions have triggered a

division made evident by the exclusive exchange between Erin and Nina? Erin was the only individual in the group that had explicitly challenged Nina's views. The friendship they developed and maintained over the duration of the graduate program had a significant impact on the group interaction. The whispering amplified the closeness of their relationship while placing an apparent group division under the glare of scrutiny.

As Erin continued to fill out the response sheet, she discovered a prompt specifically instructing teachers to "identify two IQWST discourse types that (the) group wants to incorporate into the (redesigned) lesson segment" (Appendix D). She mentioned this aloud to Nina, who had suggested using three discourse types rather than two. Without hesitation, Nina agreed to go ahead with the two.

472 Erin: We just need two discourse types

473 Nina: Go with it

Her quick acceptance of this directive suggests that Nina was willing to reject her own ideas in favor of Erin's. This was not the first time that Nina deferred to Erin. When Nina suggested looking "at the big picture" (lines 378-379), she rejected her own proposal to synthesize, press for understanding, and brainstorming in favor of Erin's plan to press for understanding prior to synthesizing (lines 391-396). On the other hand, when Jenna indicated that the group was "only doing two" (line 424) discourse types Nina quickly rejected the idea. Considering the differing reactions to the same idea, it is reasonable to conclude that Nina was reacting to the person rather than the idea. It is also reasonable to conclude that Nina was experiencing one of her many shifts in positions. Regardless of her reason for agreeing with Erin rather than Jenna on the same issue, the action reinforces the partnership that could potentially change the outcome of this interaction.

Author/Politics. Erin continued to document the consensus ideas, and repeated the ideas aloud during the process. As she wrote down pressing for understanding as the first discourse type, Nina resisted yet again.

477 Nina: I just have trouble with this because what are they understanding?

478 They don't have any content yet.

Erin and Drew reminded Nina that she had previously agreed to assume that the students already had the content (lines 308-309). What is significant about this action is that Nina was again shifting her position by disagreeing with an idea that she had previously agreed with and vice versa. Nina had experienced so many shifts in her position that provoke questions about her state of mind, her intentions, and the meanings she negotiated as a result of the deliberations. The friendly banter that ensued between Erin and Nina neutralized any possible tensions that could have resulted from her shifting positions.

The other group members supported Erin as she wrote down consensus ideas. Specifically they reminded her of the ideas to include and assisted with phrasing the sentences.

487 Drew: Did you write the purpose of incorporating...?

488 Erin: (writing) The purpose of incorporating this kind of discourse is

489 to...ahm we want them to ahm...sorry...here we want them to make sense...

490 Jenna: Of the two activities...

491 Erin: Of the two activities in preparation for the synthesis that will come next

492 Nina: Awesome, I love it!

The collaboration evident in this segment is a reflection of the consensus that the group had finally achieved after several minutes of back and forth. However, Nina's response

was teeming with sarcasm; a disquieting indication that further conflicts were impending.

Nina and Erin continued their social banter, again excluding Drew and Jenna who were focused on notes they had written during the interactions. Rather than whispering with each other, Erin audibly related a personal incident involving her son while Nina punctuated her remarks with utterances of concern (lines 503-529). It was clear that the camaraderie shared between Erin and Nina did not extend to Drew and Jenna.

Miss bossy pants

Context. While Erin wrote down consensus ideas, she was careful to include contributions from the rest of the group. For instance, she would read what she had already written based on group input then ask, “do we want to say anything else?” (line 535). This allowed Jenna and Drew to provide necessary feedback, and to give them a voice in the final decisions documented by the group. Erin was clearly in charge of the deliberations as she wrote, reread the prompts, and made suggestions for the next steps moving forward. Inexplicably, Nina interrupted her with a noteworthy confession.

542 Nina: I am sorry I’m being like Miss Bossy Pants

543 Erin: I love that you are being Miss Bossy Pants because I’m usually bossy...

544 Nina: I’m a type A, I’m sorry...

This admission may shed light on Nina’s propensity to shift her position during the course of the deliberation. It may also provide an insight into power structures within the PLC that influence the process of meaning negotiation among the teachers.

Author. Nina’s statement came out of nowhere. In other words, there was no preceding comment that led to this apology. Erin was leading the team through the

documentation portion of the deliberations, and was attempting to move on to writing teacher questions as required by the prompt when Nina interrupted her sentence with the shocking confession. Incidentally, Erin had previously rejected Nina's idea to use three rather than two required by facilitators (line 472). Nina had responded favorably to Erin's suggestion, but could there have been some residual frustration associated with the rejection? Was this frustration the cause of the sarcasm detected in her previous response to the group's progress (line 492)? Why was Nina apologizing for being "Miss Bossy Pants" when it was Erin in charge of the discussion at the time? There are endless explanatory possibilities but I will focus on two.

First, there is a very strong possibility that Nina was surreptitiously chiding Erin for taking the lead on the deliberations so far. Erin unwittingly responded that she had tendencies to be bossy (line 543) also, hence admitting awareness of the controlling manner in which she conducted herself during the interactions. She took charge of the discussions, and now the documentation of the ideas. It was Erin's ideas, not Nina's, that were selected for the consensus. It was Erin, not Nina, who appeared to have had the final say on the number of discourses to integrate. It was Erin, not Nina, who was managing this interaction. It was Erin, Not Nina, who was being the boss of this discussion. Admitting to the boss that you are "being like Miss Bossy Pants" (line 542), might have been an underhanded way to suggest that Erin, not Nina, was being Miss Bossy Pants. The next possible explanation is that Nina was genuinely apologizing for her passive aggressive (Harrn 2011) antics throughout the course of the interactions. In reflecting on the trajectory of the interaction so far, she felt compelled to explain her

shifting positions and her tendency to be intractable. Nina indicated that her Type A personality was responsible for her actions.

My lack of familiarity with the theory surrounding personalities led me on a brief but interesting journey into the psychological and medical discourses that have contributed to everyday knowledge of the subject. The Type A versus Type B personality theory originated in the 1950s by two cardiologists named Freidman and Rosenman. According to Freidman and Rosenman (1959), individuals with type A personalities are typically aggressive, ambitious, controlling, highly competitive, impatient, rude, and tightly-wound. They are more likely to interrupt others in conversations in order to complete their sentences, get annoyed if discussions do not go exactly as planned, become irritated by minor issues, and to take charge of every situation. The personality traits described by the theory accurately portrayed Nina's characterization of herself, and provided profound insights into her actions as interactions ensued. Nina's confession also indicated an awareness of her behavior and its impact on the process of meaning negotiation among her peers.

Politics. Drew and Jenna appeared to have ignored the acknowledgement of controlling tendencies by Erin and Nina, and moved on with the discussion regarding teacher questions for the proposed discourse types. Relying on the codified information provided by the facilitators (Appendix B), they negotiated understandings of phrasing teacher questions to press for understanding.

545 Drew: For the first question like...based on the results from the pendulum

546 experiment how can we figure out what happened to the...

547 Jenna: That's funny, I was looking at that one too...I think we need to hit that

547 one too.

Drew adhered to the consensus idea to press for understanding first, and as such consulted with codified information to assist with the phrasing of the teacher question. Jenna, who also read the material agreed with Drew's suggestion. Almost immediately after, Erin looked intently at Nina whose face was flushed. Nina was aware of Erin's gaze and responded, "I'm good...look at me" (line 550). Both Erin and Nina then laughed mirthlessly leaving grins of faint derision and smug confidence. This series of actions would perhaps have gone unnoticed if Erin and Nina had not been previously involved in a whispering session that notably excluded Jenna and Drew.

The secret exchange between Erin and Nina was possibly associated with the display of emotion I witnessed while observing the interactions in the PLC. In any case, the tension was palpable. Erin laughed again, then asked Drew to repeat her idea. This request provided Drew with the opportunity to articulate her thoughts as she connected the consensus ideas to her own understanding of possible teacher questions to engage students in classroom discourse. Erin sought clarification on the discourse type and again Drew reiterated her idea that the teacher question should ask students to figure out the results of the bowling ball demo based on previous discussions about the pendulum (lines 555-558). Jenna, in supporting Drew's position, indicated the importance of including a "how can we figure out statement" (line 568) to align with suggestions for teacher questions provided by the facilitators (Appendix B). Again, this reflected the integral role that codified knowledge played in the process of meaning negotiation among teachers.

Nina, again, chose not to contribute to this exchange. She remained silent while Erin, Jenna, and Drew attempted to design teacher questions for the redesigned lesson.

Rather, she stared into space with the derisive grin firmly planted on her face. Nina had disagreed with the idea of initiating classroom discourse by pressing for understanding when Drew suggested it earlier in the discussion. Later, when Erin indicated an agreement with Drew, Nina embraced the idea as a consensus. As the rest of the group attempted to document this idea, Nina's actions became blatantly undesirable. She started her passive aggressive tantrum with an outburst of derisive laughter, followed by an episode of smiling and shaking, then ended with the exasperated expression "ay caramba!" (line 574). This demonstration suggested disagreement with the ideas that were being documented by her peers. It also represented a change in the power strategies she had been employing to influence the outcome of the discussions. Previously she initiated pseudo-conflicts, delayed consensus by erratically shifting her positions on the issue under discussion, and avoided committing to the ideas of her peers. Apparently, her admission of guilt unleashed the very essence of her Bossy Pants Type A personality.

Author/Politics. Jenna and Drew showed no visceral reaction to Nina's antics and continued with business as usual. Erin showed concern for her friend but reacted in a way that abetted Nina's behavior. She whispered to Nina, "you are biting your tongue" (line 581). This was uttered as a statement rather than a question, which demonstrated once again the close relationship between the two. In this case, Erin anticipated Nina's reaction to the suggestion of her peers hence concretizing the camaraderie between the two: a camaraderie that had been silently dominating the process of meaning negotiation among the teachers. Nina responded to Erin's statement by indicating that she is probably wrong and as such she had to bite her tongue.

582: Nina: That's ok though...sometimes you have to do that. And I'm
583 often times wrong so I'm just gonna sit back and do it okay [laughs]. I'm
584 probably wrong. Are you kidding?

Nina's reactionary statement was loaded with snobbery. Not only did she insinuate that Drew and Erin's ideas regarding discourse types were incorrect, Nina implied through her actions that her ideas were right. Her self-righteous convictions were evident in her behavior and confirmed by her allusion to the notion that there is a 'right' and 'wrong' way to design classroom activities. For the duration of the deliberations, she failed to accept the ideas of her peers because she believed that their ideas were simply wrong. Toward the end of the interaction as her peers documented what they believed to be consensus ideas, Nina, among other things, 'bit her tongue' in protest of ideas she had previously consented to during discussions with Erin (line 396). For all intents and purposes, this was a last ditch attempt on Nina's part to influence the outcome of the discussion. In other words, employed alternative power strategies aimed at supplanting the 'wrong' consensus ideas with her own 'right' ideas.

Monkey wrench

Context. Just before Nina's outburst, Drew proposed the teacher question, "based on the results of the pendulum, how can we figure out what happened with the (bowling) ball?" (lines 565-566). Jenna supported this idea, Erin did not commit but sought clarification about phrasing for the document she was preparing, and Nina responded by shaking, 'smug smiling', and biting her tongue. Drew continued deliberations without acknowledging Nina's behavior or the conversation that ensued with Erin. She asked for suggestions from the group regarding ways in which students could respond to the question she proposed. Jenna tried to rationalize possible

students' response by creating a classroom scenario. Before she had a chance to complete her description, Nina interrupted with yet another disapproving claim.

588 Jenna: Let's say that we had a big object and a little object and there are
589 cases where they are doing the same thing...swinging at the same rate or
590 falling at the same...

591 Nina: Yes, but that's seeing that they are the same as opposed to using one
592 to figure out what's happening in the other...

Jenna was denied the opportunity to completely articulate her ideas before Nina's interruption. As a result, Nina was being critical of comments she anticipated from Jenna rather than the comments she heard. Jenna's suggestion to include large and small objects swinging and falling at the same rate were quite similar to teacher demonstrations in the original lesson segment. However, given the fact that the proposed teacher question required students to come to an understanding based on these demonstrations, it is reasonable to assume that Jenna would have presented ideas for student responses relative to previous demonstrations. Her responses during the deliberations to this point have been reasonably associated with the document provided by U-FUTuRES facilitators, and the notes she wrote while watching the lesson segment. As such, there is no reason to believe that her explanation, had she been able to complete it would be absurd, illogical or impractical.

Politics. Nina's premature response not only obstructed the sharing of new and possibly innovative ideas, it highlighted her tendency to undermine others by criticizing responses before they are completely articulated. Nina opposed Jenna's partial idea by indicating that including large and small objects swinging and falling at the same rate would lead students to perceive the similarities rather than "using one to figure out

what's happening to the other" (lines 591-592). This response implied that Nina anticipated Jenna asking students to point out similarities between the behavior of the large and small objects. This was neither implicitly nor explicitly expressed in Jenna's comments. Jenna had been very careful to state the need to include a "how can we figure out statement" (line 564) so it is unreasonable to assume that she would exclude this in favor of a comparative approach. The central idea guiding the design of these teacher questions and possible student responses was the integration of the pressing for understanding discourse type. Having students figure out or make sense of these activities was essential to the lesson redesign. Nina, in providing a misguided critique of Jenna's anticipated comments, was also actually agreeing with the idea to have students figure out or make sense of new activities in light of the previous demonstrations. As such, her untimely and unfavorable assessment of Jenna's undeclared ideas, was yet another attempt to provoke discontentment with the consensus ideas Nina perceived to be 'wrong'.

Her efforts were rewarded by Erin who threw a 'monkey wrench' into the group's original plan of using the pressing for understanding discourse type before synthesizing in the lesson redesign. Incidentally, Nina anticipated her thoughts and declared the monkey wrench before it was actually thrown.

593 Erin: So, cause I...

594 Nina: Yes monkey wrench, go ahead...

595 Erin: So, I'm gonna throw a monkey wrench.

Again, the impact of Erin and Nina's close social relationship on the deliberation was brought into question. How did Nina know that Erin was about to throw a monkey wrench? Why did Erin throw a monkey wrench now that a consensus decision that she

had agreed to was being documented? Was this monkey wrench triggered by Nina's desperate passive aggressive antics? Was Erin trying to preserve the social relationship they had developed during the course of the program? Erin's friendship with Nina provided insights into her Type A temperament, and may have prompted Erin to want to change the consensus idea. In order to stem her friend's seething, she would have to shift the order of the discourse types to reflect synthesis before pressing for understanding.

Knowledge/Politics. In order to ensure unanimity, Erin used codified knowledge to support her argument. So far, the group had not contested the knowledge of experts so Erin's power strategy was likely to succeed. Drawing on Bloom's taxonomy of learning domains (Bloom & Krathwohl 1956), Erin suggested that synthesizing is a lower level activity compared to pressing for understanding, which requires students to extend their thinking beyond surface answers.

598 Erin: Synthesizing is a higher order question looking at this [the lesson design]

599 Nina: Yes...yeah

600 Erin: This to me looks like the order...like synthesizing is actually the lower

601 level because all you are doing is tying the ideas together. And it's the

602 pressing for understanding when you are going beyond. You are going

603 deeper and you are going beyond the surface questions. And I think we are

604 doing it the reverse way, I think that we are trying to...what we are trying to

604 do here is synthesizing...

Bloom's taxonomy is a classification system proposed in 1956 and thereafter revised several times. It focuses on learning objectives in the cognitive domain and categorizes knowledge and understanding as lower level processes compared to synthesis and

evaluation (Ferguson 2002). This characterization runs counter to Erin's suggestion that synthesizing is a lower level activity relative to pressing for understanding. Erin, therefore, presented an argument based on misrepresentation of the venerable Bloom's taxonomy.

Despite reference to Bloom's taxonomy, Erin's argument was based on information provided by the U-FUTuRES facilitators (Appendix B). According to this document, synthesizing "involves putting ideas together or assembling multiple activities into a coherent whole" while pressing for understanding involves "going deeper, beyond the surface answers". These ideas were clearly reflected in Erin's understanding of the taxonomy of discourse types (lines 600-604). Bloom and others (1956) emphasized the taxonomy of learning objectives and defined synthesis and understanding in slightly different ways. For Bloom's taxonomy synthesizing involves putting ideas together to form a whole, with an emphasis on creating a new meaning or structure (Ferguson 2002). Creating new meaning from previously isolated ideas requires higher order thinking skills, and as such the process is placed on the higher tier of the cognitive domain. Understanding or comprehension, on the other hand, remains on the lower tier and involves activities such as organizing, comparing, and interpreting (Bloom & Krathwohl 1956). Erin, therefore, had confused the taxonomy of discourse types associated with the inquiry curriculum with Bloom's taxonomy of learning objectives. None of the other group members acknowledged the error, and the argument Erin presented appeared to have met their approval.

Author/Politics. Nina was ecstatic. Her friend Erin threw a monkey wrench in her direction. Her response to the potential shift in the consensus idea was bereft of

decorum. She cheered, laughed, applauded, and publicly expressed gratitude to Erin for initiating the swing. All this, as Erin continued to make her case.

604 Erin: What we are trying to do here is synthesizing...

605 Nina: [shouts] Yes! [laughs and claps]

606 Erin: ...but we are calling it pressing...

607 Nina: [laughs] Yes!

608 Erin: ...and then pressing would actually be going further.

609 Drew: I think you are right

610 Erin: That's what I...

611 Nina: [to Erin] Thank you!

Nina's excessive celebration was a slap in the face of teacher collegiality. It pointed to her highly competitive nature, and her conviction that there is a single 'right' way to design a science lesson. It also surfaced the motive behind her persistent scheme to obstruct a process of meaning negotiation that was, as far as she was concerned, headed in the 'wrong' direction.

Drew accepted the change without resistance as Nina became more vocal. Erin had proposed that the group "keep the same [teacher] questions...just reverse the order" (line 613) of the discourse types to reflect synthesizing before pressing for understanding. Nina, however, had an objection to the teacher questions that were previously agreed on. Jenna and Drew had suggested the use of a "how can we figure out statement" (line 564) for a teacher question corresponding to the pressing for understanding discourse. Nina argued that asking students "how can we figure out what is happening?" (lines 615-616) would be inappropriate "because we can't" (lines 617-618). According to Nina, students should be asked "how are they similar?" (line 616) or

“how is this related to this?” (lines 616-617). Again, she attempted to supplant what appeared to have been a consensus idea with a nebulous claim that no one can figure out why the large and small objects fell and swung at the same rate.

For reasons that are unclear, Nina opposed the idea of asking students to share ideas about how to make sense of the demonstrations they had observed and suggested rather that they be asked about similarities and relatedness. Jenna asked Nina to indicate possible student responses to the teacher questions she proposed.

620 Nina: They could...they should say it was the same...even though it was
621 falling at an angle or falling straight down they still fall at the same rate
622 regardless of where they started, or regardless from what direction they fall,
623 they still fell at the same rate. Hopefully they are seeing that they are the
623 same.

Nina’s reply obfuscated the issue by introducing scenarios and concepts that were not previously discussed by the group. Teachers were documenting rather than deliberating consensus ideas and as such these new ideas were not subject to the negotiation as previously agreed on scenarios. Nevertheless, Erin documented Nina’s ideas as a skewed representation of consensus ideas, hence demonstrating the influence of their partnership on the process of meaning negotiation.

Knowledge/Politics. I cannot overemphasize the influence that codified information had on the way teacher participants negotiated meaning. It did not matter to the other teachers that Erin misrepresented Bloom’s ideas to support her argument. It did not matter that Bloom’s taxonomy was related to learning objectives rather than discourse types. It mattered, however, that Erin cited Bloom as the basis of her new understanding. Without challenging Erin’s misconceptions regarding the location of

synthesis within the cognitive domain, her peers embraced a shift in consensus ideas simply because Bloom's taxonomy was mentioned. Nina admitted that teachers were "indoctrinated with Blooms" (line 615) during teacher preparation programs. Evidently, they were also indoctrinated to uncritically accept expert ideas even if they are misrepresented or distorted. The teacher participants were willing to abandon the meaning they negotiated for themselves during a forty minute-long deliberation in favor of an expert idea that was not only misquoted but also unrelated to the topic under discussion. A formalized discourse, therefore, was the monkey wrench that effectively changed the trajectory of this discussion leading teachers to accept a new decision in a protracted and tedious process of meaning negotiation.

Skydiving

Context/Politics. Nina had presented a case for integrating all three discourses in the order synthesizing, pressing for understanding, and brainstorming. Her idea of using all three discourse types was rejected in favor of one that integrated pressing for understanding and synthesizing respectively. In a last minute move that swung the deliberations in Nina's favor, Erin suggested that the group integrate the synthesizing before the pressing for understanding discourse. Nina was pleased with this new development, and as such became more vocal during the ensuing discussion. Drew and Jenna did not resist these changes and were willing to contribute to any refinement of the new idea. Jenna, however, insisted that the teacher questions proposed for pressing for understanding include a "how can we figure out statement" (line 564). Nina had rejected this idea indicating that "we can't" (lines 617-618), and provided no further explanation for rejecting the idea. Jenna persisted with this idea because she was confident that it aligned with information provided on the U-FUTuRES document

(Appendix B), and also because it resonated with her developing conceptualization of pressing for understanding discourse types.

The group, however, was unresponsive. For ten seconds no one responded. Drew had her head lowered, and Erin and Nina exchanged furtive glances before lowering their heads also. Erin responded first with a sigh then Jenna continued to make her case. Drawing on Erin's explanation that pressing for understanding involves "going beyond the surface questions" (lines 602-603), Jenna indicated that one of the teacher questions could have students connecting the classroom demonstrations with "something outside" (line 638) such as "amusement park rides" (line 636). In the middle of her explanation, Nina and Erin started to whisper again showing scant regard for the ideas she shared. After a brief inaudible exchange, Erin took the consensus document she was preparing and pushed it over to Nina, and said "here finish" (line 639). This exasperated outburst signaled disagreement with Jenna's suggestion. Disregarding Jenna's suggestion, Erin made a new case for teacher questions that promote synthesis rather than pressing for understanding. This time, her comments were directed to Nina.

Politics/Knowledge. Nina took over the responsibility of preparing the consensus document after the uncharismatic resignation of Erin. As leaders of the discussion, they decided to take matters in their own hands to wrap up the negotiation. As a group they were expected to "develop a list of at least three teacher questions to promote" (Appendix A) the synthesizing and pressing for understanding discourse types. Erin and Nina discussed the possibilities.

640 Erin: Can you maybe ask in the synthesizing...can you think of another
641 situation where two objects of different masses act in the same way...or
642 something along those lines

643 Nina: What we have here...how are they the same...like how are they
644 different? And did it have any effect on our observations. These
645 differences...did it change our observations? Even though the set ups were
645 quite different.

646 Erin: Yea, I mean that could be synthesis...you know we could use two ideas
647 together that even though they look different, it's still the same concept. And
648 then, maybe, how does this connect to gravity? How mass, gravity, and
648 weight are related?

In this exchange, Nina and Erin articulated slightly different conceptualizations of synthesis. Nina maintained that during a synthesizing discussion students are involved in a comparative assessment of two different phenomena, and analyzing whether or not the differences affected their observations. Erin's suggestions for teacher questions indicated that while a comparative assessment was essential, students should be encouraged to connect the observed phenomena to a single concept. In this particular instance, engaging students in a discussion where they make connections between the pendulum and ball/marble activities, and the concept of gravity. This idea is quite similar to Jenna's view that students should connect their observations in the science classroom with their experiences in an amusement park. However, Jenna's suggestion was to promote the pressing for understanding rather than the synthesizing discourse, and this created a point of contention between the two parties. Another difference between the two views was that Erin wanted students to make connections to an abstract concept such as gravity while Jenna suggested a connection with their experiences at an amusement park.

The idea of connecting classroom observations to real world experiences appealed to Drew who decided to interject with a proposal to have students make a connection to skydiving. Specifically, she suggested a connection to a famous skydiver Felix Baumgartner who had just recently broken the sound barrier in a free-fall that reached a maximum speed of 844 miles per hour (Langewiesche 2013).

652 Drew: How might you connect this to skydiving? How might you connect this
653 to what Felix did?

The quote above was Drew's second attempt at making her point. Her first attempt was met with a four-second bout of silence during which Erin and Nina again exchanged furtive glances. Nina and Erin acted in collusion to disregard ideas that did not meet their approval. They both ignored Drew's suggestion while Jenna remained silent. Jenna had been silent since the group pointedly snubbed her suggestion on amusement parks.

To emphasize their disapproval of and indifference to Drew's skydiving suggestion, Erin continued the conversation she was having with Nina before Drew spoke. Erin and Nina were discussing possible teacher questions to promote the synthesizing discourse. After Drew shared her skydiving idea, Erin turned to Nina and asked her to suggest student responses to the teacher questions they had developed during their exclusive conversation (lines 640-648). They continued to discuss possibilities for the consensus document making reference to the skydiving idea without directly addressing Drew. Incidentally, one of the teacher questions Erin told Nina to include in the consensus document made connections to gravity. This decision was made during dialogue that excluded contributions from Drew and Jenna. However, she rationalized the rejection of the skydiving idea.

656 Erin: Okay, so how does this connect to

657 gravity? Cause the only thing with Felix...was the resistance of the

658 parachute so now you are introducing another scientific idea.

In this response, Erin was herself introducing a scientific idea to the existing lesson segment. There was no reference to the concept of gravity during the video segment.

Asking students to connect observations to gravity would be, in effect, introducing a new scientific idea. Her rationale for rejecting the skydiving proposal was that it introduced another scientific idea. According to Erin, the concept of air resistance would have been introduced and this would make reference to skydiving an inappropriate choice for a teacher question. Was she concerned that another scientific idea was introduced? Or was she concerned that the new idea was not the same as hers? Why didn't she directly address Drew to explain her rejection of the skydiving idea? Drew had not stated in her proposal the intention to introduce air resistance. She simply stated skydiving and mentioned a famous individual that some students could relate to. Erin analyzed Drew's comments through a decidedly preconceived lens of rejection and as such failed to identify the value nestled within the seemingly impulsive suggestion to have students connect with exciting and newsworthy information. Drew's proposal was pronounced dead on arrival to the drawing board, and Erin eager to announce a cause of death, provided a weak argument that generated more questions than answers.

Politics. Jenna's proposal to have students make connections with their experiences at the amusement park fell flat. So did Drew's idea to have them make connections with Felix, the skydiver. For reasons that were unclear, the power couple of the deliberations rejected suggestions that would have provided students with the opportunity to connect their classroom experiences with real life scenarios. Since the

public announcement of her type A personality, Nina had made every effort to provide evidence to support her self-proclaimed title of Miss Bossy Pants. She engaged Erin in exclusive bouts of whispering and laughing; protested Drew and Jenna's idea by smiling, shaking, and biting her tongue; disengaged from conversation that ran counter to her ideas; and engaged in excessive celebrations following a shift of the consensus ideas in her favor. Since then Erin had made every effort to steer discussions in a direction that was favorable to Nina. Not only did she change consensus ideas to reflect a version more appealing to Nina, she aided and abetted the intimidating and distasteful display of clout by Nina, and proceeded to exclude the other participants from the process of negotiation by engaging Nina in direct exchanges rather than including the other two teachers.

The partnership continued as Nina and Erin whispered during the preparation of the consensus document. Erin audibly asked Nina, "you're biting your tongue, aren't you?" (line 662). Erin first asked this question after Nina's initial outburst (line 581). The question of whether or not Nina was biting her tongue again highlighted the camaraderie between the two, and pointed to a sinister element to the whispering and laughing they periodically engaged in. The exclusion of the other two teacher participants established a hierarchy within the PLC, which placed Drew and Jenna at a clear disadvantage where the acceptance of ideas were concerned. In other words, their ideas, which in most cases were reasonable, compelling, and based on their understanding of the discourse types were often rejected for reasons that were not clearly explained. Nina and Erin, whose actions positioned them at the top of the power structure, decided on teacher questions and possible student responses to promote the

discourse types, as required by the prompts. Nina and Erin completed the consensus document without further consultation with the other two teachers. An analysis of the consensus document would likely indicate whether or not the ideas presented were skewed in favor of the power couple, Nina and Erin.

Analyzing Consensus Document

The ideas represented in the consensus document did not accurately reflect the meaning negotiated by the group. Two ideas presented by Nina, and rejected by the group were included in the final document (Appendix D). First, Nina had persistently stated her belief that “the purpose of the lesson (was) the importance of experimentation” (lines 59-60), and that the redesign of the lesson should reflect the nature of science rather than a scientific content area. As such, she suggested that teachers ask students to “come up with scenarios where (the large and small objects) wouldn’t fall at the same rate” (line 219) and to “create a situation where they would have different rates of dropping” (lines 221-222). The group disregarded these ideas because Erin was convinced at the time that there was a greater focus on the “science content” (line 166) than experimentation. The consensus document prepared by Nina and Erin included two teacher questions, written in Nina’s handwriting, that were eerily similar to the ideas she mentioned earlier during the discourse. These questions include “can you think of any situations where falling objects would behave differently than what we have observed?” and “how could we test to see if these examples really do behave differently?” (Appendix D). A quick comparison between these two questions and the suggestions made by Nina (see lines 219, 221-222 above) revealed that ideas that the group rejected were included under the guise of consensus.

Second, Nina insisted that the group integrate the three discourse types (lines 423 & 425) rather than the two required by the prompt. The response sheet provided by the U-FUTuRES team included a blank table to accommodate the two discourse types, and the teacher questions to promote the selection. Nina, who assisted with the documentation of consensus ideas, defiantly disregarded the instructions and wrote a note indicating “alternative discourse #2 on back” (Appendix D). As expected, on the back of the document, Nina constructed her own table to include the third discourse type, brainstorming. Earlier during the discussion, she had insisted that the redesigned lesson included the discourse types in the following order: synthesizing, pressing for understanding, and brainstorming (lines 381-389). Although Erin (“We just need two discourse types” – line 472) and Jenna (“We are only doing two” – line 424) articulated their objection to the use of three discourse types, Nina’s idea was clearly reflected in the final document as consensus.

Three other ideas were reflected in the consensus document despite not being subject to negotiation by all four teacher participants. First, a suggestion that students “view video with air resistance” was included under the pressing for understanding discourse. Drew had made a suggestion to have students make connections with Felix Baumgartner skydiving feat (lines 652-653) but this was rejected by Erin who insisted that this would be “introducing another scientific idea” (line 658) of air resistance. Drew’s idea was publicly snubbed yet somewhat included as part of the consensus ideas. Was her idea suddenly good enough for Erin and Nina? Did they privately reflect and decided that the idea was worth consideration? Was the intention to snub Drew regardless of how good her idea was? The teacher question suggested asked students

“how might the activity change with air resistance?” (Appendix D). This idea was included in consensus documents although it was not negotiated by the group.

Second, another teacher question that was not discussed by the group was “what evidence do we have that objects with different masses fall or swing at the same rate?” (Appendix D). Although there was extensive discussion regarding the comparison of the pendulum activity and the marble/bowling ball, no decision was taken by the group to question students on evidence. Drew and Jenna had consistently argued for a “how can we figure out statement” (line 564) in teacher questions promoting pressing for understanding discourse. This idea was repeatedly rejected in favor of questions that were never even discussed during deliberations. Third, an idea proposed by Nina but never ratified by the group was included (in Nina’s handwriting) in the consensus document. She had mentioned a scenario in which objects were “falling at an angle or falling straight down” (lines 621-622), but she did not develop her ideas in a way that would garner a response from the group. This idea was included in a teacher question that promoted the synthesizing discourse type, and required students to note similarities under varying circumstances. There was no negotiation among group members but this idea was nonetheless represented as part of the consensus ideas.

Summarizing the Interaction

In sum, the science teachers were required to summarize the content addressed in the lesson segment viewed, and collectively redesign the lesson by integrating two of the discourse types featured in the IQWST curriculum. The discussion began with a seemingly quick consensus, which eventually began to unravel when the views of certain participants were not unanimously accepted. One teacher in particular demonstrated visceral and emotional reactions when alternative ideas were advanced.

This teacher was not willing to support possibilities outside of her own cognitive framework, and was not comfortable accepting ideas she perceived as erroneous. As a result, she employed various strategies aimed at ensuring that all participants accept her reality as consensus. In preparing the consensus document, she disregarded some of the decisions taken by the group and replaced them with some the ideas she had tried to impose during the discussion. The consensus document, therefore, did not reflect the views of all the participants.

Through the lens of Foucault's theory of power. From the perspective of Foucault, the professional development facilitators attempted to chart a course for teacher learning by designing an activity aimed at encouraging teachers to apply content from formal courses to practical experiences in the science classroom. This action ensured that the science teachers in the interacting group would come to a common understanding of how to integrate basic principles of inquiry into their classroom instruction. The interaction that ensued involved a series of actions, each defined and determined by the preceding actions of participants. All participating teachers exercised power during the interaction, however the action of one particular teacher hindered real consensus among teachers. Her exercise of power was to the detriment of collaborative decision-making, and silenced the ideas of those who did not accept hers. Despite her actions, the teachers whose ideas were excluded from the consensus document, exercised power in a way that allowed deliberations to continue. The consensus document submitted was compromised because of the action of one individual who exercised power in a way that hindered authentic collaboration among group participants.

Through the lens of constructivism. The participating science teachers were expected to integrate their own experiences with science instruction with new information regarding the IQWST curriculum. As a group, they shared ideas as they attempted to deliberate on the discourse types associated with the curriculum and how they might be integrated into a redesign of the lesson segment viewed. During this process, one teacher was particularly resistant to change. She was unwilling to modify her ideas in light of the contradicting perspectives of her peers. According to the constructivist view of learning, conceptual change occurs when there is adaptive modification of prior knowledge based on the organization of formal instructional experiences (Gredler 2009). From the constructivist perspective, individuals learn during this process of conceptual change. This teacher in question, therefore, missed an opportunity to learn when she disregarded the ideas of her peers and rather doctored the consensus document to reflect her own views. In so doing, she possibly stymied opportunities for collective learning within the PLC.

Through the lens of Self. The science teachers were instructed to watch a lesson segment, summarize the content and redesign a lesson using two of the three discourse types associated with IQWST. As soon as they came together they came to a consensus of two discourse types used in the lesson segment viewed. Then they began to talk about ways to redesign the lesson but they could not arrive at a consensus as to the focus of the original lesson. One teacher who seemed particularly sure of herself started to behave in a way that suggested that the views of the other teachers were not as important as her own. She demonstrated an attitude of intolerance to contradicting views. She was unwilling to compromise and her facial expression and body language

reflected a less than impressive opinion of the cognitive abilities of at least two of her peers. Was this type of behavior necessary? Were the views of others not important to achieving consensus? Did she believe herself to be smarter than the others? What of the feelings of the teachers whose views she disregarded? Did she not care that she might be hurting their feelings? Despite the behavior of this teacher, the other participants continued to share their ideas in a bid to arrive at consensus. Did they not realize that this particular teacher was dismissing their ideas? Why were they responding with such stolid docility? Why were they so calm? Were they afraid of her? Did they even care? One teacher volunteer wrote down the consensus ideas on a document provided by the facilitators. However, the consensus document included ideas that were not agreed upon by the entire group. It was skewed to reflect the ideas of the extremely confident and knowledgeable science teacher who stalled the deliberations with her intermittent outbursts.

The next interaction. This interaction was selected to demonstrate the exercise of power within the PLC under study. Although some knowledge was constructed, the interaction was not conducive to learning because deliberate power strategies that were enacted to influence the outcome of the deliberations. Not all participants were open to the views of others, and this arguably hindered the learning potential of this group. The interaction presented in Chapter 6 was slightly different. Although power was exercised, there were more opportunities for the co-construction of knowledge as teachers negotiated their understanding of effective science teaching practices.

CHAPTER 6 FINDINGS II: MORE GOLD

Reporting More Findings

In Chapter 6, I report more findings from the analysis of the data derived from interactions of middle school science teachers within a PLC. My analysis was guided by the following question and sub-questions:

- 1 How can professional learning communities (PLCs) operate as a site for learning and development of middle school science teachers in the process of implementing an inquiry curriculum?
 - a) How do middle school science teachers negotiate meaning and construct knowledge about their practice during interactions within a PLC?
 - b) How does the exercise of power influence the process and outcome of consensus making among middle school science teachers within the PLC?

These findings are the result of complementary processes of deconstruction of data using Foucauldian-inspired discourse analysis tools, and subsequent reconstruction using an eclectic blend of theories relating to power, knowledge, and learning. This particular interaction was selected because power strategies employed were subtle, yet extremely effective. Additionally, there were numerous opportunities for learning as teachers negotiated their understanding of concepts they were introduced to during formal instruction.

Identifying Effective Teaching Strategies in the Science Classroom

The interaction reported below took place as teachers worked in groups to identify teaching practices that have proven effective within their science classrooms. They were also required to brainstorm strategies to assist other teachers in adopting these practices. The prompts provided to each group were as follows:

- 1 What science teaching practices have been the most effective with your students? Provide evidence for your claims.

- 2 Come to consensus about two to three science teaching practices that the team feels are the most effective.
- 3 Brainstorm ways to help other teachers understand and adopt these practices.

The activity allowed teachers to reflect on their practice, share instructional episodes with their peers, negotiate to determine the three most effective, and to think about ways to assist other teachers in the improvement of their practice. The description below details the meaning science teachers negotiated as they share their understanding of what constitutes effective instruction. It also highlights the processes involved in arriving at a consensus regarding most effective practices as well as power strategies, if any, employed during the interaction. The reconstruction of this interaction is presented in a sequential manner in order to demonstrate the shifts and transformations evident in the consensus making process.

Introducing the Teacher Participants

This PLC consisted of six teachers, namely Nina, Sue, Megan, Erin, Jessica, and Rob. Nina is a fifth grade teacher with eight years teaching experience; Sue is employed with a regional educational service agency that provides administrative and instructional support to schools in the surrounding school districts; Megan has had ten years experience teaching sixth graders; Erin has been teaching sixth grade for the past nine years; Jessica has eight years experience teaching eight grade; and Rob is a seventh grade teacher with eleven years experience teaching science. Except for Sue, Jessica, and Megan the other teacher participants had approximately four months experience implementing the reform curriculum IQWST. Although Sue has had a total of thirteen years experience teaching science in elementary and middle grades, she has never taught the IQWST curriculum. In fact, her work experience had been more

associated with curriculum management than classroom teaching. Megan has been teaching IQWST for approximately two years and has repeatedly received favorable feedback from the U-FUTuRES research team regarding her exemplary enactment of the curriculum. Many of the teachers enrolled in the masters program visited her science class prior to registration in order to observe the implementation of IQWST. As a model instructor for the IQWST curriculum, Megan had participated in several workshops led by curriculum designers and other teacher educators prior to enrolling in the masters program. Jessica has taught the IQWST curriculum for approximately one year prior to enrolment in the program but had not participated extensively in the workshops provided by curriculum designers.

From Dissonance to Consonance

As middle school teachers deliberated to achieve consensus on most effective science teaching practices, there were varying opinions of what constitute good science teaching. During the deliberations, teachers' misconceptions were surfaced as they re-evaluated prior beliefs and knowledge in the face of new understandings gleaned during the interactions. The group discussions provided opportunities for teachers to share their experiences with the inquiry curriculum IQWST while considering modifications to their practice in an attempt to improve instruction. An analysis of the discourse generated as a result highlights cognitive shifts as differences in opinions gradually faded to reveal underlying similarities in viewpoints. The reconstructions below were guided primarily by Foucault's theories on power and knowledge as well as the tenets of social constructivism, perceived in my composition as a learning theory. Each segment was subtitled based on the specific incident highlighted.

Small talk

Context. The discussion began with casual conversation among four of the six participants: Nina, Sue, Jessica, and Erin. They were engaged in small talk (lines 1-27) about iPads they had recently received through the U-FUTuRES program. It started when Erin complimented Nina on the case she had bought for the iPad. As Sue and Jessica admired the case, they noticed that Nina had downloaded the Quickoffice HD Pro software to her iPad in order to prepare documents, spreadsheets, and presentations. Sue indicated that she had downloaded iWork software to her iPad for a similar purpose. Erin acknowledged the utility of iWorks but indicated shortcomings in its design. Sue mentioned that they had recently upgraded the software in order to address these weaknesses.

Author. Megan and Rob did not participate in the small talk, and did not show interest in sharing information regarding their newly acquired iPads. Rob also did not participate presumably because of the way he had been socialized as a male. Megan is a native of Puerto Rico, and appears to connect more readily with individuals on a professional rather than social level. She is bilingual and speaks with a heavy but comprehensible Spanish accent. Megan's decision not to participate in small talk appeared to be more related to culture rather than disapproval of the small talk. Nevertheless, she decided to end the casual conversation by asking her peers to confirm the number of teacher practices they were expected to identify.

As a Jamaican with a somewhat different social and cultural background, I sometimes feel a bit awkward when my peers engage in small talk when there are more functional issues to be addressed in group-work. My tendency to disengage from these informal discourses does not reflect my disapproval of small talk but rather an internal

sense of urgency to complete the required task. Megan's body language suggested a similar concern as she tried to get her team on task in light of the limited time they were given to come to a consensus. She was very diplomatic in the redirecting the conversation to the teaching practice they were required to identify. Rob, on the other hand, waited patiently as his peers admired iPads and cases. As the lone male in the program, he had been very good-natured about the multiple idiosyncrasies that have been demonstrated by his female counterparts. Although Rob and Megan did not participate in the small talk, the rest of the group accepted their decision and politely respected Megan's thinly veiled request for discontinuance.

Asking questions

Context. Megan redirected the discussion on iPads, accessories, and software to the instructional strategies they were required to share. She did this by asking the group to remind her of the number of practices they needed to share. Erin indicated two to three, and Megan responded that she had already written down two that she would like to share. Megan's actions demonstrated her desire to get the deliberations started, and reflected her no-nonsense approach to the activities of the PLC. Her request for information on the prompt was part of a subtle strategy to change the trajectory of the discussion. The response of her peers was favorable in that regard resulting in the initiation of group deliberations.

Knowledge. Megan identified "asking questions" (line 32) as an effective teaching practice, and Erin indicated a similar selection hence demonstrating consensus with Megan. Megan continued to explain that asking questions had been seamlessly and naturally integrated in her repertoire of instructional activities. She reminded the group that she was a model instructor for the IQWST curriculum, and

informed them that teachers visiting her classroom were typically surprised that her students “were asking so many questions” (line 42). She believed that the shift from teacher-led discourse to one that is more student-centered reflected a big change in her practice. Megan’s explanation clarified her understanding of ‘asking questions’ as a teaching strategy. According to Megan, facilitating a classroom discussion in which students are engaged in asking questions fosters the natural inquisitive nature of children, and as such constitutes effective teaching. Megan believed that good teaching strategies are contingent on the way students respond to instruction rather than on the activities of the teacher during instruction. Megan’s explanation also established her as somewhat of an expert with the IQWST curriculum. Having taught the curriculum for over two years, and being considered by curriculum developers as an exemplar, she presented herself as a credible voice in a discussion on effective teaching strategies. This she did, in the hope that teachers would respect her contribution to deliberations and include her suggestions in consensus ideas.

Nina responded by indicating the importance of teacher-led questioning. She acknowledged Megan’s expertise in enacting the IQWST curriculum by sharing her own experiences as a visitor to Megan’s classroom. She described a teaching episode during which Megan was asking questions and allowing students to “think about it and analyze it and come up with the answers” (line 49). In her assessment of Megan’s instruction, she reported that she was impressed by the way the teacher-led questioning encouraged students to share their ideas without fear of disapproval. Nina’s comments were significant for two reasons. First, it reflected her understanding of effective teaching as being related to the teachers’ activities, which would likely generate

favorable student responses. This perception of effective teaching strategy as teacher-centered (based on action of the teacher) is different from Megan's view, which considers student activities as central to the categorization of effective instruction. Second, it acknowledged Megan as an exemplary instructor of the IQWST curriculum. She expressed a favorable assessment of the her classroom visit using affective statements such as, "You asked the question and I love it" (line 48), "And I like that wrong answers are okay" (lines 49-50), "I love that it kinda encourages..." (line 50), and "I really liked that portion of it" (line 51). This reflection on Megan's instruction allowed Nina to provide a peer evaluation while boosting Megan's credibility as the expert of the group.

Megan, by virtue of her experience with IQWST and the favorable feedback by at least one member of the PLC, has been established as highly knowledgeable about the inquiry curriculum and very competent at its enactment. She wanted her idea of using "students asking questions" (line 57) to be included with the consensus. She asked for her peers' opinion but no one committed to the idea. In a bid to garner their support, she continued to relate a classroom episode "when all the questions (were) coming from (her) students" (line 59). She explained that her sixth graders were reading about the periodic table, and became so engaged with the topic that they were asking a range of questions reflecting complex concepts that extended beyond the curriculum and their grade level. Based on her student-centric interpretation of effective teaching strategies, she implied that when students become engaged with the content they synergistically generate questions, which can foster higher order thinking skills. Notably, Megan did not share the activities she as a teacher engaged in to promote this reaction from her

students. Her explanation focused on the activities of her students hence reinforcing the notion that teaching strategies are contingent on the activities of the students rather than the teachers. This episode, she believed, provided evidence for her claim that 'students asking questions' was an effective teaching strategy.

Politics. The IQWST curriculum emphasizes scientific practices including the analysis and interpretation of data, as well as the construction of scientific explanations consisting of claim, evidence, and reasoning. Formalized discourse on scientific explanations has permeated the teachers' discussion through the prompts provided by the U-FUTuRES facilitators. These prompts are designed with a focus on claims and evidence in order to ensure that the discourse becomes embedded in teachers' practice. As teachers engage in discussion regarding effective teaching practices, the 'claims and evidence' discourse dominates in silence as it guides deliberations and dictates consensus ideas. Teachers, after identifying effective practices, were required to provide evidence in support of their choice. Although the power of formalized discourses was evident in this case, teacher actions associated with such prompts including reflecting on and replaying classroom episodes will likely contribute to teachers' understanding of the inquiry curriculum.

Wait time and argumentation

Context/Politics. Megan's proposal to include students asking question as an effective teaching strategy appeared to be gaining acceptance among her peers. Her vivid description of classroom episodes not only supported her claim but also opened a figurative window to her classroom, which allowed her peers to see the student engagement and higher order thinking as a direct result of student generated questions.

As Megan spoke, however, Nina interrupted to indicate that based on her interpretation of the prompt, there should be more focus on the features of IQWST.

67 Nina: Yeah I think that...maybe I am on the wrong page but I guess I am

68 thinking that we are supposed to be focusing more directly on...

69 Erin: Okay

70 Nina: the features

Because the prompt did not specifically require a discussion on the features of IQWST, it is reasonable to assume that Nina misinterpreted the objectives of group activity or simply did not want to hear Megan's re-enactment of her classroom success. Nina had interrupted Megan mid sentence to indicate that the focus of the group discussion was not on the classroom interactions that Megan was sharing but rather solely on the inquiry curriculum that engendered such interactions. According to U-FUTuRES documents, teachers were required to discuss teaching practices that have been the most effective with their students and also to provide evidence for their efficacy. Megan was well within the boundaries of the directives of U-FUTuRES facilitators to describe those classroom episodes that validated her selection of teaching strategies. Whether Nina misunderstood of the prompt or was annoyed by Megan's success stories, the interruption was not warranted, and could potentially silence other members of the group with similar stories to share.

Knowledge. Sue informed the group that the focus of the prompt was teaching strategies rather than IQWST features, and demonstrated solidarity with Megan by indicating that she had also written "asking questions as an effective teaching strategy" (line 72-73). This led to a brief pause during which the teachers re-read the prompts in order to figure out how to approach deliberations. Erin broke the momentary silence by

sharing a teaching strategy that had improved since she began implementing the inquiry curriculum.

77 Erin: One of the things that...I think...IQWST and one of the things I've
78 learned that I thought I did before and I thought I did a good job of before was
79 the wait time and the processing time.

The brief pause allowed Erin to critically reflect on her practices and on the ways in which student engagement have improved as a result. She indicated that prior to implementing IQWST, her wait time was abbreviated and this deprived students of the opportunity to think about her questions. Erin used the prompts provided by IQWST to guide her questioning while modifying them periodically based on the way her students responded. She acknowledged that “allowing them to have that just silence” (line 82) where “the kids are just thinking” (line 83) has been highly effective in her classroom. Furthermore, she has developed the practice to open up the classroom discussion by having more students share their ideas rather than moving on to the next question after accepting the first student response.

Erin’s contribution to the discussion at this point revealed a change in the way she approached classroom interactions. This change was informed by the inquiry curriculum, and reflected a more student-centered approach in which students were provided with more time to think and process information. Erin believed that if students were given more opportunities to think, they would be able to contribute to classroom interactions in more meaningful ways. She also implied that allowing more students to share their ideas would foster a relaxed classroom environment that encourages participation and engagement. The IQWST curriculum, she conceded, surfaced weaknesses in her practice and also provided prompts to guide her questioning.

Modifying these prompts demonstrated Erin's own control of the activities taking place in her classroom. Although she was required to implement IQWST with fidelity, Erin made these modifications to establish herself as the final authority in her classroom, and to take ownership of that portion, however miniscule, of the curriculum.

Nina supported Erin's view of increasing wait time and reiterated the value of uncritically accepting student responses rather than telling them that they were wrong. According to Nina, the IQWST curriculum encourages students to support their answers with evidence while providing other students with the opportunity to share their ideas. Again, she highlighted weaknesses in her practices that were amplified during the implementation of the inquiry curriculum.

86 Nina: In the past if the kids gave the wrong answer you could

87 correct them, and where now it's okay to be wrong.

Nina's response indicated that previous practice involved correcting students' responses rather than having them articulate their thought processes. This strategy, she believed, silenced students who would have otherwise been engaged in classroom discourse. The practices promoted by IQWST facilitate classroom discourse by encouraging students to "support (their) answer" (line 88), and to "review, edit, and modify each other's (responses)" (line 91). Nina opined that implementing a more student-centered approach to classroom interaction, engaged students in a constructive process of evaluating their responses as well those of their peers. A student-centered approach would require teachers to relinquish their position of sole authority with respect to the evaluation of student responses, and students to assume a more significant role in the assessment of learning.

The rest of the teachers in the group overwhelmingly supported Nina's articulation of the effectiveness of peer-evaluation in the science classroom as a means of improving student engagement. Erin also alluded to the use of models, another feature of IQWST, which encourages students to use drawings to depict their understanding of a scientific phenomenon. She reported that students were extremely excited about modifying their peer's depiction on the 'Elmo' document projector. Nina interrupted with classroom episodes of her own.

94 Erin: Especially with the models my kids fights over who's getting up on the Elmo

95 Nina: Yeah, I mean and if someone says something, almost invariably

96 someone else in the class would say "but...but...but"...they want to argue instantly

The process of reflection that elicited these re-enactments of classroom interactions plays an important role in teachers' learning and development. Not only do they share details of their practice, it opens up these strategies to critical evaluation of their peers. It also allows for the synergetic development of new ideas as teachers communicate their experiences. Nevertheless, in this particular segment of the interaction, Nina indicated that when students were encouraged to evaluate each other's responses and models, they invariably engaged in argumentation. As the instructor, she facilitated these discussions by telling students to wait their turn and used prompts such as "do you want to add anything, do you want to change anything, do you want to add anything, do you want to take anything away?" Sharing these prompts provided Nina with an opportunity to assist her peers in refining their practices especially in similar situations requiring teacher support for argumentation in classroom discourses.

Politics. Megan agreed with Nina's ideas of encouraging argumentation among students during a more student-centered approach to instruction. She indicated that she

experienced similar reactions from her students when they are asked to evaluate each other's models and responses. Without asking or waiting for contributions from Sue, Rob, and Jessica, Erin declared a consensus idea.

102 Erin: So we are saying wait time, argumentation and that's like three right

103 there, and student

Erin's keenness in arriving at a consensus resulted in the exclusion of other ideas from the other three participants. Erin documented the first three teaching strategies shared among teacher participants, which suggested that her automatic acceptance of these ideas was not based on personal bias. Although, Erin's actions ensured a timely end to the deliberations, the potential for the exploration of additional strategies as well as the critical evaluation of such were eliminated with the premature declaration of consensus. It was also a brash move that demonstrated she was taking control of the proceedings so far.

The teachers' accounts describing changes to classroom practice reflected the strong influence that IQWST has had on their pedagogy, and by extension student engagement. The power of inquiry-based curricula to transform pedagogies cannot be overlooked and must be considered as a viable option for science teacher development. For this particular group of science teachers, IQWST has been the silent authority on the implementation of science instruction. Both Erin and Nina identified previous practices that were supplanted by IQWST teaching strategies that have become the norm in their science classrooms. Furthermore, IQWST and its associated discourses have dominated deliberations as teachers become assimilated in the culture of inquiry instruction.

Add, modify and expand

Context. Erin, after a brief discussion with Nina and Megan, announced a consensus of effective teaching practices that included students asking questions, wait time, and argumentation. This consensus reflected a view that a teaching practice may either be an action on the part of the teacher as in wait time, or on the part of the students such as asking questions and engaging in argumentation. Based on the teachers' understanding, good teaching strategies ultimately result in improved student engagement and there is less of an emphasis on the teacher practices involved in getting students interested in science. Before Erin completed her announcement of consensus, however, Sue summarized her understanding of wait time and argumentation.

104 Sue: It's almost like establishing a protocol for the students for their
105 argumentation and discourse because by you modeling the wait time and
106 them having to wait before they can respond to what students are doing they
107 are building a protocol without actually being aware of it... [Emphasis added]

It was evident from this response that Sue positioned herself outside of the teaching profession. Sue, who had been working in an educational service agency for the past several years, negotiated her understanding of the recounted classroom episodes from an administrative perspective.

Author. According to Sue, when teachers increase their wait time in a bid to encourage higher order thinking skills and argumentation, they establish a protocol or code of conduct for their students to adopt. In other words, teachers model the types of behavior they would like to see in their students. In making her assessment of teacher actions, Sue repeatedly used the word 'they', which suggested that she was speaking

from the perspective of an outsider. Her prolonged absence from the classroom coupled with her lack of experience in implementing the IQWST curriculum contributed to the way she negotiated meaning regarding the classroom episodes reported. Additionally, her administrative role within the school district limited her contribution to one of an evaluator rather than a practitioner. Needless to say, Sue highlighted the importance of science teachers modeling those scientific practices that their students are expected to emulate. She also underscored the need for teachers to increase wait time to provide students with the opportunity to think more carefully about the questions being posed. Sue believed that these opportunities would lead to more “argumentation and discourse” (lines 104-105) among students.

Knowledge. Nina responded to Sue’s comments by explaining that students negotiate meaning based on their “own experiences and understandings” (lines 108-109), which guide students’ evaluation of each other’s models and claims. Again, she indicated that when students are involved in the evaluation of the peers, the responsibility of reviewing and correcting students’ work is shared. Erin added that engaging her students in peer evaluation had been a very successful strategy in her classroom. She indicated that she fostered a classroom culture in which students “add, modify, and expand” (line 113) each other’s work. She described her strategy and students’ reaction.

114 Erin: So a kid will throw out an idea and we’ll kind of [inaudible]...

115 and I’ll say who can add or modify what so and so is saying so they are like

116 paying attention, they are listening, and they are adding...

117 Nina: Yeah, I love that.

118 Erin: So they are sometimes correcting if there is something incorrect in

119 that student's claim or they are adding evidence to further support...

This disclosure again suggested that teachers believed that their strategies were successful if their students are engaged in the lesson. According to Erin, students are engaged if they are paying attention, listening, and following instructions. Additionally, her comments indicated that students modify incorrect statements or claims, and make suggestions to improve the arguments presented by their peers.

It appeared, based on discussions, that teachers are of the view that students' ideas can sometimes be 'incorrect' and as such must be 'corrected' as soon as they are articulated. In several instances, Nina indicated that students corrected each other "as opposed to me being the one to correct them" (lines 109-110). There is a general sense that teachers are apprehensive about 'correcting' their students, and the shift in responsibility from teachers to other students has been well received by teacher participants. Teachers, however, are conflicted in their ideas about managing students' responses during classroom discussions. Nina mentioned earlier in the discussion that "wrong answers are okay" (lines 49-50) and that "it's okay to be wrong" (line 87). She indicated that rather than 'correcting' students, they are given opportunities to support their claims with evidence. Yet, other comments by Nina suggested that 'correcting' students claim is a necessary part of the science classroom discourse, and sharing that responsibility with her students enhances engagement. Erin shared a similar view, indicating that students enjoyed "getting up on the Elmo" (line 94) in order to correct each other's work. She implied that when students are engaged in peer evaluation, they are more attentive to other students' ideas as they attempt to modify or support them.

Politics. Nina interrupted Erin to share a similar experience with her students. Her exuberant tone suggested that sharing these classroom episodes could be a source

of encouragement for teachers attempting to inspire confidence in their own teaching practices. However, Nina's proclivity to interrupt her peers while they report on their classroom experiences has the potential to suppress the enthusiasm generated through this group activity. Nina had interrupted Megan while she was sharing an episode during which her students had begun to extend their class discussions to concepts beyond the IQWST (line 66). Since then Megan has not shared any other experiences. Also, Erin had prefaced one of her episodes by indicating that her assistant principal visited her classroom during one of her student peer evaluation sessions (lines 111-112). Nina interrupted the flow of her conversation so Erin did not have the opportunity to explain the significance of the principal's visit to her classroom. What did administration think about the transformation in classroom interactions? Did they pledge additional support for other teachers attempting to improve their practice? Did a positive evaluation by personnel boost her confidence and contribute to her development as a teacher? Unnecessary interruptions, in this case, disrupted the flow of teachers' thoughts as they attempt to make sense of their classroom teaching experiences while relating them to their peers. By changing this flow, the interrupter exerts enormous influence on the process of meaning negotiation among interacting teachers in a PLC.

Unpacking scientific teaching practices

Context. The teachers were required to select two or three science teaching practices that have been effective with their students. Somehow there was confusion among teachers as to the expectations of the facilitators. Megan was the first to express her confusion but again because she was interrupted before completing her comments, it was not entirely clear what her misconceptions were.

125 Megan: Where I'm a little confused because I'm thinking...she has there,

126 scientific teaching practices so I'm thinking also...teaching practices that also...

127 Erin: So how do you word 'teaching practices' as opposed to...

128 Sue: 'Cause it says which science teaching practices have been the most effective.

129 Megan: 'Cause I would include like the use of evidence but I'm not sure if I

130 am in the right...

It is evident from this exchange that the three teachers had three different concerns about the wording of the prompt.

Author. Megan believed that the facilitators wanted teachers to also consider the scientific practices that are essential to the IQWST curriculum. According to the IQWST Front Matter (n.d), these scientific practices include models and modeling; data gathering, organization and analysis; and evidence-based scientific explanations. The IQWST curriculum was designed on the premise that when students are engaged in these scientific practices, they experience the ways in which scientists construct knowledge within the field. Megan inferred, based on her developing knowledge of the conceptual framework of IQWST, that a scientific teaching practice would necessarily include scientific practices, such as "the use of evidence" (line 129). In order to negotiate meaning, Megan made connections with her working knowledge of IQWST as well as her experience implementing the curriculum in her sixth grade classroom. Interruptions to the flow of her statements as she negotiated this meaning prevented Megan from articulating an understanding of the term science teaching practice.

Knowledge. Erin's concern was related to the wording of the prompt. She implied that the term "teaching practices" (line 127) was confusing to her and was about explain to the group her current understanding on the matter when Sue interrupted. Sue was trying to make sense of the use of the terms effective and science to qualify

teaching practices. She believed that “effective practices are effective in all curriculum” (line 132) and as such found the use of the term ‘effective science teaching practices’ redundant. Sue’s concern was related to semantics rather than the specifics of classroom instruction. She had very little, if any, practical knowledge of the implementation of the curriculum, and as such negotiated meaning from the perspective of a district administrator rather than a practitioner. There is a danger in nurturing inconsequential issues, such as superfluous wording of a prompt raised by Sue, rather than the more substantive issue of whether or not the teaching strategies selected should necessarily reflect the scientific practices. Engaging in protracted discussions about the ‘right’ words to use in a prompt is hardly a constructive or productive activity, especially after a consensus was declared. These types of discussion can be infuriating to individuals attempting to address essential requirements of the prompt in a timely manner. Sue, despite her lack of experience implementing the IQWST curriculum, wanted to contribute to the discussion from the position of an expert. As such, she chose to debate a point that may have been relevant to her administrative stance but irrelevant to the central task of this PLC.

Naturally, the practitioners held a slightly different view from Sue’s position that “effective practices are effective in all curriculum” (line 135). Megan indicated that she “kind of disagree(d)” (line 136) with Sue because scientific practices, such as the use of evidence to support claims, are specific to the field of science. According to Megan, “math traditionally has not looked for any evidence” (lines 138-139) and as such scientific practices emphasized in science classrooms do not apply to math classes. This response from Megan, suggests that she believed that effective science teaching

practices are inextricably linked to students' engagement in scientific practices. She indicated that effective strategies, such as requiring evidence, employed in science would generally not be applicable to math. Nina interjected by informing Megan that advanced math courses required students to provide proof of certain theorems and identities. Her interjection not only abbreviated Megan's articulation of her disagreement with Sue, it also established Nina as somewhat of an expert in math pedagogy.

Politics/Knowledge. Nina is a middle school math and science teacher. She is the only teacher in this PLC with documented expertise in teaching math and science. She indicated that although math students are not required to provide evidence or proof at the middle school level, it was a requirement "when you get much higher up" (line 140). Sue begged to differ. According to Sue, students are required to support their answers in math.

141 Sue: But they have to support...I mean, as coming from...I taught math, and
142 if they brought me the wrong answer I'd say well show me, you know,
143 support what you've got there.

In this statement, Sue attempted to establish herself also as an expert in math instruction. The phrase "coming from" (line 141), although incomplete, suggested a history of math content and pedagogy. Subsequent statements implied that Sue was a math teacher, information that was omitted from previous conversations and documents regarding teachers' professional qualifications and experience. Nevertheless, Sue argued that in math, "there is only one correct answer" (line 144) but "there is more than one way of to get to an answer" (lines 143-144). Sue's comments seemed to acknowledge this distinction between math and science but indicated that both subjects converged on the issue of the process involved in arriving at a solution. According to

Sue, students “as they go through math” (line 146) employ inquiry processes “in order to get to the correct answer” (lines 146-147). Evidently, Sue’s understanding of inquiry was that the process is generally the same across curriculum although modifications may be required for specific subjects. It was this understanding that guided her claim that “effective practices are effective in all curriculum” (line 132) and that by specifically requiring effective science teaching practices, the prompt was superfluously written. Regrettably, Nina pursued this debate to its contentious end.

Nina reiterated that providing proofs for theorems and identities is not a requirement for math until “when you get to calculus” (line 148). She argued that the science practices characteristic of IQWST engage students in providing evidence at the middle grades “whereas with math you don’t get to prove” (lines 151-152) theorems “until you get to higher levels” (lines 152-153). Sue interrupted in disagreement but Nina interrupted her interruption and continued to argue her point.

152 Nina: Or in whatever until

153 you get to higher levels...

154 Sue: You don’t necessarily...

155 Nina: And that’s what we are saying about the evidence portion...the

156 evidence portion at this stage of the game. It’s like if you are in a reading

157 class prove your answer by going back in the passage. Prove your answer

158 by looking at the evidence you have but I would say that it is universal to all

158 content areas...

159 Sue: It’s not, but it still doesn’t mean that it’s not a good practice.

160 Nina: No, I agree

Nina's argument began to unravel as it became unclear what the conflict was really about. Sue had indicated that in her math classes, she makes this a requirement so students have to explain how they arrived at answers. This position stemmed from another argument that "effective practices are effective in all curriculum" (line 132) including math. Nina maintained that students are not required to provide evidence in the earlier grades while science practices foster the use of evidence to support claims at all grade levels. She then went on to explain that students are also required to provide evidence in reading classes, and as such the practice was "universal to all content areas" (line 158). It appeared from this statement that Erin and Nina have converged on the issue of universality of at least one of the scientific practices. Yet, the tone of their exchange suggested conflict.

Politics. Curiously, Sue disagreed that the practice of using evidence to support claims is used across curriculum. In this case, Sue obfuscated the issue by contradicting her own statement then reinforcing the point that the use of evidence was an effective practice regardless. Nina agreed. Sue emphasized her point that a good practice "doesn't have to be science specific" (line 162), and may "be tweaked depending on what subjects" (line 163) are being taught. As Sue defended her position, Nina burst out laughing. But this was no ordinary laugh. Reeking of sarcasm, this laugh was meant to ridicule and protest a pointless issue that was needlessly taking on a life of its own. As if to drive a stake in the heart of this fluttering issue, Nina curtly informed Sue of the current focus on the science classroom.

167 Nina: I guess (the facilitator) is wanting us to use the one's that are working
168 in the science classroom, so...requiring evidence...

The extended dialogue between Nina and Sue could be considered a pseudo-conflict because it was difficult to ascertain exactly what the point of contention was. Both individuals indicated that the practice of using evidence to support claims or answers extended across subject areas. Nina's objection was related to the grade level at which this occurred in math. Nevertheless, the terse conversation between the two revealed an underlying concern that could influence the process of meaning negotiation in this PLC.

Two power strategies were enacted as individuals attempted to establish themselves as power players in this fledgling deliberation. Sue initiated a pseudo-conflict that contributed very little to the process of meaning negotiation among the teachers in the group. As the only individual in the group without experience implementing IQWST, Sue wanted her voice to be heard within an arena in which she was comfortable. Her years of experience in an educational agency that provide support to classroom teachers stimulated an instinctive response: critically examine the wording of the prompt. Sue's action garnered a reactive response from Nina as a brief back and forth ensued. Careful examination of the discourse suggests that Nina and Sue were so engrossed in the act of creating conflict that they failed to realize that the essence of their disagreement was a nonissue. Nothing constructive was achieved as a result of this tit for tat except for the understanding that "an effective practice is an effective practice" (line 135) regardless of the domain in which it is implemented.

The other power strategy involved the curiously timed derisive laugh by Nina in the middle of Sue's explanation of her position. The outburst of laughter came immediately after Sue said, "being in science" (line 161) in reference to effective science

practices. Because Sue was perceived by the rest of the group as an administrator rather than a science teacher, Nina found the statement “being in science” as misrepresentative. Sue was clearly not referring to her science teaching career in making her statement but Nina responded to the portion of the sentence that appeared to contradict the obvious. Nina’s laugh was, therefore, a passive aggressive act (Harrn 2011) aimed at intimidating and or humiliating Sue as she attempted to emphasize her point. Sue’s action in response to this laugh was one of great resolve. Despite the ‘in your face’ outburst, Sue did not miss a beat, and coherently completed her sentence without the shadow of a fluster. This response implied that Sue was neither intimidated nor humiliated by Nina. Despite Sue’s inexperience with IQWST implementation being considered the elephant in the room, she refused to be silenced by the other experts who were sharing enactment experiences. As far as she was concerned, she was an entitled participant of this PLC and she was going to contribute to the deliberations even if it was from a slightly different perspective. My observations of Nina and Sue during the course of the program indicate that there was no love lost between the two. They were both outspoken individuals with dominant personalities, and were experts at beating a horse long after it has expired. If the actions, and responding actions of these two go unchecked, the process of meaning negotiation will likely be jeopardized.

Reviving deliberations

Context. After a brief hiatus in deliberations that involved terse exchanges between Sue and Nina, the teachers regrouped and restarted conversations about effective science teaching strategies. Megan shared with her peers one of the features of IQWST that had transformed her teaching. She used math as a point of reference to explain her departure from the linear, step-by-step procedures characteristic of the

scientific method. She explained that she was “not giving them [students] a process, they’re coming to the answers by doing these activities” (lines 172-173), which allow them to find evidence to support their claims. From Megan’s perspective, teachers employ effective teaching practices when they provide students with the opportunities to conduct their own investigations, and emphasize the importance of evidence. Again her focus on teaching strategies centered on the student behavioral outcomes rather than the teacher’s action. Megan’s suggestion also reflected a shift in her thinking about science teaching practices. Her original idea for an effective science teaching strategy was “students asking questions” (line 32) but in negotiating an understanding of the term “scientific teaching practices” (lines 125-126), she determined that the prompt required those teaching strategies that align with the scientific practices of the IQWST curriculum. As a result, she suggested “the use of evidence” (line 129) as a teaching strategy that engaged students in scientific investigations, which generate evidence for their claims.

Knowledge. While Megan spoke, Erin went to one corner of the room to retrieve a small white board. She brought it closer to the group and began documenting the ideas that were already articulated (Appendix E). She explained her actions to the group.

181 Erin: Yeah, I am just writing down the ideas we are all throwing out so then
182 we can kinda pick the two that we think are the best.

Erin, who had previously declared a consensus of “wait time, argumentation” (line 102) and students asking questions, embraced a slightly different approach to achieving unanimity. Rather than going with the first three ideas advanced, she shifted to a stance that incorporated the ideas of all rather than that of the more outspoken members. As

she wrote down the practices, she repeated her own understanding of how they contribute to student engagement. For instance, she wrote down wait time and indicated that the practice allowed students "to process evidence for claims" (line 183). She then asked Sue to clarify a previous statement about wait time "establishing a protocol for the students for their argumentation and discourse" (line 104). Specifically, Erin asked Sue "what do you mean by discourse?" (lines 184-185). Sue's unexpected and pointed response was "I don't know" (line 187).

Author. This clueless response is a cause for concern especially because Sue had confidently used the term 'discourse' in the articulation of an understanding of wait-time and argumentation. It begs several disquieting questions. Was Sue confidently articulating awareness of information she knew little or nothing about? Was she deceptively using buzzwords and catchphrases to create an illusion of familiarity with IQWST? If she used buzzwords to appear more knowledgeable about a concept than she actually was, why did she admit to not knowing what discourse means? Why didn't she improvise or adlib? In any case, she had an explanation for her use of the word 'discourse'. Sue negotiated meaning by connecting statements made by Erin about wait time (line 78), and Nina about argumentation (line 95). According to Sue, Erin's use of wait time "establishes the protocol for the discourse" (line 188) because she was "modeling the wait time"(line 189) so that the students could adopt a similar behavior in responding to their peers during argumentation. Sue maintained that students "are having to have wait time before they can have this discourse" (line 191) because of the protocol that had been established for them.

Knowledge. Sue's explanation unearthed her understanding of the terms 'discourse' and 'wait time'. She used the terms discourse and argumentation interchangeably implying that she considered them both as being the same. Based on Nina's description of classroom experiences, Sue reasoned that students engaged in critically evaluating their peers' ideas and models during argumentation or discourse. Sue also suggested that wait time was not only a strategy to be used by the teacher to allow students to process information but also a strategy to be used by students as they engage in classroom discussion. Formalized discourse on wait time typically presents it as an instructional strategy that represented the period of silence immediately following an instructor's questions in teacher-led classroom discussions (Bass et al. 2009; Stahl 1990). Rowe (1972) who developed the concept also determined that when these periods of silence extended beyond three seconds then the length and accuracy of students' responses are increased (Stahl 1990; Tobin 1987). Inquiry based instruction promotes a paradigm shift in the nature of classroom discourse where students are also involved in questioning. Sue's suggestion to consider wait-time as a strategy to be used by students during argumentation, therefore, seems reasonable in light of the positive outcomes that have been documented in teachers' and students' behaviors and attitudes (Bass et al. 2009; Rowe 1972).

Author. Despite the new understandings articulated in her explanation, Sue demonstrated uncertainty when she indicated that she "may be wrong" (line 195). She also mentioned, "you all may have read into that something different" (line 195) suggesting distance between herself, an administrator, and the rest of team who were practitioners. Her response also enlarged the figurative elephant in the room. Did Erin

have a motive in asking her “what do you mean by discourse?” (lines 184-185)? Was she trying to expose Sue’s inexperience with the curriculum? Was Erin’s action a surreptitious attempt to humiliate and intimidate Sue? Was she silently supporting Nina who had made a similar attempt earlier during the conversation? No one contradicted Sue’s explanation about the connections she made between wait time, argumentation, and discourse. In fact, Nina concurred when she stated, “I kinda saw all [terms] as being part of the same” (line 197). Again, if Erin was attempting to humiliate or intimidate Sue, her effort was unsuccessful. Sue rebounded swiftly after she confessed ignorance of the meaning of the word ‘discourse’. In retrospect, her reaction “I don’t know” (line 187) may have been used as an instinctive phrase that individuals sometimes use when they have been ‘put on the spot’. Sue’s follow-up explanation clearly reflected her ideas regarding discourse and wait time, and these ideas were not ‘corrected’ or disputed by the practitioners in the PLC. If this were a test of Sue’s ability to engage practitioners in dialogue about the science classroom, she passed with flying colors.

Collaboration as a teaching strategy

Context/Knowledge. Erin started to document teachers’ ideas with the intent to select the best three for the consensus document. So far, Megan suggested students asking questions, and the use of evidence; Erin suggested the use of wait time; and Nina recommended argumentation. Although Sue theorized an association between wait time and argumentation, she did not advance an effective teaching strategy presumably because she was not implementing the IQWST curriculum at the time. Megan added that collaboration should be added as a practice, reporting that she was favorably evaluated on that element recently. She explained that one of her lower achieving students was working in a mixed ability group when she heard him use the

term 'molecular structure' during a lesson exploring various odors of different substance. Megan believed that the students heard the term from discussions within the group and gradually integrated it into his vocabulary. In this case, she argued that students while engaging in conversations among themselves during collaborative activity were able to learn the language associated with that particular unit. Again, Megan's suggestion reflected her understanding of an effective teaching practice as being linked to students' rather than teacher actions. As Megan provided evidence of student engagement as a result of collaborative activity, Nina interjected with what she identified as a modification of Megan's statement.

Knowledge. According to Nina, she wanted to "modify that [Megan's] statement" (line 205) to indicate that "collaboration should be listed as a teaching strategy" (line 206). Nina went on to describe changes in her practice as a direct result of implementing the IQWST curriculum.

210 Nina: And so I don't think it's that

211 collaboration is a good teaching strategy that is working but I think it's the
212 explicit instruction on how you work with others. I mean that's what I have
213 noticed...like I'm actually...I have noticed that I have given more specific
214 instructions on this is what I expect each member to do, and this is what I
215 expect the outcome to look like...

Nina's comment suggested a focus on teachers' rather than students' actions. She believed that direct instruction of collaboration as a teaching strategy "has changed collaboration in the classroom" (line 216). In other words, it is direct instruction and not collaboration that should be listed as a teaching strategy. Students, she implied, do not naturally collaborate with each other and as such have to be explicitly taught how to

work with others. This understanding was negotiated by connecting her previous classroom experience with changes she has had to institute as a result of the features of a new curriculum.

Megan tried to clarify the statement she had begun to make prior to Nina's interruption. She explained that the individual who evaluated the class she had previously described indicated a difference between collaboration and the use of cooperative learning groups. According to Megan, in cooperative learning groups "each [student] has a role, they are learning from each other" (lines 218-219). She was unable to complete what would have been her understanding of the difference between the two strategies because Nina interrupted her...again. Nina stated that the inquiry curriculum "forces us to rise to the occasion and teach" students how to collaborate with each other. This statement reiterated comments she had made earlier regarding the explicit instruction of collaboration. This statement also silenced Megan who was interrupted midsentence as she articulated an understanding of the difference between two terms that are often used interchangeably. Nina's interruptions may not have been a conscious or deliberate attempt to silence Megan, but there has been an emerging pattern in the timing of Nina's interjecting statements.

Politics. The first occurred while Megan was describing a lesson she demonstrated for teachers in another school district (lines 40-45) and Nina interrupted to commend her on the implementation of IQWST (lines 46-51). Next, Megan explained how students extended concepts beyond the curriculum because they were engaged in asking questions (lines 63-66) and Nina interrupted her to indicate that the prompt did not require these classroom experiences (lines 67-68). Megan also started to explain

her understanding of differences in strategies for teaching math versus science (lines 136-139) and Nina interrupted her to state that math instruction required evidence in higher grade levels (line 140). Megan started to explain that collaboration promoted the use of scientific language in one of her low achieving students (lines 199-204) and Nina interrupted to indicate that direct instruction is required for student collaboration (lines 205-216). Megan then tried to articulate an understanding of the difference between collaboration and cooperative learning (lines 217-219) and Nina interrupted to reiterate the need for direct instruction (lines 220-21). Again, although Nina's interruptions appeared deliberate, there was very little evidence from body language to indicate that these actions were anything but a power ploy aimed at preventing Megan from 'tooting her own horn'. Many of Megan's interrupted statements related exceptional student outcomes as a result of her teaching strategies, such as extending concepts beyond that required by the curriculum, using scientific terminologies beyond grade level, and asking higher order questions that reflect critical thinking skills. Perhaps the toot from Megan's horn appeared to be constant source of annoyance to Nina, who sometimes interrupted with a honk of her own.

Megan's understanding of the prompt, however, was that teachers were required to share why they thought that a specific teaching strategy was effective. Each time she suggested a strategy, she provided a classroom episode to support her claim that the practice indeed fostered student engagement. By presenting episodes of positive student outcomes in response to the prompt, Megan was misunderstood as being pretentious, boastful, and overbearing. Her actions, however, were based on her interpretation of the requirements of the prompt, and did not reek of malicious intent.

Nina's responding actions were based on a misinterpretation of Megan's motives. Unfortunately, these actions also hindered Megan's attempt to negotiate meaning through the articulation, and subsequent critical consideration of her understandings by peers. Potential learning opportunities were squandered when the other teachers were unable to hear pearls of wisdom from a colleague who had gained valuable experience after three years of implementing IQWST.

Knowledge. As teachers continued to share ideas, Sue suggested argumentation as an effective strategy. According to Sue, when students "are allowed to argue with each other" (lines 223-224) they get opportunities to modify their original claims. Erin responded with what appeared to be an objection to Sue's statement. She started her responding statement with the conjunction 'but'. Erin argued that while argumentation promoted student engagement, the science teaching practice is actually direct instruction on "how you do it [argumentation] and that's your debating...you are questioning the idea or the claim" (lines 229-230). In this statement, Erin outlined her understanding of what argumentation entails. She indicated that argumentation involved the critical examination of the claims or ideas of their peers, and that these skills have to be taught by the teacher. This view places the focus of effective teaching strategies on teacher actions rather than on student outcomes. Her interpretation blended with that of Nina who also suggested that direct instruction of collaboration be considered an effective teaching strategy as opposed to collaboration in and of itself. Megan and Sue had similar conceptions of what constitutes effective teaching strategies. They both perceived student outcomes as the focus rather than the teacher actions that generated such.

In presenting her rebuttal to Sue's statement, Erin began with a curious statement. She said, "if you remember, we actually studied the correct way to engage in a scientific argument as discourse" (lines 227-228). In prefacing her argument, she referred to understandings from a formal course that addressed argumentation as a part of classroom discourse. Earlier during the discussion, Sue spoke about wait time establishing "a protocol for the discourse" (line 188) as students engage in argumentation. Erin had asked Sue to explain the term 'discourse'. On the surface, it appeared that Erin was attempting to gain an understanding of a term she was not familiar with. Although I questioned her motive earlier in this composition, there was no clear evidence to suggest mischief. Erin's reference to the study of "scientific argument as discourse" suggested that she was fully aware of the idea of discourse as well as the association that can be made with argumentation. Erin, therefore, attempted to put Sue on the spot by asking her "what do you mean by discourse?" as part of an apparent plan to intimidate and humiliate her because of her lack of experience with the implementation of the IQWST curriculum. Nina had engaged Sue in a tit for tat earlier during the deliberations that exposed possible tensions between the two. During their exchange, it was also apparent that Nina was attempting to magnify Sue's inexperience with the curriculum. This inexperience was the figurative elephant in the room. Nina and Erin's social relationship has cemented their potential to influence the process of meaning negotiation among the teachers they collaborate with.

Politics. One cannot at this point ignore the power of the IQWST curriculum in effecting transformation in teacher practices. Teachers have shared various changes to instruction in order to align with discourses associated with the IQWST curriculum.

These discourses dominate in silence as teachers eschewed strategies they have used over the course of their career in favor of those imposed on them by this new curriculum. For instance, Nina indicated that the curriculum inspired her to explicitly teach students about collaboration in the science classroom (lines 207-216).

Additionally, Erin reported that she had increased her wait time to allow students effectively process information before responding with their ideas (lines 77-84). Megan also reported that she had been facilitating more student-led discourse as a result of requirements of the curriculum (lines 40-51). These teachers have modified their established teaching style in order to accommodate another way of teaching. They are doing this not necessarily in response to workshops, seminars, and explicit instructions from science teacher educators. Rather, they have transformed their practices in response to discourses associated with the inquiry curriculum and the favorable changes in student behavior they observed as a result.

Claims and evidence

Context. Erin attempted to get additional ideas from her peers, including Rob who had not contributed to the deliberations so far. Rob indicated that he was unable to “come up with anything else” (line 238), and that he believed all possible options were already discussed. Jessica, who also had not spoken since deliberations began, suggested that the group “make it [the ideas] into a claim and provide the evidence” (line 241). This statement implied that the ideas, as they were, did not adequately address the requirements of the prompt and as such have to be presented as claims. Jessica’s understanding of claims, as suggested by this statement, reflected a certain level of specialization with respect to how they are to be presented. According to the IQWST front matter (n.d), a claim is a statement of one’s understanding about a

phenomenon, and is often written as a complete sentence. Her suggestion, therefore, that the ideas be made into claims was associated with the meaning she negotiated from IQWST discourses as well as her own experiences teaching her students to write claims.

Knowledge. Erin proposed that they consolidate the ideas that are similar into “one grand thing” (line 244). As such, she suggested merging wait time, discourse, and argumentation into a single claim, and then considering peer evaluation or modification of ideas as the second claim. Although Sue agreed with the idea of using argumentation, she had a slightly different opinion of what should be selected as consensus ideas.

247 Sue: I almost feel like that could go with argumentation as well, so if we just
248 went for requiring evidence, and then structured argumentation and
249 discourse, and then explicit teaching of collaboration.

These three ideas were more representative of the group. Sue added that “modification of each other’s work could be the evidence for” (line 250) for one of the ideas. However, Nina interrupted before Sue had a chance to complete her statement. Nina’s interjection implied that Sue wanted the modification or peer statements to be used as a claim rather than evidence. She told Sue that she would have to support her choice of modification with evidence. Jessica, in support of Nina, chimed in by stating “but we have to show evidence of our claim” (line 254). Because Nina and Jessica addressed the need for evidence when Sue, in fact, stated that the “modification of each other’s work could be the evidence” (line 250), there is reason to conclude that their responses may have been directed to the individual rather than the idea itself.

Author. Since deliberations began, Sue had been struggling to gain credibility among teachers with varying levels of expertise in the implementation of the IQWST curriculum. She had so far been laughed at when she suggested that she was a science practitioner (line 161), and probed for a definition of a terminology that had repeatedly been used during formal courses (lines 184-185). As Sue boldly advanced her opinion of a consensus idea, and began to explain the required evidence for her claims, she was curtly interrupted with recommendations that were not applicable to the statements she made. In other words, she was asked to provide evidence for the evidence she provided. Had Nina and Jessica listened carefully to Sue before interrupting, they would have realized that Sue was actually providing the evidence they were urging or perhaps provoking her to provide. Sue was very persuasive in her response to calls for evidence.

255 Sue: And one of our evidence is that as a result...in the past in our
256 classrooms, it was not only unlikely but it was highly unlikely you were going
257 to get students much less a group of students that were capable of modifying
258 each other's work in a forward direction.

Sue was making a case for the use of peer modification of ideas as evidence to support the three claims she made earlier. If for some reason she suspected that she was being badgered, she did not demonstrate her awareness.

She initiated her argument by making a comparison between student behavior in the traditional classroom and the classroom transformed by the teaching practices she previously outlined. According to Sue, it is not the norm to have students actively involved in classroom discourse that resulted in the constructive evaluation of each other's ideas. Three teachers had indicated that this change in student behavior had been the most evident. Megan indicated that her students typically indicated that they

agreed or disagreed with each other (line 101). Erin said her students “fight over who’s getting up on the Elmo” (line 94) and Nina reported that her students were “using their own experiences and understandings” (lines 108-109) to modify the ideas of their peers. These classroom episodes supported Sue’s suggestion that changes in student behavior toward their peers’ ideas could be attributed to the teaching practices that have been employed in the science classroom. She continued to clarify and articulate her position.

260 Sue: We now have students that not only can engage in wait time
261 they can effectively argue, they can validate through discourse what their
262 thinking is, and where they’re moving then they can turn around, and actually
263 make modification to each other’s work in a way that is productive, and that
264 modification in itself shows our evidence for the effectiveness of those
265 strategies or those practices that they engaged in.

Although Sue was not implementing the IQWST curriculum, she used the classroom episodes described by her peers to compose a coherent and robust argument in support of modification as evidence for the strategies she proposed. In other words, she negotiated an understanding of the impact of the curriculum on student engagement from the experience of her peers.

Knowledge. A few of the other teachers appeared impressed enough with Sue’s comment to want to include it as part of the consensus document. Megan asked Jessica, who was making notes during the deliberations, if she wrote down any of what Sue had said. Jessica indicated that she wrote, “wait time leads to more scientific argumentation and discourse” (lines 267-268). This phrase represented Jessica’s understanding of Sue’s argument as well as her understanding that a claim must be

written in the form of a sentence. Curiously, Sue had not included wait time as an effective teaching strategy. In fact, Sue's had never referenced wait time as a teacher action but rather as an action to be demonstrated by students during argumentation. Jessica's summary, therefore, slightly misrepresented Sue's original argument in the process of reinterpretation for the consensus document. As teachers reinterpreted codified information and understandings of their peers, there were often slight distortions to the original account based on frame of reference used during the process of meaning negotiation. The inclusion of wait time in the phrasing of the claim rather than the evidence, as Sue proposed, may have revealed a preconceived notion on the part of Jessica that wait time should be presented as a claim rather than evidence. Nevertheless, the decision to include Sue's proposal in the consensus document represented a shift in the perceptions of those who may have doubted her credibility as a contributing member of this PLC.

The big ones

Context. As Jessica attempted to refine the claim she began to write about wait time, she questioned the unanimity of the choice. She asked, "is wait time our big thing?" (line 274). Erin, who had suggested wait time as an effective teaching strategy, revised her previous selection of wait time, discourse, and argumentation. This revision appeared to have been inspired by Sue's comments although Erin may have viewed modification of peers' claims as a claim rather than evidence.

278 Erin: I think scientific argumentation is a big one. I think collaboration is a big
279 one, and I think the modification

Sue had proposed argumentation, requiring evidence, and explicit teaching of collaboration (lines 247-249) as the three teaching strategies to be selected. Megan

demonstrated support for Sue’s proposal when she interrupted Erin to assert that modification be used as evidence rather than a claim. Megan also insisted, “the requiring of evidence (would) be another teaching strategy” (line 283), and that the rest of the ideas presented during the discussion be used as evidence. In other words, Megan suggested a consensus idea of argumentation and requiring of evidence as two effective teaching strategies that could be supported by students’ evaluation and modification of each other’s claims. This idea fulfilled the minimum requirement of the prompt, which instructed teachers to present two to three science teaching practices. Megan’s idea also reflected her view that the science teaching practices should align closely with the scientific practices associated with IQWST. Additionally, she shifted the focus of teaching strategy from the actions of students to those of the teachers when she insisted on “the requiring of evidence” (line 283) rather than “the use of evidence” (line 129).

Knowledge. Since the beginning of the deliberations, Megan had consistently held a position that focused on student outcomes a central to the choice of science teaching practices they were expected to select. As such, her ideas would often reflect changes in her students’ behavior rather than the teacher actions that had led to such changes. Her first suggestion was students asking questions, and then she added the use of evidence after negotiating the term science teaching practices as having to be aligned with the scientific practices promoted by IQWST. Her most recent idea was the requiring of evidence, which reflected a shift in the way she thought about teaching strategies. What prompted this shift? Was this an inadvertent slip of the tongue? Did she negotiate new meaning as the deliberations progressed? Based on Megan’s

recommendation (lines 283-286), the claim or teaching strategy was a teacher action, and the pieces of evidence she proposed were students' actions as a result of the teaching strategy.

283 Megan: And then the requiring of evidence would be another teaching
284 strategy, and our extra evidence for that would be they have gotten so good
285 at using evidence they can basically argue with each other...they are all
286 basically are evidence for each other.

This statement also endorsed argumentation as evidence rather than claim. The group so far had accepted scientific argumentation as a claim so Megan's recommendation also represented a deviation from consensus ideas. Erin attempted to clarify once and for all the consensus decision.

Although teachers have shared their ideas regarding effective science teaching practices, they were required to achieve consensus on the best two or three ideas. So far, three teachers have advanced different views as to what should constitute a consensus. Erin tried a different approach to the selection of the final two or three.

289 Erin: So are we saying that argumentation is definitely going to be one of
290 them?

291 ALL: Yes

292 Erin: Okay. Then we are saying that the requiring of evidence for claims is
293 going to be another one?

294 Nina: I think...I think it is

According to this exchange, argumentation was unanimously approved and Nina and Megan were the only two members who stated an approval of the requiring of evidence as an effective teaching strategy. It is not exactly clear why Erin presented only these

two ideas for group feedback. She had consistently endorsed argumentation (lines 244, 278, 289) while flip-flopping on collaboration and requiring evidence (lines 278, 292). She also shifted on a previous position, which supported explicit teaching of argumentation rather than argumentation itself as a teaching strategy. This position held teacher actions instead of student outcomes as the focus of teaching strategies, and was consistently backed by Nina and most recently Megan. However, Megan reacted to Erin's consensus suggestion in a manner that reflected inconsistencies with her own line of reasoning regarding effective teaching strategies.

Megan had previously declared the requiring of evidence (teacher action) and the resulting argumentation (student outcome) as claim and evidence respectively (lines 283-286). In an unusual twist of opinion, Megan announced argumentation and collaboration as claims, and a consolidation of the other ideas as evidence.

295 Megan: The way I see it is two claims...one argumentation...one
296 collaboration, and then we are gonna use the others to support...

There is a distinct possibility that Megan changed her recommendations in order to reflect the views of the group. So far, argumentation had been staunchly supported by all while the requiring of evidence received mixed reviews. Erin had selected collaboration as "a big one" (line 278) so Megan may have considered this as she modified her proposal. She also suggested that all other claims be consolidated into evidence in order to ensure that consensus ideas reflect the views of all. Although Megan attempted to ensure that the voices of all group members were heard, her action brought into question the method to the madness, which guided their selections.

It did not appear that the claims were systematically selected based on heuristics that could have served as a guide in the selection of the teacher strategies. For

instance, it was not clear in establishing the science teaching strategies, that teachers formulated a guide that defined teaching strategies as teacher actions or resulting student actions. As such, the ideas were unsystematic and arbitrary. There was no clear indication as to what teachers used to differentiate between effective teacher strategies and the evidence to suggest that the selected strategies were, in fact, effective. The deliberations so far revealed that teachers have not made a distinction between the two and as such perceived teaching strategies and evidence to support their effectiveness as one and the same. Megan, on several occasions, indicated that the ideas presented as effective teaching strategies be used as “evidence for each other” (lines 285-286) or “as a claim and evidence” (line 266). This suggestion was repeatedly endorsed by Erin, Jessica, Sue, and Nina who presented at different times the same idea to be used as both claims and evidence. For instance, Erin wanted modification of students’ ideas to be used as a claim (279) while Sue suggested that the same idea be used as evidence (lines 255-265). Additionally, Nina (lines 251-252) and Jessica (line 254) objected to the use of modification as evidence by implying that it was better presented as a claim. Teachers, therefore, have not adequately demonstrated a clear and common understanding as to what constitute claims and evidence for this particular activity. This ambiguity has so far hampered the process of meaning negotiation and could undoubtedly present additional challenges as teachers arrive at a consensus.

All under argumentation

Context/Knowledge. Megan offered a proposal that was being deliberated by her peers. She suggested using “two claims...one argumentation...one collaboration” (line 295) with requiring evidence as support for argumentation, and wait time “used as evidence for collaboration” (line 301). This was an effort to get a consensus that was

representative of all the views advanced during deliberations. In consideration of Megan's proposal, Rob opined that all the ideas forwarded during discussions were all connected to argumentation. Nina and Megan agreed.

308 Megan: Well that's true because collaboration fosters argumentation

309 Nina: That's what I am saying...everything supports everything else. Like we

310 could actually write our claim, and then use everything as its evidence.

Again, it became evident that teachers did not demonstrate awareness of the difference, if any, between claims and evidence. So far, they had switched ideas indiscriminately between both categories with no regard for pre-existing designations. Given that the group agreed to the interchangeability of ideas, Sue suggested a new approach to hasten the completion of a consensus document. Argumentation, which had gained increasing popularity as deliberation ensued, appeared to be a unanimous choice for a claim. According to Sue, because of the connection identified among the ideas, a single claim could include "two to three teaching practices" (line 316). There was a quick consensus among teachers, and Erin wrote a claim to reflect this. She spoke audibly as she documented "argumentation is a science teaching strategy that encourages and promotes scientific learning" (lines 320-321). Rob appeared to be at odds with the consensus idea.

Author/Knowledge. Rob did not address the entire group but rather whispered to Sue who was sitting next to him. He reiterated that all the ideas fit under argumentation but his statements reflected how he negotiated his understanding of argumentation.

322 Rob: Argumentation such as collaboration and discourse. You see what I'm

323 saying? They all fit under...

324 Nina: I don't think that collaboration is argumentation though...

325 Sue: Which practices?

326 Nina: You have argumentation within your collaborative groups but I don't

327 know that one is synonymous with the other.

328 Rob: The definition of argumentation, wasn't part of it agreeing and

328 disagreeing?

329 Nina: Yes

330 Rob: But collaboration means working together.

Rob had repeatedly stated that all the ideas including collaboration and discourse corresponded with argumentation (lines 305, 322-323). However, there is some indication that Rob believed collaboration and discourse to be examples of argumentation (line 322). Nina shared that while argumentation typically occurred within collaborative groups, she did not agree that "one is synonymous with the other" (line 327). Rob maintained that argumentation, which involved individuals "agreeing and disagreeing" (line 328), is the same as collaboration because of the element of group involvement.

Based on Rob's statement, he perceived argumentation as the umbrella term for individuals working in agreement and disagreement. When individuals are in agreement, they are collaborating but when they are disagreeing they are involved in discourse. Both cases reflecting agreeing and disagreeing are considered argumentation. It was not apparent whether or not Rob's ideas resonated with the others, neither was it clear if he had accepted Nina's view. There was also no indication that he negotiated an alternative to the understanding he cautiously expressed. Rob had not been very vocal during the deliberations. In fact, Erin prompted his first

utterance by asking if he had anything else to add to the pool of ideas presented (line 237). Did the other members of the group intimidate him? Did he feel uncomfortable stating his views to the females he was working with? Did he sense any tension brewing among members and chose to remain passive? Was his passive demeanor a result of dominance demonstrated by the females of the group? Would his behavior have been different if there was another male in the group? Despite his reasons for doing so, Rob allowed the outspoken members of the group to lead the deliberations, and this demonstrated a remarkable vote of confidence in their abilities to arrive at an acceptable consensus.

Rob's first utterance to the group began as a whisper to Sue. Nina, who heard his comments, responded to the group hence unwittingly drawing him into a public debate. At various times throughout the discussion, I observed Sue and Rob exchanging furtive glances, smirks, and nudges. These subtle actions established support for each other's ideas. Rob chose to reveal his understanding of argumentation to Sue rather than the entire group thus reflecting camaraderie between the two. It may have been this support from Sue that inspired him to declare his developing understanding of the concept argumentation. His perspective was radical, not accepted by all, and possibly rife with misconceptions. Nina shared her conceptions of argumentation but not with the intent to sway him. Rob did not argue with Nina despite her opposing view, he simply restated his position then discontinued his line of reasoning. Did Rob miss out on a learning opportunity because he did not want to start a conflict? Would prolonged exchange between himself and Nina have contributed to further reflection and subsequent modification of his ideas? Had Nina's conflicting

remarks created dissonance in Rob's thinking, and had Rob continued to pursue and express his line of reasoning, the outcome of the discussion would have been different. Perhaps Rob would have had the opportunity to critically reflect on his own understanding of argumentation in light of Nina's conflicting view resulting in the negotiation of new meanings.

Knowledge. The discussions continued despite the objection raised by Rob. Sue had already written a consensus claim based on the unanimous view that argumentation should "definitely be one of them" (lines 289-290). Erin was curious to know what she wrote.

340 Erin: What are you writing?

341 Sue: I was just writing argumentation is an effective teaching strategy that

342 leads to deeper scientific understanding and discussion. But I...

343 Megan: That sounds good

344 Nina: I like it

345 Erin: Yes

There was agreement among the main participants, Erin, Sue, Megan, and Nina. Rob and Jessica had not contributed much to the discussion so far, and did not indicate their view on the consensus claim written by Sue. Earlier during deliberations Jessica wrote, "wait time leads to more scientific argumentation and discourse" (lines 267-268). This was modified shortly after when Jessica conceded that wait time was not the main (line 274) idea generated from the discussion. Since then Erin had written "argumentation is a science teaching strategy that encourages and promotes scientific learning" (lines 320-321). Sue's claim was a slight modification of Erin's version, and highlighted "deeper scientific understanding and discussion" (line 342). This modification reflected

Sue's belief that argumentation not only promoted scientific learning but led to a deeper understanding of concepts. In other words, Sue's claim emphasized more favorable and profound consequences of argumentation that extended beyond mere scientific learning. This modification also indicated that teachers were engaged in the same scientific practices they were promoting among their own students. They were adding, modifying, and expanding each other's others claims in an effort to ensure that the claim represented the views of the entire group. In this case, Sue's version was accepted by the other power players in the group.

These three words

Context. The consensus claim "argumentation is an effective teaching strategy that leads to deeper scientific understanding and discussion" was approved by the group. Nina suggested two pieces of evidence she believed supported argumentation as an effective teaching strategy. First, students in an argument have to prove they are "right so they rely on evidence" (lines 349-350), and second, students "are able to modify each other's claims" (line 350). It is not very clear why the teachers decided on providing two pieces of evidence for a single claim. The prompt had specifically instructed teachers to identify two to three effective teaching practices, and to provide evidence in support of their claims. Did the teachers misinterpret the requirements of the prompt? Did they decide to accept Sue's proposal to include two to three teaching practices in a single claim (lines 315-316)? Did they also agree with Megan's and Nina's proposals to just use all the other ideas as evidence (lines 309-310)? Evidently, teachers have modified the prompt in a way that aligned with the circumstances of the deliberations. At this point, they have selected argumentation as a claim, and have

decided to use other ideas including requiring of evidence, and modification of ideas as support for their claim.

Knowledge. As teachers discussed the evidence, they reflected on three words they had been using since the beginning of the deliberation: add, modify, and expand. It appeared that Megan had coined these three words as a guide for her classroom discourse. Earlier during the discussion, Erin told Megan that she “liked the terminology that she [you] used” (line 177) to talk about her students’ approach to evaluating each other’s models or claims. Megan took credit for coining the three words: add, modify, and expand into a catchphrase as her peers considered including it in the consensus document. Nina suggested that the words “be coined” (line 353) while Sue encouraged Megan to “write the book with those three words now before someone else does” (lines 356-357). As teachers constructed knowledge in the PLC, they demonstrated an awareness of original ideas or catch phrases and seemed enthusiastic about receiving recognition for unique ideas. In this case, they endorsed a catch phrase coined by one of their peers, and expressed their intention to integrate it into their classroom discourse. Specifically, Erin asked her peers if they would be willing to “do the add, modify, and expand with both work-like models, and making-sense questions, and statements that they” (lines 360-361) contribute to the classroom discourse. She added, “so we do it with everything then?” (line 362). The entire group agreed.

The significance of this event lies in the fact that the teachers perceived one of their own to be responsible for constructing knowledge that they all made a pact to integrate into classroom discourse. This action allowed Megan to take credit for the coined phrase while cementing her peers’ support through assimilation into their

repertoire of strategies. Megan took ownership of the catchphrase, and she received accolades from her peers who believed that there was value to its use during classroom discourse. In further support of the catchphrase, Megan shared actual classroom episodes during which students are able to engage in constructive argumentation with being prompted with the question “would you like to add, modify, or expand?” She indicated that her students would typically state their agreement with each other, that they “would want to add” (line 366) or modify their peers thus extending classroom discussion beyond the allotted time. According to Megan, “it takes (like) forever to go through a lesson, but it’s good” (lines 369-370) practice for the students. By sharing actual classroom events, Megan provided evidence to support the effectiveness of the three words in generating constructive classroom discussions. She explained that students have been acculturated to the practice of expressing an agreement or disagreement with peers’ statement; adding, modifying, and expanding each other’s claims; and as such did not have to be prompted to initiate such discussions. Using the prompt, therefore, resulted in favorable student outcomes. Why then was this being considered as evidence rather than claim? Why are teachers unable to disambiguate claims and evidence? Does the ambiguity reflect weaknesses in their understanding of what constitute claims and evidence?

The teachers appeared to have decided on two pieces of evidence in support of argumentation as a teaching strategy. Nina suggested students’ use of evidence and the practice of adding, modifying, and expanding each other’s claims. Jessica had been making notes as the deliberations progressed. She wrote, “students rely on evidence to support their claims and that they are able to add, modify, and expand each other’s

work” (lines 373-374). Nina added that when students engage in argumentation they are given opportunities to “articulate their thinking better” (lines 377-378), which result in enhanced learning experiences. Megan also wanted to add to the growing conversation on argumentation, but as she began her statement, Nina suddenly burst out laughing. It was not immediately clear what prompted the laugh. She was not involved in a conversation with anyone neither was she reading from anything at the time. She simply erupted into a brief fit of laughter then turned to Erin and said “patience” (line 380). Erin responded with a smirk. Megan sensed the undercurrent, and requested permission to speak. To this Erin sarcastically responded, “yes, go for it Megan.” (line 382).

Politics. At various points during the deliberations, it became evident that Nina had intentionally interrupted Megan whenever she shared details regarding her students’ responses during certain classroom interactions. It also became evident that the camaraderie between Nina and Erin had contributed to the derision and sarcasm that impregnated the exchange described earlier. After taking credit for coining the catchphrase add-modify-expand, Megan shared classroom episodes that supported the effectiveness of such. As she spoke, she was interrupted first by Nina who laughed in the middle of Megan’s comments and stated, “right” and “great” (line 367), and then later by Erin who asked Jessica to share the “evidence so far” (line 372). The interjections followed a pattern, and up to this point the main perpetrator was Nina. It appeared that Nina became annoyed when Megan shared classroom episodes. In this particular case, she demonstrated her irritation by laughing derisively at the precise moment Megan began to share another classroom episode. Furthermore, the use of the word ‘patience’ in response to Megan’s actions suggested that Nina had perceived

herself as suppressing her annoyance in the face of unrelenting success stories generated from Megan's classroom. If Megan believed herself to be the subject of a private joke between Erin and Nina, she was not very quick to demonstrate this. Instead, she respectfully asked, "can I add?" (line 381). Erin, who appeared to demonstrate support for Nina's indiscretions, seamlessly resumed the derision with a laugh, and an invitation to "go for it" (line 382). They had already patiently endured seemingly endless accounts of students extending the lesson beyond the limit of the curriculum (lines 63-66), students asking multiple questions during student-centered classroom discourse (lines 40-45; 59-61), and students integrating complex science vocabulary into their conversations with other students (lines 199-204). Nina reassured Erin, when she told her to have patience (line 380), and that listening to another episode would certainly not hurt.

Knowledge. Erin gave Megan permission to add to the developing conversation on evidence in support of argumentation as an effective teaching strategy. Again, drawing from her own implementation experiences, Megan cited instances in her classroom where students were able to "correct and check their own understanding" (lines 383-384) during argumentation. In other words, the process of argumentation encourages students to critically evaluate each other's claims resulting in the identification, and subsequent clarification of emerging misconceptions. She also added that argumentation fostered independent thinking in students as they tweak their ideas in light of conflicting views of their peers. Megan's contribution bolstered the consensus claim "argumentation is an effective teaching strategy that leads to deeper scientific understanding and discussion" (lines 341-342). She provided substantive accounts of

students engaging in discussions that contributed to a deeper understanding of a given science concept. By sharing these descriptions of student engagement, Megan gave teachers an opportunity to consider alternative consequences of the scientific practice that won the overwhelming support of members in this PLC.

Pieces of one puzzle

Context. The teachers, so far, have decided on argumentation as “an effective teaching strategy that leads to deeper scientific understanding and discussion” (lines 341-342). As evidence to support their claim, teachers agreed that “students rely on evidence to support their claims and that they are able to add, modify, and expand each other’s work” (lines 373-374). Nina suggested that they move on to the next claim, which they had agreed was collaboration. Erin told the group that Sue had modified her understanding of collaboration as an effective teaching strategy, and invited her to share her new ideas with the group. According to Erin, while the rest of the group was attempting to synthesize the first claim and evidence, Sue confirmed her belief that collaboration is a huge part of argumentation.

402 Sue: You can’t have argumentation without collaboration.

403 You can’t really have discourse without argumentation and collaboration that
404 is effective.

This modified understanding appeared to have been shaped by Rob’s conceptions of collaboration. Rob previously indicated that “argumentation such as collaboration and discourse” (line 322) all fit under the same category. This view was contradicted by Nina who informed him that while it was possible to “have argumentation within (your) collaborative groups but” she was unsure “that one is synonymous with the other” (lines 326-327). Although Rob decided not to pursue his line of reasoning with Nina, he

engaged Sue in follow-up conversations that evidently led to a revision in Sue's original ideas regarding argumentation.

Knowledge. Initially, Sue perceived argumentation and discourse as being the same, and as such used the terms interchangeably as she spoke about establishing protocols for classroom discussions (lines 104-107; 187-193). Subsequently, she identified three distinct teaching strategies for the consensus claims including requiring evidence, structured argumentation and discourse, and explicit teaching of collaboration. Sue renegotiated her understanding of the connections among these strategies after speaking with Rob, who had radical views regarding collaboration and discourse. Based on Rob's comment that collaboration and discourse are types of argumentation (line 322), Sue modified her ideas to reflect an inextricable relationship among the three terms. In support of Rob, Sue presented a slightly different case to the group for approval. She also shared new perspectives on argumentation and its purpose in the science classroom.

According to Sue, discourse, argumentation, and collaboration are all pieces of one big puzzle. When students develop effective communication skills, "they can walk out of the classroom and they can apply those skills just about anywhere" (lines 406-407). From Sue's perspective, argumentation is "a way of drawing out information out of other people" (line 408), and fosters dialogue among students who may be "uncomfortable asking questions" (line 409) or otherwise contributing to discussions. Rather than demonstrating an inextricable link among the three terms, Sue provided additional justification for integrating argumentation into science classroom discussions. Despite this, she concluded her case by saying, "and this is just me...I see all of that as

pieces of one puzzle” (lines 412-413). This concluding statement suggested that her main argument integrated discourse, argumentation, and collaboration into one category. Curiously, she stated, “this is just me” (line 412) suggesting that this new perspective was a result of her own reasoning rather than in collaboration with another individual. It was not very clear why Sue specifically indicated that her argument did not reflect the views of anyone else. As a matter of fact, this new perspective clearly mirrored the idea Rob had cautiously advanced previously as a whisper to Sue. This idea bungled collaboration and discourse under argumentation, and was immediately rejected by Nina, who had drawn Rob unwittingly into open discussion with the group. In response, Rob had discontinued his line of reasoning, choosing instead to privately plead his case with Sue. The whispering exchanges, the nudges, and the glances between the two yielded some success because Rob’s argument was repackaged and re-introduced to the group as Sue’s point of view.

Author. Perhaps Rob was intimidated by the dominating voices of Megan, Erin, Sue, and Nina who had been directing the course of the deliberation since it began. He had not voluntarily contributed to the discussion neither did he offer to play a passive role such as scribe or timekeeper. Why has he been so quiet? Was this voluntary? Was he coerced? Did he have nothing to contribute? Was he afraid that the others would disagree with his views? Despite his reasons for remaining silent, Rob decided that his voice would still be heard. To achieve this, he developed a strategic partnership between himself and Sue that would ensure that his views were articulated. Sue may not have had the implementation experience that Rob had, but she was very good at using talking points to whip up a strong argument. What Sue lacked in classroom

experience, she made up for with her convincing eloquence and confidence. Rob attempted to change the trajectory of the discussion using Sue's voice to express his ideas. This was a clear yet subtle power strategy used by the lone gentleman in the group, who appeared to have lacked the courage to take a stand on an issue he firmly embraced. Sue allowed herself to be inveigled into a scheme that required her to speak on behalf of Rob whose views on argumentation did not reflect her own original ideas. Sue may have very well changed her initial views or she may have simply thrown out a game-changer just to see its influence on her peers' understanding of argumentation.

A claim for collaboration

Politics. Nina was having none of it. She was very clear in the articulation of her idea of collaboration as a teaching strategy that she was referring to "the explicit instruction of how to be a collaborative member" (lines 416-4417) rather than "the use of collaboration itself" (line 418). In response to Sue's position that argumentation, collaboration, and discourse are "pieces of one puzzle" (line 413), Nina stated her agreement as well as her point of contention.

414 Nina: I agree with you, I think it's all pieces of the same puzzle but...I throw
415 in my but. I think that and maybe I misunderstood...but the collaboration
416 portion was not so much the use of collaboration but the explicit instruction
417 of how to be a collaborative member.

Sue's rebuttal had a hint of sarcasm that was not lost on Nina.

419 Sue: And that would separate it a little bit because obviously they would
420 have to learn argumentation also...

421 Nina: (shouting) They are a part...I mean no...I really agree that they are all
422 or part of the same thing...they are all part of the same pie but the teaching

423 strategy would be how are you teaching them...you are teaching students

423 how to argue

Nina raised her voice, perhaps, out of exasperation as her valid argument was met by an equally valid assertion.

The sarcasm in Sue's response was carefully veiled because there was nothing unusual about her tone. However, she acknowledged that viewing collaboration as teacher strategy rather than student outcome would "separate it [from argumentation] a bit" (line 419), but that the same case could be made for argumentation. Sue perceived Nina's preferential consideration of collaboration as an instructional strategy as a deliberate attempt to contradict the view that collaboration and argumentation are "pieces of the same puzzle" (line 413). In other words since both activities, depending on how they are conceptualized, can be categorized both as teacher strategies and student outcomes, the contradiction appeared deliberate and personal. Sue indicated that students "obviously had to learn argumentation also" (lines 419-420) thus questioning the legitimacy of Nina's contradiction. Nina's point of contention as evidenced by her statement, "I throw in my but" (line 414) fell flat in light of Sue's rebuttal, and this evidently infuriated Nina. Nina shouted her response to Sue but this response conceded that argumentation, like collaboration could be perceived as a teacher strategy.

Knowledge. For the first time since the discussion started, a working definition for 'teaching strategy' was articulated. Nina indicated in her exasperated response to Sue that "the teaching strategy would be how you are teaching them" (lines 422-423). Yet, the consensus claim regarding effective teaching strategies so far reflect otherwise. The group has largely accepted argumentation as a process carried out by students.

For instance, Nina indicated that argumentation allowed her students to support their claims with evidence, as well as encouraged them to “review, edit, and modify each other” (line 91) during classroom discussions. Additionally, Sue suggested that the process of argumentation allowed students to “argue with each other and modify their answer” (lines 223-224). Nina’s working definition of teaching strategy represented contradictory shifts in her understanding of the term. In other words, she suggested explicit instruction on collaboration as a teaching strategy based on her understanding that teacher action is a pre-requisite for this categorization. However, she endorsed argumentation as a teacher strategy while acknowledging that the process is student-centered. It is not clear at this juncture if she was aware of the contradiction in her understanding but she admitted in her response to Sue that students do need explicit instruction on how to engage in argumentation.

In support of her claim that teaching “students explicitly how to work collaboratively” (lines 425-426) is an effective instructional strategy, Nina provided evidence from her own classroom.

431 Nina: And I would say good evidence in my room for the explicit instruction
432 on how to be a collaborative group is the lack of time wasted during labs, the
433 lack of arguing during labs. Right, the students are able to get along and
434 communicate with each other without even any kind of tips...ahm...the ease
435 with which students are able to go on to one stage of an activity to the next
436 stage of the activity, and then the fact that they seamlessly move into the
436 argumentation portion of the...okay at the end of the lab, what did we learn?
437 What have we got here? How does this relate to this? They could just kinda
438 jumped into that without a lot of...ahm...hands-on guidance from me...

439 means that they are being successful with those collaborative techniques. This comprehensive report of classroom success not only provided overwhelming support for Nina's claim but also actual student outcomes as a result of the strategy she presented. Her experiences demonstrated that when students are taught how to work together as a team, they are more efficient in carrying out required activities and student interactions are more productive. This facilitated implementation of activities during labs and other classroom-based lesson. The reporting of classroom experiences also allowed Nina to reflect on her actions as a practitioner while evaluating the impact of direct instruction on student behavior. According to her assessment, the fact that students are able to carry out laboratory procedures, engage in argumentation, and interact positively with each other suggested that the collaborative techniques were successful.

Politics. The practical experiences related by Nina will likely inspire other teachers to experiment with effective strategies in their own classrooms. It was unfortunate, therefore, that on the occasions Megan attempted to share, Nina repeatedly interrupted these classroom accounts effectively silencing her over the course of the deliberation. Nina's report was uninterrupted, and this implied that teachers were genuinely interested in hearing about her experiences. By granting Nina her full turn at talk, the group members demonstrated interest in the content of her speech, and respect to the speaker as a contributor to the ongoing discourse. Nina, and to a lesser extent Erin, did not grant Megan similar respect as she shared her experiences, which were a bit more extensive by virtue of two additional years of involvement with the IQWST curriculum. Despite this, Megan continued to contribute positive to the conversation. If she perceived Nina and Erin's actions as disrespectful,

she did not demonstrate this awareness neither did she overtly attempt to retaliate. Megan's action or inaction in response to perceptible indications of this disregard facilitated the continuation of meaning negotiated without the additional and unnecessary display of power strategies.

Knowledge. Nina provided evidence from her own classroom in support of direct instruction of collaboration. She emphasized that the "collaboration portion was not so much the use of collaboration but the explicit instruction of how to be a collaborative member" (lines 416-417). After Nina shared this evidence, Megan stated a need for "a claim for collaboration" (line 440). Sue agreed, and both Jessica and Megan articulated claims for consensus.

445 Jessica: The claim is that explicit instruction on collaboration improves the
446 depth of science learning.

447 Megan: I have true collaboration is an effective practice that facilitates
448 engagement and deeper learning...something like that.

449 All: Works well...fine...okay.

The group accepted both claims but it important to point out that the claims represented two contrasting understandings of what constitute a science teaching strategy. Jessica's claim reinforced the view that a teaching strategy is an approach employed during instruction to ensure specific student outcomes. It suggested an emphasis on the teacher action rather than the student outcomes. According to Jessica's claim, when teachers provide explicit instruction on collaboration, students benefit by experiencing more meaningful learning.

Megan, who earlier suggested the need for a claim in support of the evidence Nina shared, also wrote a claim. Her claim made no reference to instruction but rather

to collaboration as an effective practice. This claim reinforced the view that Megan has held from the beginning of the deliberation. Megan's understanding of effective teaching strategy centered on student outcomes rather than teacher actions. She believed that the prompt required a consensus on science practices, which emphasized expected student outcomes. In wording her phrase, she was careful not to include any reference to instruction or to an improvement or enhancement of a specified student outcome. She also qualified collaboration with the word 'true'. Could it be that she perceived the possibility of collaboration being superficial? Did she believe that there are certain features required for collaboration to be effective or genuine? In any case, her claim did not reflect Nina's notion of explicit instruction and perceived collaboration as centered on the students not the teachers.

Despite the glaring difference between both claims, the group accepted them both. In other words, the group's consensus on collaboration as a teaching strategy consisted of two contradictory claims. It was not evident that anyone identified the difference between the two claims because all members accepted them both without questions or comments. The significance of this pseudo-consensus lies in the different meanings teachers negotiated with respect to collaboration and how this is demonstrated in the science classroom. Collaboration is traditionally viewed as an activity carried out by students in the science classroom. Nina's unique take on designing instruction about collaboration was overtly accepted by the members of the PLC. However, Megan's claim suggested that while she may have verbally indicated her agreement, she had not changed her conceptions regarding the subject. This is not uncommon in social interactions. Very often individuals resist views without even being

aware that the meanings they negotiated are not the same as those collectively negotiated by the group. In this case, Megan had been consistent regarding her view that effective teacher strategies are characterized by student outcomes. As such the meaning she negotiated reflected this view. She was so entrenched in this belief that she is unable to perceive the contradictions presented in the other claim Jessica presented.

On the other hand, Nina has been inconsistent regarding her views of what constitute a teaching practice. She stated that a teaching practice should reflect how students are being taught rather than the activities students are engaged in. However, the two claims she endorsed were contradictory in that regard. For instance, the argumentation claim she endorsed was, by her own admission, an activity that students are engaged in during classroom discourse (lines 95-100). For the second claim she insisted that it was not collaboration as a student activity that is a teaching strategy, but rather the explicit teaching of collaboration (lines 414-418). This, she maintained, aligned with her view that the “teaching strategy would be how you are teaching them” (lines 422-423). Again, this view was not reflected in her choice of argumentation for the first claim. This questions whether or not the meanings Nina negotiated reflected misconceptions, misunderstandings, or mistakes. That no one acknowledged the inconsistencies, presented another cause for concern.

What it should look like

Context/Knowledge. After the group achieved consensus on the minimum of two effective science teaching practices, they moved on to the third part of the required prompt. The teachers were instructed to “brainstorm ways to help other teachers understand and adopt these practices” (lines 453-454). Sue took the initiative to

address this prompt on behalf of the group in the interest of time. Her proposal reflected a strong stance towards the practical solutions that demonstrate to teachers what the practices are “going to look like” (line 461). She began by acknowledging that teachers would likely resist the adoption of new practices. However, she indicated that if “questions that engage students in argumentation, collaboration and discourse” (lines 457-458) were modeled for the teachers, they would be more likely to embrace new practices. She suggested that modeling could be achieved “either IRL...in real life, real time or through videos” (lines 458-459), adding that the visual effect of videos could be a powerful tool in engendering change in resistant teachers. She also proposed team teaching as a means to “scaffold teacher release into the practices” (line 463). According to Sue, “a teacher may have the book knowledge of how it’s supposed to work [but] the reality of the classroom” (lines 464-465) would likely present enactment challenges. Team teaching, she believed, would provide teachers with the opportunity to become comfortable with the new teaching strategies in their own science classrooms.

Author/Knowledge. Sue’s proposal revealed that despite Nina’s comprehensive explanation regarding the “explicit instruction of how to be a collaborative member as opposed to the use of collaboration itself” (lines 417-418), she was still very much fixated on her initial idea of argumentation, collaboration, and discourse being “pieces of one puzzle” (line 413). Although Nina had agreed that they are all similar, she had pointed out that collaboration was being used in a slightly different context. Sue appeared to have agreed with Nina when she responded by saying “that makes a lot of sense” (line 427) because “the teachers have to be taught the collaboration” (line 428)

in order to be able to adapt new skills to their own classroom. However, her proposal for helping other teachers reflected the demonstration of strategies that “engage students in argumentation, collaboration, and discourse” (lines 457-458). In sum, Sue had not modified the original meaning she negotiated regarding this subject despite agreeing with a contrasting point of view.

Sue’s proposal also revealed a strong stance toward “a gradual release model for teachers” (line 469). Her rich experience working with an educational support agency provided her with a perspective geared more towards learning and development in teachers rather than students. For instance, when Nina spoke about explicit instruction of collaboration to students, Sue made sense of this idea by relating this explicit instruction to teachers who would then have to “take that back to the classroom” (line 429). Additionally, when Erin suggested “wait time and argumentation” (line 102), Sue interpreted these through the lens of teacher professional development. She viewed the process as teachers “establishing a protocol for the students” (line 104) for classroom discourse. In other words, Sue’s frame of reference was more associated with providing support for teachers rather than with actual classroom experiences with students. This was due to her professional background as an administrator rather than a practitioner. With regard to teacher development, Sue was a huge supporter of modeling the strategies to demonstrate to teachers what “it’s going to look like” (line 461).

Nina added her own perspectives to Sue’s proposal. She used her personal experiences as a learner to frame her response. Nina shared what she had learned from a “fantastic book” (line 473) about “discourse in the classroom” (line 474). According to Nina, this book provided “very explicit instructions to teacher on how to

explicitly teach the students how to wait for one person to stop talking, (and) how to preface an argument” (lines 476-477). She mentioned that despite her previous studies “on discussion and discourse in the classroom” (lines 470-471), it was not until she had read this book that she was able “to get the ideas of discourse together” (line 472). Her experiences with eight-graders taught her that “they have no clue” (line 480) how to “communicate with each other” (line 475) in the science classroom and as such they have to be instructed by the teacher. As far as helping other teachers was concerned, Nina thought that it “would be important to them to say this is what it should look like and this is why it is effective” (lines 481-482). Nina’s proposal reflected codified knowledge she had constructed both as a pre-service and in-service teacher. She used her learning experience to shape her ideas for helping teachers adopt effective teaching practices. According to Nina, telling the teachers what the strategies are, what they should look like, and why they are effective is one possible approach to sharing with other science teachers.

Sue objected to Nina’s suggestion to tell teachers what the strategies should look like. It was evident from her proposal that Sue was a strong proponent of modeling strategies rather than telling teachers about them. Her objection was reflected in the following exchange.

484 Sue: You have to be careful with... ‘this is what it should look like’ because

485 I mean...all of you have been in training where you are going...

486 Nina: Well I’m saying let’s not do that...

487 Sue: I know but I am saying that you have been in training where you are

488 going ‘oh my God...those aren’t my kids...they don’t know my kids

489 Nina: Yea right, don’t tell me what it’s supposed to look like...tell me how to

490 get from here to here...give me a roadmap.

491 Sue: That's why that's a whole lot more effective when you can either show

492 them something that looks like where they are coming from you know...I

493 hate perfect classes and videos because you know that's not how it is.

This exchange was significant for three main reasons. First, it revealed contradictions in Nina's proposal as she defended her argument in light of Sue's objections. Second, it reflected two perspectives of teacher professional development that shaped Nina and Sue's understanding of how best to help teachers adopt new practices. Third, it implied that Nina did not apply lessons learned from her "fantastic book" (line 473) regarding group communication to her own interactions within this PLC.

Sue objected to Nina's suggestion to tell teachers "this is what it should look like" (line 482) because difference in classroom cultures may require slight adjustment in implementation techniques. According to Sue, presenting ideal situations with "perfect classes and videos" (lines 492-493) is not helpful to teachers because all classrooms are not the same. In response to this objection, Nina explained that she was proposing that they "not do that" (line 486). In other words, she recommended that teachers be told "what [the strategies] should look like" (line 482) and "why [they are] effective" (line 482) but flip flopped after Sue's objection to say "don't tell [the teachers] what it is supposed to look like" (line 489). This contradiction was not imagined. Did Nina misspeak when she made her first statement about telling teachers what effective strategies should look like? Did she flip flop because she was unable to invalidate Sue's objection? Was she afraid of appearing misinformed? If Sue did not object, would she have adjusted her statement? If she had a reasonable rebuttal, would she have resisted the objection? Why did she capitulate? Since the start of the deliberations, Nina had

confidently stated her position on various issues that have emerged. The type A personality she admitted to during earlier interactions would dictate a propensity to always be 'right'. Certainly, shifting positions to gain favorable group response would qualify as a strategy to maintain credibility in the PLC.

In articulating their ideas for helping teachers adopt new practices, there was sharp divergence in Sue and Nina's perspectives on teacher development. Sue strongly advocated for a "gradual release model" (line 469) in which the desired practiced is modeled for the teachers over time until they feel confident enough to implement strategies on their own. According to Sue, it is "a whole lot more effective when you can show them" (line 491) and have them practice strategies with their own students so they can make adjustments during the training period. In other words, rather than undergoing training "where (teachers) are going oh my God, those are not my kids...they don't know my kids", teachers would be provided with "team teaching" (line 466) until they are "really comfortable" (line 469). Nina's perspective reflected a learning by reading "a fantastic book" (line 473) approach that is supported by a telling them "this is what it should look like and this is why it is effective" (line 482) technique. This reflects Nina's strong stance on direct instruction as an effective strategy. Not only did she advocate for the direct instruction of collaboration to science students as an effective teaching strategy, she also proposed direct instruction of this strategy to the science teachers. Nina's preferred learning technique would be "tell me how to get from here to here...give me a roadmap" (lines 489-490). According to Nina, providing teachers with a set of guidelines, instructions or explanations as to how to achieve a desired goal would be highly effective in changing teacher practice in the science classroom.

Politics. I found it interesting that Nina mentioned that her “fantastic book” (line 473) taught her “how to wait for one person to stop talking” (line 477). Her tendency to interrupt other individuals in midsentence reflected that she had not been able to adapt her own communication strategies to align with what she claimed to have read. This contradiction between what she teaches and what she practices as an individual brought into question Nina’ adherence to the strategy she firmly supports. It appeared that Nina had not completely bought into the idea of waiting for others to stop talking before responding. When teachers fail to buy into certain ideas, they do not integrate them into their everyday practices. This contribute to the issue of teacher resistance alluded to by Sue earlier during deliberations. If Nina had indeed bought into the communication strategies she read about, her repeated interruption of Megan may simply have been a power strategy to reflect her annoyance with the reports of classroom success. This strategy potentially silences speakers whose thoughts and ideas are rudely suspended in a move that demonstrate disregard and disrespect.

Consensus claims and evidence

Context. The three prompts had been addressed during group discussions, and Erin was concerned about the documentation of consensus ideas. Megan and Jessica had been writing down ideas so the rest of the group was depending on them to articulate consensus claims and evidence for final approval. Erin asked Jessica to read her notes to the group.

511 Jessica: Argumentation is a teaching strategy that leads to deeper scientific
512 understanding and discussion. Evidence...students rely on evidence to
513 support their claims. Students add, modify, and expand each other’s work
514 and correct their own misconceptions. Second one...true collaboration is an

515 effective teaching strategy that facilitates engagement and deeper learning.

516 Evidence...smoothness of labs, questions and discussions among students

517 while in their labs, and students taking roles in activities.

Despite Nina's insistence that "the collaboration portion was not so much the use of collaboration but the explicit instruction of how to be a collaborative member" (lines 415-416), the consensus document reflected otherwise. No one objected to what was read. Did they not perceive the misrepresentation of ideas? Were they just really more focused on ending the discussion rather than clarifying these ideas? Why did Nina not object? Earlier during discussions, the group accepted two conflicting claims. Jessica's claim included "the explicit instruction on collaboration" (line 445), which better reflected Nina's views. Megan's claim, which was selected for the consensus document, referred to true collaboration as a teaching strategy. The consensus document, therefore, did not accurately reflect the ideas agreed upon during meaning negotiation.

Author. Sue initiated consensus ideas for the third part of the prompt. She seemed to be invested in this question especially since she had single-handedly conceived the ideas expressed in response. Despite Sue's extensive and comprehensive proposal involving the use of "a gradual release model for teachers" (line 469), the teachers emerged with a consensus idea that appeared to disregard much of the initial proposal. In response to the prompt to "brainstorm ways to help other teachers understand and adopt these practices" (lines 453-454), the group agreed to write "videos of research in action" (line 532). Not only did this misrepresent Sue's ideas, it questions the group's understanding of what constitutes research in action. Sue did, in fact, mention the use of videos to model or demonstrate "questions that engage students in argumentation, collaboration, and discourse" (lines 457-458). She also

suggested team teaching, and “collaborative planning and support for teachers who are willing to adopt these practices” (lines 460-461). Evidently, the group translated Sue’s ideas to mean “videos of research in action” (line 532) although the views expressed did not explicitly reflect this.

Curiously, Sue did not object to the meaning the group negotiated based on her comments. Was that signaling an agreement with the group’s understanding of her ideas? Was she simply exhausted by all the back and forth? Did she actually believe that her views were summed up in the phrase ‘research in action’? It is possible that Sue was not aware of the meaning of the term and trusted her practitioner colleagues’ representation of her ideas. She embraced the phrase because of its impressive overtone, and the enthusiasm with which the group members received it. In the end, the teachers achieved consensus on the required prompts, although there were questions regarding their own understanding of the ideas agreed on during deliberations.

Summarizing the Interaction

During this interaction, teachers were required to arrive at a consensus regarding effective science teaching practices, and to provide justification for their claims. The teachers shared instructional strategies that they believed to have been effective in engendering student engagement in their own science classrooms. In so doing, some teachers identified weaknesses in their practice and discussed how the IQWST curriculum was guiding improvements to their instruction. Additionally, certain misconceptions about curriculum and instruction were surfaced as teachers shared their developing conceptions on scientific practices, such as argumentation and questioning. Not all teachers contributed equally to the discussion, which was dominated by four of

the six teachers in the PLC. Nevertheless, a consensus was reached that met the approval of the participants.

Through the lens of Foucault's theory of power. In an attempt to stimulate reflection on practice, professional development facilitators designed an activity requiring the science teachers to arrive at a consensus regarding effective science teaching practices. This activity prompted teachers to share personal teaching episodes that resulted in critical examination of practice, and encouraged a discussion on various ways to take action within the specific context of the IQWST curriculum. The series of actions resulting from the activity also allowed teachers to revisit prior understandings of science instruction based on knowledge constructed by experts in the field of science education. Some of the participants were more vocal than others in sharing their understanding of the curriculum, and as such were more actively involved in decision-making. Nevertheless, a consensus was reached that met the approval of all the participants in the PLC.

Through the lens of constructivism. The science teachers were required to collectively negotiate an understanding of effective science teaching practices as defined by the IQWST curriculum. During the interaction, teachers engaged in discussion and reflection as they attempted to make connections between their experiences and the information provided by IQWST developers. During this dialogic process, some teachers experienced cognitive dissonance as ideas were shared, which prompted them to restructure ideas based on the experiences of others. All the teachers did not contribute equally to the discourse, but the ideas generated were verified by the group, and eventually accepted within the learning community as valid interpretations of

effective teaching strategies. The group, therefore, arrived at a consensus that was approved by the group.

Through the lens of Self. The teachers were expected to arrive at a consensus regarding effective science teaching practices. They were also expected to justify their claims. The discussion was dominated by four of the six teachers in the PLC. These four teachers seem to be competing for talk time because they kept interrupting each other in order to make their voices heard. Some people are naturally talkative but during group interactions I think there ought to be some self-restraint in order to ensure that all participants are provided with opportunities to contribute to the conversation. Then again, some persons are more knowledgeable about the content area and as such will have more to contribute than others. Who determines what degree of expertise qualifies an individual to dominate the dialogue? How can individuals with known expertise in a given area share their knowledge and abilities without marginalizing the others? How can PLC members ensure that colleagues who are less knowledgeable about a given subject feel valued as part of the group? Despite the inequality of talk time, some teachers were able to share specific teaching experiences during which their students were particularly engaged. As they shared their experiences, some teachers admitted that they needed to improve certain aspects of their practice. Two of the teachers did not share teaching episodes nor talk about any weaknesses in their practice. Did they feel intimidated by the more vocal members of the group? Were there steps that could have been taken to include them in the discussion? Did they miss out on learning opportunities by choosing to remain silent? In any case, when the consensus ideas were finalized, they did not express any objections to the document prepared.

Chapter seven. Chapter 7 further analyzes the reconstructions provided in chapters four and five in order to provide explicit answers to the research questions. Both interactions addressed knowledge construction and the exercise of power in the PLCs. However, the first interaction presented in Chapter 5 provided more instances to substantiate the claims made in response to the issue of how power is exercised within the PLC. Likewise, the second interaction was frequently used to instantiate claims addressing meaning negotiation and knowledge construction in the PLC studied. In Chapter 7 the main research question and sub-questions are individually addressed using examples from both interactions to support claims made about the PLC under study. Additionally, literature cited in the Chapters 2 and 3 of this composition will be referenced in order to further bolster my argument, and to position my findings within the context of related research in the area.

CHAPTER 7
SYNTHESIS OF FINDINGS AND CONCLUSIONS: SHARING THE GOLD

Response to Research Questions

One of the most basic requirements of empirical research is that researchers address the line of inquiry or the claims made prior to beginning the process of discovery. My research questions have been the primary focus of the analysis and subsequent interpretation of my data. These data were analyzed using tools inspired by Gee (2011) and Foucault (1972), and interpreted through the lenses of constructivism, Foucault's theories of power/knowledge, and Self. These methodological processes yielded gold as I approached the Rainbow's end, but how do I share this gold with those who were not a part of this meticulous undertaking? How do I help readers make sense of the deconstructions and reconstructions that may have overwhelmed them in the preceding chapters? How do I help them see that my laborious journey through the torrent of science education literature, and the scorch of illuminating theories has yielded valuable knowledge that contributes to, and expands on past work in the field?

In writing Chapter 7, I scoured both Chapters 5 and 6 for specific episodes within the interactions that related to the research questions. Although the relationships were made explicit in the reconstructions presented in Chapters 5 and 6, consolidating them in a single chapter will likely concentrate the sporadic glitters of gold into an intense radiance aimed at illuminating any possible obscurity surrounding my research questions. My inquiry was guided by the following question and sub-questions:

- 1 How can professional learning communities (PLCs) operate as a site for learning and development of middle school science teachers in the process of implementing an inquiry curriculum?
 - a) How do middle school science teachers negotiate meaning and construct knowledge about their practice during interactions within a PLC?

- b) How does the exercise of power influence the process and outcome of consensus making among middle school science teachers within the PLC?

In this chapter, I will explicitly address each question while referring to literature reviewed in chapter two that either supports or contradicts my findings. In so doing, I am acknowledging the reflexive stance assumed for this inquiry, which requires truth claims from the process to be positioned as one form of knowledge among other possible forms. In referencing other truth claims, I am also embracing the perspective of others despite the cultural specificity of my findings. According to Thayer-Bacon (2003), this qualified relativism compensates for “cultural embeddedness” (p.418) associated with research of this nature. In addressing these questions, I will begin with the sub-questions, which were deliberately crafted to indirectly address the main question exploring the opportunities provided for teacher learning and development for PLCs. First, I will examine the activities within the PLCs observed in order to determine how middle school science teachers negotiated their understanding of the IQWST curriculum. Next, I will explore how the exercise of power influenced consensus making in PLC. The main research question will be addressed in the final section.

Negotiating Meaning Within PLCs

The activities within the PLCs under study were designed to ensure that science teachers develop a better understanding of the IQWST curriculum. During each of the interactions observed, teachers were provided with structured activities to facilitate their understanding. The two structured activities included 1) observing a teaching episode in order to identify discourse types, and redesigning the instruction in a way that conforms to the vision of the IQWST curriculum; and 2) arriving at consensus regarding effective science teaching practices and providing evidence for their claims. This section outlines

some of the processes employed by science teachers as they negotiated an understanding of the IQWST curriculum. In other words, how did these activities contribute to teachers' understanding of their role as science instructors? How did they come to terms with their responsibilities in facilitating student learning? How did they make sense of their experiences learning about and implementing IQWST? How did teachers arrive at consensus in light of conflicting views emerging from interactions? How did the cognitive dissonance they experienced contribute to new understandings about IQWST? What cognitive processes were spawned as a result of the structured activities provided for middle school science teachers within the PLC? From the findings, I identified seven related and often overlapping processes that contributed to the negotiation of the science teachers' understanding of IQWST. These include recounting teaching episodes, reflecting on practice, reorganizing knowledge structures, rationalizing ideas, reinventing practice, re-envisioning science classrooms, and refining instructional strategies (see Figures 7-1 and 7-2).

Recounting teaching episodes

In achieving consensus among members regarding effective science instructional strategies, teachers shared examples of their own practice that they perceived resulted in active student engagement. Megan vividly described specific instances where her sixth graders' curiosity about the periodic table generated questions beyond the expectations of their grade level. In recounting this example, she shared distinct strategies that stimulated student questioning in the science classroom. She also shared strategies that were successful in achieving more student-centered discourse during her science lessons. Erin and Nina also reported on the effectiveness of IQWST-related instructional strategies in increasing student engagement in their lessons. The

general understanding negotiated among teachers regarding the expectations of IQWST was that instruction should stimulate 1) student centered discourse, 2) higher order thinking, 3) attentiveness, and 4) interest. When teachers experienced these reactions from their students, they felt more confident that they were implementing the curriculum according to the vision of its developers. More importantly, by sharing these experiences, teachers metaphorically opened the doors of their classroom to other teachers thus providing opportunities for critical evaluation and feedback.

According to Morell (2003), when teachers open their practice to scrutiny and engage in substantive dialogue about practice, they are inspired to be more deliberate in future lesson planning. In the PLC under study, teachers developed confidence in their own instructional choices when their peers evaluated and provided positive feedback regarding their efforts. In one particular instance, Nina briefly shared a public teaching episode where she observed Megan implementing IQWST strategies in her sixth-grade classroom. As she reported on this episode, she commended Megan for specific strategies she had used to generate student-centered discourse in the science classroom. Additionally, she commented on how Megan's own questioning strategy may have contributed to favorable student response. When teachers had a mental picture of IQWST implementation, strategies that appeared challenging in theory may have seemed more doable, particularly to teachers who lacked confidence in their ability to enact a new curriculum. Furthermore, specific challenges that could emerge as a result of generating student engagement may be addressed as teachers share their personal success stories. The use of these narratives to describe authentic classroom situations that illustrate typical problems emerging from IQWST implementation is analogous to

the use of cases in pre-service teacher preparation. Originally advocated by Shulman (1986), cases or descriptive episodes of teaching experiences are powerful tools in the development of PCK, and the improvement of teaching strategies (Darling-Hammond & Snyder 2000; Supovitz & Turner 2000; Wilson & Berne 1999).

According to Lave and Wenger (1991), individuals make sense of their experiences through the systematic processes of interpretation and action. These processes, when assimilated into a routine behavior will contribute to the generation of new scenarios that will engender further negotiation of meaning (Wenger, 1998). Middle school science teachers, by relating their IQWST implementation experiences, contribute to meaning negotiation for their peers. In this way, both the reporting and responding teacher benefit. The science teachers who reported teaching episodes gained confidence in their pedagogical abilities while receiving critical feedback, and the responding teachers made sense of their own experiences by making associations with those of their peers. The teaching episodes of others implementing the same curriculum ultimately become a resource that could allow science teachers to adjust certain strategies to meet the needs of their classrooms. When science teachers are given repeated opportunities to talk about or relate their IQWST implementation experiences, they are able to articulate tacitly held knowledge of instruction and the curriculum. According to Wilson and Berne (1999), this articulation “serves both to dignify the educators’ work and shape its substance” (p. 191). As teachers successfully negotiate between the curriculum’s overarching learning goals, and the realities of their own classroom experiences, they are provided with multiple opportunities to learn.

Reflecting on practice

Essential to the professional learning process, is the ability of science teachers to reflect on their experiences and those of others with a view to modifying or regulating their behavior as a result. The recounting of teaching strategies during teacher interactions prompted a process of reflection as other teachers considered sharing their own teaching episodes. For instance, during one of the interactions that required consensus on effective teaching strategies, Megan shared episodes with group members describing active engagement of her students in classroom discourse. Her report prompted a response from Nina, who shared a similar experience with her students. Erin also shared experiences after reflection on her practice, and assessing the effectiveness of her IQWST implementation strategies. The brief moment of reflection allowed teachers to identify and also share the teaching episodes that contributed to improved student engagement in their science classrooms. Again, an activity designed to have teachers agree on effective teaching practices contributed to reflection on current practices as teachers shared experiences that they believed to be successful in engendering student engagement.

The findings also indicated that teacher reflection surfaced deficiencies in their current practice that were highlighted during discussions of effective teaching strategies. For instance, Erin indicated that during her classroom discourse, she did not provide her students with adequate 'wait time' to think about questions she posed. As a result, student involvement in classroom discussion was minimal. Based on chronological analysis of the interaction, this self-evaluation came after Erin reflected on Megan's report of a teaching episode involving student-centered questioning. In support of Erin's critical self-analysis, Nina also acknowledged weaknesses in her practice. Nina

highlighted tendencies to correct students' responses rather than having them articulate their thought processes. Her critical assessment of this tendency led to the conclusion that in attempting to amend student responses, she silenced students who would have otherwise been engaged in classroom discourse.

Other opportunities for reflection were provided during the interaction in which teachers tried to achieve consensus. The activity required teachers to view teaching episodes with and identify effective classroom discourse. Three classroom discourses characterize the IQWST curriculum: brainstorming, pressing for understanding, and synthesizing. As teachers attempted to identify these discourses in the teaching episode, they made associations between the formalized information in the front matter of the IQWST curriculum, and the actions of the teacher in the video. Associations were made through reflection as teachers made sense of readings they had done during the courses they completed as part of the program. Teachers' reflection was not limited to the literature they read. Erin, after viewing the video clip, admitted that she rarely used the synthesizing discourse in her classroom. Again, observing and listening to the experiences of others provided opportunities for critical examination of practice through reflection.

Researchers support the need for teachers to critically reflect on current practices with a view to understanding how identification of their deficiencies can be instrumental in effecting instructional change (Haney & Lumpe 1996; Shulman & Shulman 2004). The reflection process is key to the negotiation of meaning. It represents the first stage of an individual's attempt to make sense of his or her experiences. In this case, science teachers were attempting to make sense of an inquiry

curriculum they were in the process of implementing. The teaching experiences they shared provided a springboard for reflection not only on weaknesses but also on the strengths of their practice. Once identified, teachers indicated a plan of action based on the successful experiences of others. Erin indicated plans to increase wait time, and Nina planned on uncritically accepting students' responses before initiating activities designed to allow for changes in their alternative frameworks. Teachers, therefore, become reflective practitioners who harness tacitly held knowledge through the critical examination of their own practice and that of their peers (Kwakman 2003; Wood 2007). Eraut (2000) calls this mode of professional learning experiential as it involves "deriving explicit knowledge through reflection on experiences" (p. 124).

In the PLCs under study, teachers articulated experiences that ultimately become powerful learning tools as they attempted to make sense of a reform science curriculum. According to Coburn (2001), this process of sense making encourages teachers to question pre-existing assumptions about science teaching (Roseberry & Puttick 1998). Through reflection on practice, teachers became aware of their flawed conceptions, and explored various ways to modify their practice in light of new ideas. Unless teachers perceive their practices to be ineffective in generating student interests, they are unlikely to make attempts to change (Capps & Crawford 2013). The reflection process allowed the science teachers to critically examine their practices in light of their new experiences and information.

Reorganizing knowledge structures

As teachers reflected on the reported experiences and tried to make sense of current practices, they had several opportunities to re-organize mental structures regarding implementation strategies. This was evidenced by Erin and Nina's decision to

make adjustments to instruction after critical reflection on practice prompted by articulation of experiences. Although the designed activity did not specifically require teachers to commit to an action plan, Nina and Erin felt an overwhelming need to make appropriate modifications to ensure enhanced student engagement. This re-organization occurred as they negotiate tensions between the vision of IQWST and perceived deficiencies in their practice.

As teachers interacted to achieve consensus on the three most effective teaching practices they had encountered in the reform curriculum, they had several opportunities to reinterpret or re-conceptualize previously held ideas regarding instruction. They also co-constructed and reorganized knowledge about those practices that engendered favorable learning environments for their students. The science teachers used the interactions within the PLC to seek clarification for ideas that they had not completely understood within the context of the formal courses they took. For instance, during consensus making activities, Erin asked Sue to explain the meaning of discourse in order to gain a better understanding of the concept of argumentation. After Sue shared her constructed understandings, Erin was able to make sense of argumentation within the context of her own science classroom. The interactions were also used to share personal interpretations and adaptations of pedagogical innovations to which they had been introduced. For instance, both Megan and Erin articulated their understanding of student engagement. According to Megan, students are engaged when they are asking questions and are involved in high order thinking. Erin expanded on this idea when she indicated that students are engaged when they are paying attention and responding to teacher prompts. As the other participants consolidated both Erin and Megan's views on

the subject, they co-constructed new understandings of student engagement within the context of their own classrooms.

Teachers also had opportunities to reorganize knowledge structures when they made associations between prior knowledge and the formalized discourse associated with the IQWST curriculum. Studies by Goodnough (2010) confirm that teachers rely on codified and personal knowledge to facilitate the reconstruction of conceptual frameworks that allow them to make decisions about practice. In other words, they use theories and concepts constructed by others to pursue their wonderings about practice. For instance, Erin admitted that she had previously considered the synthesizing discourse as one in which students make connections among related concepts. She viewed the process as a relatively low-level task requiring minimum effort on the part of the students. As discussions ensued Erin, through critical reflection on documents associated with IQWST, identified a misconception in her conceptualization of synthesis. The cognitive dissonance created as a result, prompted a discussion among her peers during which she was able to reorganize prior conceptions to align with the front matter of IQWST. As a result of the interaction, Erin concluded that the synthesizing discourse involved more than just connecting concepts but rather weaving them into a coherent whole. This, she decided, required higher order thinking compared to other classroom's discourses such as brainstorming. As Erin considered these knowledge frames, she developed new insights into different aspects of her professional knowledge, thus constructing new understandings of the synthesizing discourse. According to Goodnough (2010), when teachers reorganize various knowledge structures, they are more likely to transform abstract ideas into practice.

From the perspective of Wenger (1998), negotiation of meaning is necessary if individuals are to arrive at a consensus. As such, Erin's misconception regarding synthesis placed her at odds with her peers who had different views on the subject. The conflict prompted shifts in her conceptualization that contributed significantly to knowledge generation in the group, and facilitated subsequent achievement of group consensus. Researchers support the value of cognitive dissonance in order to perturb science teachers' prior beliefs about student learning and instruction (Kelly 2006; Kwakman 2003; Loucks-Horsely & Matsomoto 1999). The activities among middle school science teachers within the PLCs encouraged open debate as teachers came to terms with their alternative frameworks. Conceptual change resulted in the development of new understandings as individuals critically examined the ideas of others, discussed differences and similarities of multiple views, and adopted the idea deemed the most practicable. Findings, therefore, demonstrated that science teachers' experiences implementing IQWST, coupled with their social interactions with peers, stimulated a reflective process that yielded new understandings and insights into teaching and learning.

Rationalizing ideas

In order for science teachers to develop new understandings, they would have to critically examine the ideas of their peers and discuss similarities and differences between their own ideas and those of their peers before selecting one that is the most rational (Lorsbach & Tobin 1992; Savery & Duffy 1996). This process of negotiation encourages science teachers to justify the selections they make and is essential to consensus making. Additionally, in making sense of conflicting views, science teachers have to rationalize the changes they make to their existing cognitive structure in light of

the dissonance created. According to Lorschach and Tobin (1992), individuals modify their original perspectives after resolving cognitive conflicts as a means of embracing new cognitions.

Findings suggested that the activities implemented during both interactions required teachers to achieve consensus. As such, teachers were expected to provide rationales for the ideas they generated. For instance, teachers were required to provide evidence for any claims they made regarding effective science teaching practices. During the interactions, therefore, teachers who advanced their opinions had to provide an argument strong enough to shift the original views of others. Nina, for instance, provided proof of engagement when she encouraged her students to critically evaluate the responses of their peers during argumentation. Specifically, she indicated that her students were now motivated to participate in class discussions, ask questions, and also complete lab work in a timely manner. Erin also suggested encouraging students to use models or drawings to demonstrate their understanding of certain scientific concepts. She rationalized this choice by sharing that her students were very enthusiastic about modifying the drawings of their peers on the document projector. The justification provided by teachers contributed to the group consensus at the end of the deliberation process.

The science teachers negotiated conflicting ideas before reorganizing cognitive structures. They also rationalized cognitive changes before considering a plan of action. Rationalization is, therefore, key to the process of meaning negotiation as teachers come to terms with an inquiry curriculum, which requires them to employ radically different strategies in the science classroom. As they attempt to negotiate these

tensions, science teachers typically draw on formalized knowledge to guide, and or support the new views they decide to adopt. For instance, during an interaction regarding the redesign of a science lesson using preselected discourse types, Jenna repeatedly referred to the U-FUTuRES document to rationalize her choice of prompts for the consensus lesson. The document, her pre-existing notions, and the views presented by her peers all contributed to the cognitive tensions she experienced as she attempted to understand the appropriateness of a discourse to specific classroom situations. The negotiation of her ideas preceded the process of reorganization that facilitated the replacement of original views with one she considered the most acceptable. Having changed her views, she rationalized the decision she made. Additionally, Erin's decision to increase her wait time resulted from processes such as reflection and conceptual change. She used readings from the IQWST front matter to rationalize her decision, and to inspire confidence in her choice, hence charting a course for instructional change.

Reinventing practice

As science teachers grappled with new knowledge, they began to conceive of ways to apply their knowledge to practice. In order to achieve this, it became necessary to consider changes to their approach to instruction. Erin believed that she had to increase her wait time, and Nina proposed uncritically accepting students' ideas. These were deliberate decisions taken by teachers as they negotiated meaning from the IQWST curriculum. Differences between prior practice and that promoted by the curriculum required extensive changes as teachers reinvented themselves. The decision to transform practices as a result of cognitive changes is key to stimulating action. According to Wenger (1998), individuals make sense of their experiences

through coordinated processes of interpretation and action. In this study, science teachers negotiated their understanding of IQWST implementation by engaging in a series of overlapping and iterative processes that prompted decisions to take actions that would eventually transform their practice.

Megan, who had been implementing IQWST two years prior to starting this program, had already reinvented her practice to accommodate the innovative instructional strategies featured in IQWST. According to Megan, there is less emphasis on direct instruction and more focus on the generation of questions from students. She had to modify her approach from delivering prepackaged knowledge to students to one that encouraged co-construction of knowledge through scientific investigations. From Megan's perspective, teachers need to implement the strategies associated with IQWST in order to achieve goals of student engagement. Nina also reported modifications to her practice. She indicated that she modified her instruction by increasing her use of prompts to generate student responses, and to promote peer evaluation among her students. Key to the IQWST curriculum is the move from a teacher-led classroom culture to a discourse-centered classroom culture. A reinvention of teacher-centered practice is, therefore, required of many teachers for the successful implementation of IQWST.

As teachers interacted within PLCs to arrive at consensus regarding effective teaching practices, they committed to continued reinvention of practice in order to meet requirements of IQWST. Teachers who had begun implementation provided evidence of changes in student engagement as a direct result of changes in instruction. These changes are likely to contribute to the generation of new circumstances that will

encourage further negotiation and meaning (Wenger, 1998). New circumstances will likely emerge as teachers continue the implementation process, and further negotiation of meaning will enhance teacher development as teachers repeatedly reinvent their practices in specific contexts. Each attempt to reinvent practice reflects new understandings generated by the teacher as a result of meaning negotiation.

Re-envisioning science classrooms

When teachers reinvented themselves in ways that aligned with the requirements of IQWST, their students become more engaged in the learning process. Erin, Megan, and Nina reported more student participation and increased attentiveness. According to Megan, as a result of the transformations in her practice, her science classroom became more student-centered as both teachers and students initiated questions. Changes in instruction, therefore, require corresponding changes in classroom culture (Horn 2010). Erin also indicated that reinvention of her practice resulted in a classroom that encouraged students to move around in order to demonstrate concepts on the document projector. Likewise, Nina's students became more involved in argumentation and as such critically evaluated the ideas of their peers. These changes, according to the teachers, were a direct result of changes in their instruction.

The IQWST curriculum encourages science teachers to establish a classroom culture that promotes discussion among students rather than between teachers and those students who raise their hands. This re-envisioning of science classroom culture is an important step in the creation of the discourse-centered learning environment promoted by IQWST. The restructured science classroom is, therefore, an indirect consequence of teachers' decision to reinvent their practice. Nina alluded to this idea when she explained that students have to be taught how to interact with both the

teacher and their peers in productive ways. As teachers transform their practice, they have to make deliberate changes to restructure the classroom culture in ways that reflect the requirements of the curriculum. Discussions that encouraged teachers to share, critique, and redesign science teaching episodes also facilitated the establishment of innovative learning environments for students. For instance, the collaborative redesign of an observed lesson encouraged teachers to brainstorm prompts that would nurture a discourse-centered classroom culture. During this interaction, the science teachers reported changes in classroom culture that not only aligned with the curriculum but also addressed specific needs of their student population. Therefore, they negotiated contextual understandings that seemed practical and applicable to their science classrooms.

Refining instructional strategies

Teachers typically refine instructional strategies over time, and according to their teaching context. The IQWST curriculum does not address the specific needs of particular student populations. However, interactions within the PLC provided teachers with the opportunity to problematize their practice, as well as test and analyze possible solutions. The science teachers discussed some of the challenges associated with developing a discourse centered classroom culture. According to Nina, the prompts provided by the curriculum were useful resources to assist teachers in this regard. However, Megan, who had been implementing IQWST over a longer period, alluded to the necessity of modifying the prompts to address specific contexts. During the interaction, teachers shared some of their modified prompts as they related their teaching episodes to their peers. This exchange was a necessary component of the

process of refinement as teachers experimented with strategies before fully assimilating them into practice.

According to Wenger (1998), negotiation of meaning is a continuous process that involves the integration of thought processes into action. When the science teachers interacted in PLCs to achieve consensus on effective science teaching practices, their discussions facilitated the exchange of 'tried and true' strategies. Strategies become 'tried and true' through the process of refinement. Megan refined her questioning strategies in a way that enhanced student engagement, and this refinement appeared to have contributed to her understanding of IQWST. Sharing new understandings within the PLC contributed to the negotiation of the other science teachers' understanding of the curriculum. As the teachers continue to implement the curriculum, they will no doubt face unique contextual circumstances that will require modification of instruction over time.

Exercise of Power in PLCs

From a Foucauldian perspective, power is defined as a set of actions that is triggered by the action of others. As such, power is not a possession but rather a force to stimulate action and exists only when it is put into action. The exercise of power is, therefore, a prerequisite for action, and the nature of such actions may set the stage for other actions. The findings reported in the two previous chapters documented a series of actions employed by science teachers during various interactions designed and implemented by professional development providers. The actions of science teachers in the PLCs were, therefore, shaped by the actions of others external to the PLC. In other words, in exploring the exercise of power within the PLC, it is extremely important to examine those external power structures that silently dominated the interactions. The

findings of this study suggest that meaning negotiation and consensus making among middle school science teachers were influenced by both internal and external power structures. This section, 1) identifies external and internal hierarchies of power that were involved in the exercise of power within the PLC, 2) characterizes internal power structures that shape the outcome of deliberations, 3) examines ways in which external power structures influence the actions of science teachers within the PLC, and 4) details some of the internal power strategies employed to influence the outcome of consensus making in the PLC.

Hierarchies of power

Generally speaking, a hierarchy of power reflects the distribution of power among interacting individuals or within the wider society. This power structure is evident in policies and micro-practices of institutions and social communities. According to Foucault (1982), the inextricable link between knowledge and power is reflected when expert knowledge producers exert power over others through their expertise. Therefore, hierarchies of knowledge and power are sustained globally by institutions, and reproduced locally through discourse and practice. Two sets of power structures were identified from the findings. The external hierarchy was the more potent (see Figure 7-3) of the two.

In the figure, I presented a partial hierarchical structure of the various institutions that shaped the IQWST curriculum. The curriculum was funded by the National Science Foundation (NSF), which is an independent federal agency responsible for promoting the progress of science in the United States. Additionally, IQWST is designed to reflect National Science Education Standards (NSES), which were established by the National Research Council (NRC). The NSES and similar reports generated by the NRC are

typically based on independent recommendations from the National Academies of Sciences (NAS), which also receive financial support from NSF. Grant and project directors collaborated with IQWST developers to design professional development programs for middle school science teachers in order to ensure that science teaching and learning align with the vision of the NRC, and by extension, the NSF. This intricate nexus of institutions, despite the many degrees of separation, exerted power over the science teacher participants who attempted to make consensus and negotiate understandings that reflect the knowledge constructed by experts. Without even participating in the interactions, these external institutions influenced many of the decisions made, and the actions taken by the science teachers involved. In other words, by establishing guidelines for science teaching and learning, NRC attempted to shape the field of action for the teachers interacting in the PLC. This external structure, therefore, dominated in silence to influence the outcome of science teacher interactions within the PLC.

In contrast to the inflexible power structure that shapes the field of science education in the US, the hierarchies established among science teachers in the PLC shifted in response to the nature of the topic being discussed. According to Deetz (2003), power is exercised during social interactions, and demonstrates its dynamic characteristics when the actions of some individuals enable or disable actions in others. In the PLC under study, science teachers collaborated to construct understandings regarding the IQWST curriculum, and the findings suggest that outcomes were influenced both by collective and individual action. At the beginning of each interaction, individuals by virtue of their perceived knowledge or experiences regarding a subject or

their personalities, acted in ways that were either constructive or unproductive to the objectives of the PLC. During interactions, I observed a general power hierarchy illustrated in Figure 7-4 that experienced periodic shifts based on subtle power strategies employed to influence the outcome of deliberations.

The figure represents the general hierarchical structures established and maintained during the interactions. The structure was determined by the number of power strategies employed by individuals during the interaction. Additionally, other factors such as personality and science teachers' articulated expertise in the subject matter discussed were considered. In both cases, Nina who confessed to having a type A personality repeatedly acted in subtle ways to set the stage of the actions of the other teachers in the PLC. As such, she dominated discussions by frequently interrupting others and displaying attitudes that run counter to collaborative action. Erin, who aided and abetted Nina's actions, also employed subtle power strategies in response to those enacted by Nina. The stimulation of Erin's action as a result of Nina's action reflects the Foucauldian perspective of the exercise of power as enactment of strategies that set the stage for other possible actions.

Sue, who was featured in the second interaction, also had a penchant for dominating conversations. However, her lack of experience in IQWST implementation limited her contribution to the interaction. Despite this, she was able to respond to subtle power strategies enacted by Nina and Erin in ways that amplified rather than suppressed her voice. As such, Sue assumed a position similar to Erin on the power hierarchy identified in the PLC. The teachers on the lower end of the hierarchy were so placed either because 1) their actions did not influence the outcome of deliberations, 2)

they did not dominate or extensively participate in discussions, or 3) they disregarded rather than acknowledged power strategies enacted by their peers. Again, the makeshift hierarchy within the PLCs was flexible, and sometimes changed spontaneously due to the preceding series of actions that shaped the power structure. The findings indicate that the power structures established and nurtured in the PLCs influenced the outcome of consensus making. In other words, consensus documents reflected the ideas of those individuals in the upper echelon of this structure, while the views of the others were largely marginalized.

Shifting hierarchies.

I applied the concept of positionality as I explored the shifting of power hierarchies within the PLC. The term positionality is often used in feminist theory to refer to the place one assigns to a person within hierarchies of status and power (Lee & Johnson-Bailey 2004; Rehm & Allison 2006). Individuals construct knowledge based on the different ways they position themselves relative to others and as such positionality plays a crucial role in shaping the learning community. The positioning of oneself implies the simultaneous positioning of others within the community either intentionally or tacitly (Briscoe 2005). Individuals are, therefore, continuously involved in positioning themselves and others in a variety of forms under a variety of circumstances. During the deliberations, the teachers positioned themselves based on their perceived knowledge of the subject under discussion. For instance during the second interaction, Megan started a discussion regarding effective science teaching practices from a position of expert because she had had three years of experience implementing IQWST. At this point, she was exercising power by sharing with her peers some of the classroom experiences she has had as she fine-tuned her strategies. However, Nina assumed

control of the discussion by interrupting Megan with her own implementation experiences. This represented a shift because Nina was attempting to gain control as the expert. This is not to say that all speakers were considered at the top of the hierarchy. Rather than waiting her turn, Nina repeatedly interrupted Megan in order to make her voice heard. It is this simple, yet deliberate act of interrupting other speakers that characterized Nina's action as a deliberate strategy to shift the balance of power in her direction.

As the interaction continued, Sue acted in a way that again shifted this balance in a new direction. As teachers compared inquiry processes in math with those of science, Sue informed the group that she has taught math before thus qualifying her as somewhat of an expert among science teachers. However, this shift was short-lived as Nina advanced an opposing view using language associated with advanced math (calculus) to indicate that her knowledge of the domain eclipsed any experience Sue might have had teaching elementary math. Nina's action created a power struggle of sorts involving Sue, who was typically quick on her feet in responding. Although she had no experience in implementing IQWST and as such could not contribute from her experience, Sue found other ways to demonstrate her expertise. During a discussion of ways to generate enthusiasm among other middle school science teachers, Sue who had extensive experiences providing administrative support to teachers, assumed control of deliberations. Sue positioned herself as an expert in the area and even went as far as to inform her peers that she had already completed the prompt on behalf of the group. This action suggested that her expertise in the area negated the need for involving others in reaching consensus. Needless to say, Nina with her self-confessed

type A personality, found a way to shift the balance of power again. While not contesting Sue's ideas, Nina modified some of them while adding a view of her own. These actions that influenced the actions of others, contributed to the dynamism the interactions in the PLC.

According to Briscoe (2005), the actions of individuals during social interactions establish the speakers (self) and hearers (others) in specific ways while allowing them to negotiate new positions as they engage in conversations. In the PLC, the science teachers relied both on themselves (speakers) and others (hearers) in order to construct meanings from the interactions. They positioned themselves in relation to the others with whom they interacted as well as the external power hierarchies to which they were subjected. This process of forming self or identities in terms of relationship to others within a social milieu is called relational self (Gergen 1999), and can be applied generally to individuals who seek to identify their position relative to others. From Gergen's (1999) perspective, relational identities are then declared explicitly or tacitly during the course of social interaction. These declarations or actions during the course of interactions contributed to shifting hierarchies of power that characterized the PLCs observed during this study.

Power in absentia

The very establishment of PLCs to advance the goals of the NRC could arguably be interpreted as an exercise of power. Experts in the field have converged on the idea of PLCs improving teacher practice and by extension student achievement. Through their expertise, knowledge producers in the field recommended learning communities as viable sites for the inculcation of those guidelines for science education. As a result, the science teachers in the PLC were subjected to the external hierarchy of power that

shaped the field for the activities in which they participated. Institutions and individuals within the hierarchy envisioned a desired outcome, and as such employed strategies to ensure the achievement of such. The science teachers were encouraged to reflect on their practice and to take the necessary actions to ensure changes in instruction that conformed to the mission of IQWST developers. Therefore, the science teachers were allowed to take action or exercise power only within the boundaries established by IQWST. The activities designed by facilitators were aimed at regulating or normalizing instructional practice based on producers of knowledge and 'truths' within the field of science education. Any consensus achieved had to reflect these 'truths', and from this perspective, institutions and individuals external to the PLC exercised power in absentia. How exactly did this exercise of power influence the process of meaning negotiation and consensus making in the PLC?

First, IQWST curriculum and related documents were gatekeepers that guided the acceptance and/or rejection of ideas. As such, the ideas generated and the meanings negotiated were within the boundaries of the IQWST discourse. For instance, only those effective science teaching practices associated with IQWST such as modeling and questioning were featured in the discussions. Additionally, only discourse types associated with the curriculum such as brainstorming and synthesizing were presented as options from which to make selections. For instance, when Sue suggested that effective science teaching strategies are not necessarily unique to IQWST, her peers indicated that the facilitators required only those featured in the IQWST curriculum. The science teachers were, therefore pigeonholed into the principles and procedures of IQWST, and missed opportunities to explore other effective teaching

strategies. In one episode requiring collaborative design of a lesson, Jenna suggested including those prompts that were provided on an IQWST handout. Any other prompts generated were summarily dismissed if they were not included in the examples found on the handout.

Second, codified knowledge associated with IQWST and other educational theorists supplanted all personal ideas and views. Meanings negotiated within the PLCs were largely guided by the knowledge constructed by individuals in the field of science education. For instance, Erin initially held the view that synthesizing required students to make connections among ideas, and as such was a relatively low level learning activity. The views of her peers, which reflected otherwise, were not strong enough to create a change in her position. However, after reflecting on codified information related to Bloom's taxonomy as well as definitions provided in the IQWST front matter, she immediately accepted the idea that synthesis is a higher order activity that requires students to connect activities and experiences into a coherent whole. Erin uncritically accepted these ideas by virtue of the fact that they were documented and constructed by experts in the field of education. In this case, codified knowledge supplanted knowledge she had constructed for herself, and led to a process of conceptual change, which is a necessary requirement for learning. At the same time, this episode demonstrated the power exercised by experts who construct and disseminate knowledge.

In sum, power is exercised when facilitators, who were incidentally not members of the PLC, employed strategies aimed at improving science instruction in middle schools. Based on guidelines established by NRC and communicated through NSES,

IQWST developers designed a curriculum to facilitate this vision. In essence, science teacher educators and project facilitators determined, from their understanding of this vision, the activities that guided the interactions within the PLCs. Through the designation of these activities, power was exercised in ways that required the science teachers to achieve the outcomes envisioned by NRC. Power was, therefore, exercised in absentia.

Interpersonal power strategies

The actions of science teachers in the PLC were also driven by motivations to influence the outcome of certain discussions, and this activated micro-political processes during meetings (Achinstein 2002). Many current studies on PLC interactions present a picture of true camaraderie among teachers who are attempting to negotiate understandings regarding their practice. In fact, cases of conflicts among participants, passive aggressive behavior of individuals, and other issues of power have largely been omitted from the science education literature. The findings indicate that some teachers, through their actions, exercised power in ways that could hinder rather than enhance constructive dialogue in PLCs. These actions were examined in Chapters 5 and 6, and outlined in Figure 7-5.

Nina, during both interactions, employed power strategies that directly influenced both the process and outcome of the negotiations. Notably, she interrupted Megan approximately eight times during the second interaction as she shared her experiences with IQWST implementation. While her motivation was not absolutely clear, it appeared that Nina was attempting to shift attention away from Megan's expertise, and the positive impact her instruction had on her students. Nina's interruptions prevented Megan from completely articulating her thoughts and as such opportunities were missed

for the sharing of teacher episodes. By the same token, Megan's passive reaction averted possible interpersonal conflict. Nina and Erin, who appeared to enjoy a close social relationship, enacted other power ploys to influence the group's processes and outcomes. During the first interaction, they blatantly disregarded the ideas advanced by Jenna and Drew in order to ensure that their ideas were presented on behalf of the group. In so doing, they collaboratively authored the consensus document toward the end of the interaction, and deliberately omitted the ideas with which they disagreed.

Body language also played an important role in communicating individuals' intentions regarding the interactive process. Again, Nina demonstrated the most notable of these actions. During the first interaction, Drew advanced an idea that opposed a suggestion Nina made. As Drew explained her position, Nina shook her legs compulsively, laughed derisively while opening admitting that she was biting her tongue. The colloquial expression 'biting one's tongue' typically indicates that individuals would prefer to say nothing rather than say something that is offensive or hurtful to someone. Nina's actions clearly demonstrated intolerance to views that differed from the ones she espoused, and could have triggered interpersonal conflicts among PLC participants. Drew ignored Nina's attempts at exercising power, and chose to react by ignoring the antics and focusing on articulating her ideas. Drew's reaction brings us to another important observation made during the interactions.

The actions of the other science teachers in response to power strategies deliberately used by Nina and Erin, also played an important role in averting open conflicts among participants of the PLC. Studies have shown that open conflicts can lead to frustration and stress for the teachers involved (Achinstein 2002). The science

teachers who were subjected to Nina and Erin's actions were for the most part passive, and ignored the come hither calls of confrontational reactions. From a Foucauldian perspective, the disregard of individual attempts to control the process of interactions within the PLC may be considered a reactive attempt to exercise power. Figure 7-6 summarizes the actions and reactions of individuals on the lower tier of the hierarchy of power established in the PLC researched. These actions demonstrated resistance to the more deliberate attempts to control the proceedings, and facilitated consensus making under challenging circumstances. For instance, Megan and Drew redirected social conversations unrelated to the topic being discussed to ensure more constructive interactions in a timely manner. Megan and Drew also continued participating in the discussions thus allowing them to have a voice despite deliberate attempts by others to assume control. On the other hand, Rob and Jessica participated only minimally during interactions, presumably to avoid confrontation. This limited contribution to the process was an exercise of power that eliminated their voices from the process of consensus making. The power strategies collectively enacted during interactions, therefore, had both positive and negative influences on the interactions within the PLC.

Opportunities for Professional Learning and Development in PLCs

In science education, PD is regarded both as a process and a program (Greensfeld & Elkad-Lehman 2007) that focuses on teachers' professional learning and practice; students and their learning; the education systems in which teaching and learning takes place; and the distinctive nature of the scientific discipline (Hewson 2007). From this perspective, PD focuses on didactic processes aimed at transforming teacher practice. Professional learning, on the other hand, involves a complex blend of social and cognitive processes leading to a transformation of knowledge, skills, and

attitudes. It is, therefore, an important prerequisite to the teacher actions typically associated with PD. The main research question was designed to consolidate the sub-questions addressed above, and explored the affordances or action possibilities provided by PLCs. Specifically, how do PLCs operate as a site for learning and development of middle school science teachers who are in the process of implementing an inquiry curriculum? In other words, what are some of the social and cognitive processes that took place during interactions, and how could these processes transform science teachers' practice as they implement inquiry instruction? This section draws on findings reported in previous sections to summarize professional learning and development opportunities that were afforded to the science teacher participants. I identified four themes including social interaction, knowledge construction, action planning, and conflict management (Figure 7-7). I will also make the theoretical lenses used in the analysis of the data more explicit.

Social interaction

Lave and Wenger (1991) recognize learning as a social phenomenon that is an integral aspect of practice and constitutes the changing of identity as a result of membership in a community. This view of learning suggests that individuals, by virtue of their engagement in social practices within the PLC, are able to reconstruct their identities over time through increased participation. It emphasizes that social interactions and engagement within the PLC are central to the processes of meaning making, and hence learning in practice. Science teachers, therefore, learned during interactions with their peers as well as with other documents associated with the IQWST curriculum. Their learning was situated within the context of IQWST implementation, and was contingent on participation within the PLC. Science teachers also learned as

they came to know more about the discourses and features of the IQWST curriculum that guided the design of the activities within the PLCs. As such, from their experiences and interactions, science teachers learned the requirements of the IQWST curriculum as they gradually assimilate its values and practices. This enculturation into IQWST and associated practices played an essential role in the process of science teachers becoming knowledgeable about inquiry instruction within the context of their own classrooms.

Knowledge construction

From the lens of constructivism, knowledge is constructed through interaction with the environment (Crawford 2000; Gordon 2009). As such, individuals learn through a process of meaning negotiation as they interpret their experiences and interactions with ideas in the social or natural environment. This constructivist viewpoint suggests that the science teachers were provided with opportunities to learn about IQWST as they collectively negotiated their understanding of the curriculum. The knowledge they constructed was socially negotiated as they arrived at consensus regarding, for instance, effective science teaching practices. Additionally, constructivism emphasizes the process of conceptual change that occurs as a result of adaptive modification of prior knowledge based on reorganization of formal education experiences. As teachers negotiated an understanding of IQWST in the PLC, they came to gain a new perspective of instruction that enhanced student engagement in science. The social interactions, therefore, provided science teachers with various experiences that triggered cognitive dissonance, hence prompting them to construct new understandings that complement these experiences.

The constructivist view of learning also considers the social and cultural context in which knowledge is constructed. The science teachers collaboratively engaged in discussions with their peers as they attempted to make connections between their experiences and the codified information associated with IQWST. The knowledge they constructed was, therefore, inextricably linked to their classroom contexts and the inquiry curriculum they were implementing. This view of learning emphasized the science teachers, their experiences, and constructed knowledge as central to the PLC's role in professional learning and development.

Action planning

Ultimately, the expectation is that PD will result in changes in the way teachers approach their practice. Greensfeld and Elkad-Lehman (2007) suggested that if PD resulted in a change, the following conditions must exist simultaneously: teachers' beliefs, values or practices will be relatively different from what they were before; teachers will be aware of this difference; and the teachers will acknowledge the significance of the change to their practice. Teacher change can, therefore, be associated with "learning, development, socialization, growth, improvement, implementation of something new or different, cognitive and affective change, and self-study" (Fraser et al. 2007, pp. 157). Findings suggest that the science teachers made significant changes to their instruction in order to accommodate the requirements of IQWST. They reported many of the specific changes they had to make including using models, engaging students in questioning and argumentation, as well as facilitating collaborative investigations. Additionally, they acknowledged the high levels of student enthusiasm and engagement generated as a result. According to Greensfeld and Elkad-

Lehman (2007), the science teachers interacting in the PLC manifested those changes that characterize transformative PD programs.

From the lens of Foucault's power/knowledge theory, the exercise of power was necessary to set the stage for the series of actions that led to teacher change. School administrators and project personnel saw the need for improvement of science instruction, and as such implemented collaborative activities to facilitate PD. Through the adoption of an inquiry curriculum, the administrators and project directors attempted to shape the field of action for the middle school science teachers. The teachers were provided with the resources and support necessary to take appropriate actions to improve existing practice. Professional learning was an outcome of this series of actions, which provided science teachers with opportunities to develop their practice. From this perspective the exercise of power in PLCs can be productive and relational (Deetz 2003). In other words, the actions of external institutions influenced the action potential of science teachers who not only changed their practice but also collectively charted a course of action to continuously refine their instruction. This action planning allowed science teachers to collaboratively decide on steps required to achieve the shared goal of increased student achievement.

Conflict management

I used the term conflict management to emphasize a focus on limiting the negative aspects of conflict rather than attempting to eliminate them. Another important focus is increasing the positive side of conflict in order to enhance professional learning through conceptual change. Conflict is common to all social interactions, and occurs when individuals disagree over ideas, perceptions or motivations. Conflicts can escalate to trigger emotions strong enough to derail discussions and hinder professional

learning. From a Foucauldian perspective, a single action by any group member could potentially set the stage for any possible number of retaliatory actions. Science teachers in this PLC found various ways to limit negative aspects of this exercise of power. These included 1) compromising in order to accommodate diverse views, 2) withdrawing from interactions, 3) ignoring the aggression of others, and 4) resisting the actions in order to maintain one's viewpoint. The conflict management strategies inadvertently employed by the science teachers arguably averted potential breakdowns in negotiation processes within the PLC. As science teachers continue to interact, they will likely make additional adjustments to accommodate the personalities of their peers in order to maximize the understandings constructed during social interactions.

Concluding Remarks

In sum, there were several opportunities for the science teachers to learn about the IQWST curriculum while developing their practice through group collaboration that was both reflective and contextual. While engaging in prescribed activities aimed at supporting the implementation of an inquiry curriculum, the science teachers reconstructed cognitive structures regarding inquiry instruction through the negotiation of meaning. The interactions in the PLC addressed the issue of teacher isolation by facilitating constructive dialogue among science teachers who were implementing the same curriculum albeit in different schools. Additionally, peer interaction contributed to a better understanding and appreciation for the way IQWST should be implemented to enhance student engagement. The findings of this inquiry, therefore, support existing literature regarding PLCs as an effective means to improve teaching and learning. However, this study is unique because it identified cognitive and other processes that provided opportunities for learning and development among science teachers

interacting within a specific context. These opportunities were created on a moment-by-moment basis as they shared teaching episodes, arrived at consensus regarding effective teaching strategies, and redesigned science lessons based on their co-constructed knowledge of inquiry instruction. In other words, this study not only confirmed the efficacy of the PLC, it also explored activities, processes, and learning opportunities that contributed to improved teaching and learning as a result of interactions within the PLC.

This study also addressed an issue generally overlooked in existing studies of PLCs. Social interactions involving diverse personalities and views are characterized by conflict. While conflict is necessary for conceptual change, it can become a nuisance if allowed to go unchecked. The findings of this study suggest that careful management of conflicts, when they arise, can avert negative outcomes and result in more constructive deliberations. Although the management strategies employed in this study were arguably inadvertent, interactions could benefit from the formal institution of supports to address differences in opinions and personalities. This study, therefore, identified passive-aggressive actions that may be employed by certain individuals in attempts to influence the outcomes of consensus making. In other words, it explored some of the possible actions that could either enhance or hinder the process of meaning negotiation in the PLC. There is, therefore, a huge potential for professional learning and development in PLCs. However, understanding the processes within them is an important step in maximizing this potential.

Musings

I never once doubted the potential of social interaction in the development of an individual. Much of what I remember in my many years of being a student is tied to

those activities carried out in groups. Although I thoroughly enjoy individual learning, I have come to find that the co-construction of knowledge can have a profound impact both on the individual learner and the collective group members. Nevertheless, I have had many challenges during group interactions. I remember my first group interaction as a student here at University of Florida. During my first doctoral seminar, in a class with several dominant personalities, I attempted to contribute to the discussion. After all, if you do not contribute to class interactions, you could be labeled as antisocial, delinquent, unintelligent, uninterested, and unprepared. I was admittedly appalled by the nature of the interactions. Individuals interrupted each other, and as such there was overlapping chatter where the louder voices suppressed my literally tiny voice. As the interactions progressed, I threw out any hope of having my views heard. I had raised my hand three times in hope that others will see that I had something to contribute. That was the cultural norm I had adopted during my many experiences in working groups. Clearly my hands were as tiny as my voice because the class was winding down to a close and every single student had contributed to the dialogue...except me.

As the interactions continued, I realized that only the strong would survive the verbal frenzy that the class discussion had become. My survival instincts kicked in. Certainly, if I wanted to be an active member of this learning community, I would have to adjust my quiet personality and become enculturated in the values and practices of the group. I would have to raise my voice and bully my way into the conversation if my views were to be heard. And so, I decided to quit premeditating and just do it. I waited until there was a lull in the discussion and then I blurted my views at the top of my lungs in a way that visibly shocked the professor as well as the students sitting close to me. At

this point, I did not care who was shocked by the outburst of my views. I simply wanted to be considered a participant in this learning community. At the end of my class and on my way home, I remember feeling pleased that I found a way to resist the dominant voices in the group that attempted to silence my still and tiny voice. However, I still found it difficult to come to terms with the adjustments I would have to make to align with the culture of all the learning communities in which I would have to interact during this phase of my doctoral studies.

As I reflected on the PLC data, I identified some of the same passive aggressive behavior I encountered during my many years of social interaction. In fact, my experiences with these personalities have facilitated the recognition of such within the study participants. My typically firm yet passive resistance to dominant personalities in my own personal and professional interactions has reaffirmed my belief that the exercise of power is not a privilege reserved for rambunctious individuals who enjoy hearing their own voices through the din of others. It is the firm yet seemingly passive resistance that creates the balance necessary for constructive interactions. It is the firm yet passive resistance that averts potential altercations in the face of differences and oppositions. It is the firm yet passive resistance that fosters the learning and development of individuals in professional communities. Finally, it is the firm yet passive resistance that silences the voice of dominant personalities just long enough for the (typically) tiny voice of reason to be heard.

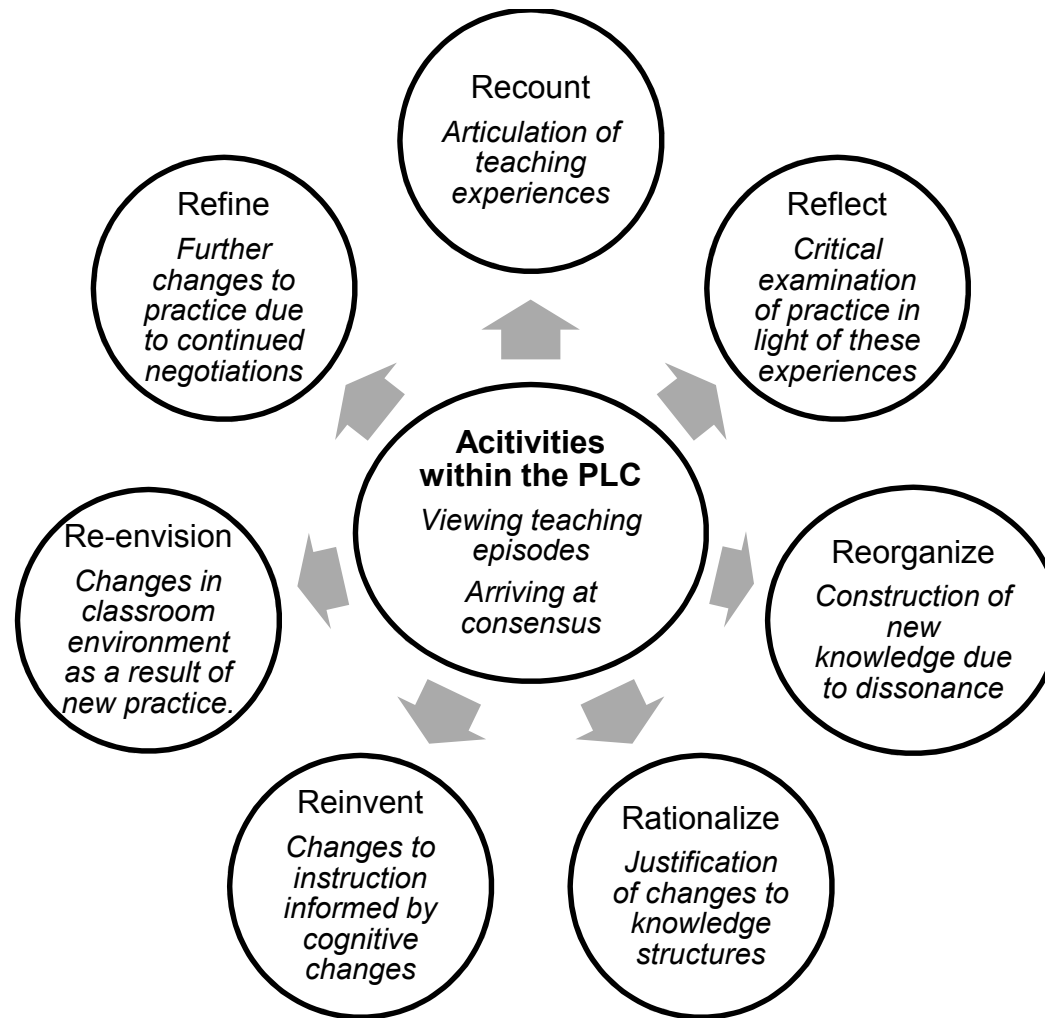


Figure 7-1. Processes initiated by activities within the PLCs

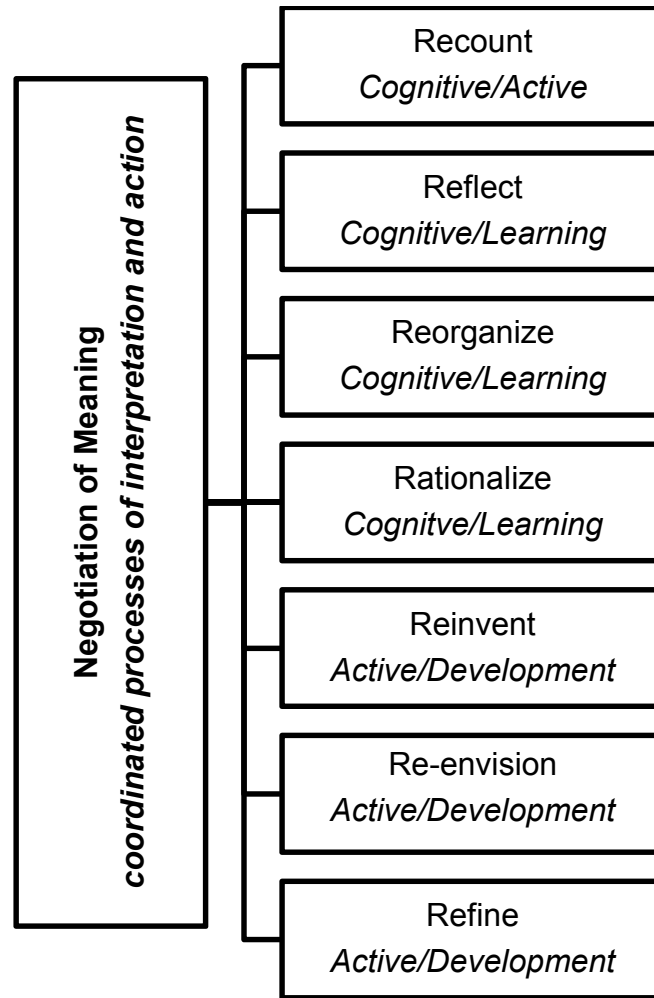


Figure 7-2. Negotiation of meaning in PLCs

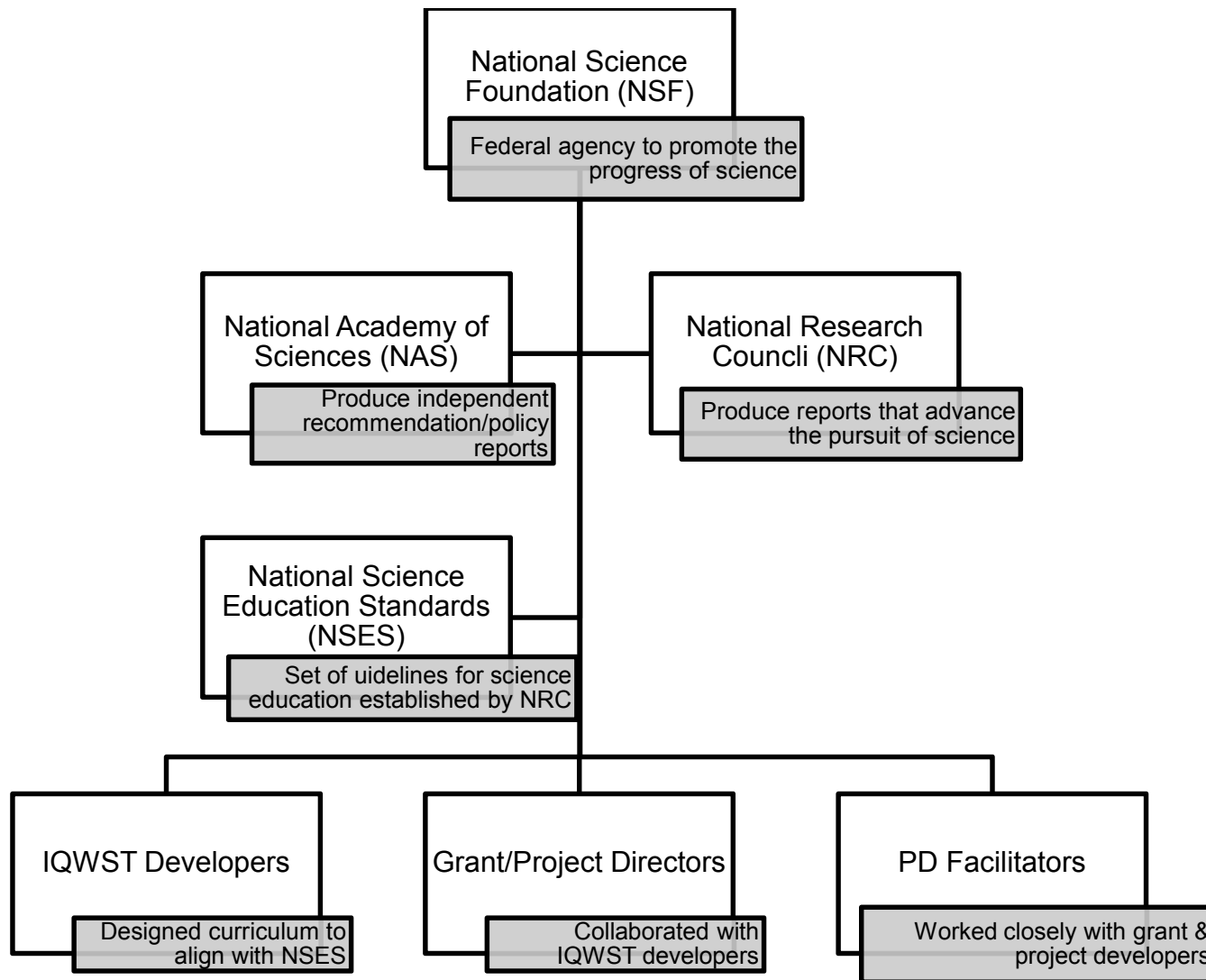


Figure 7-3. Power structures external to the PLC

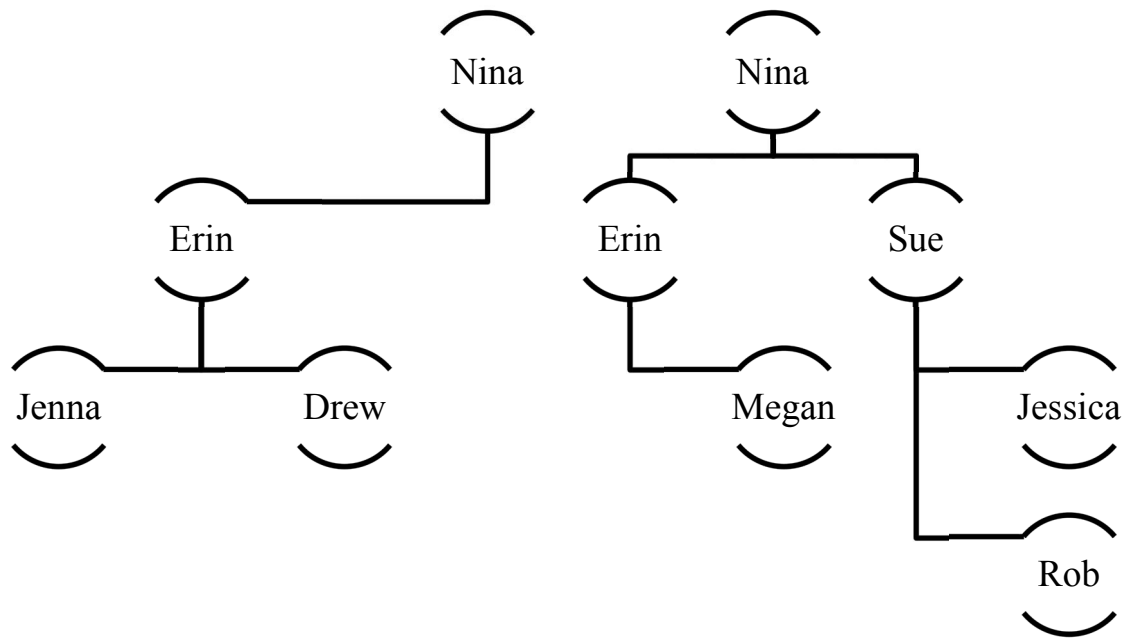


Figure 7-4. General power structures within the PLCs

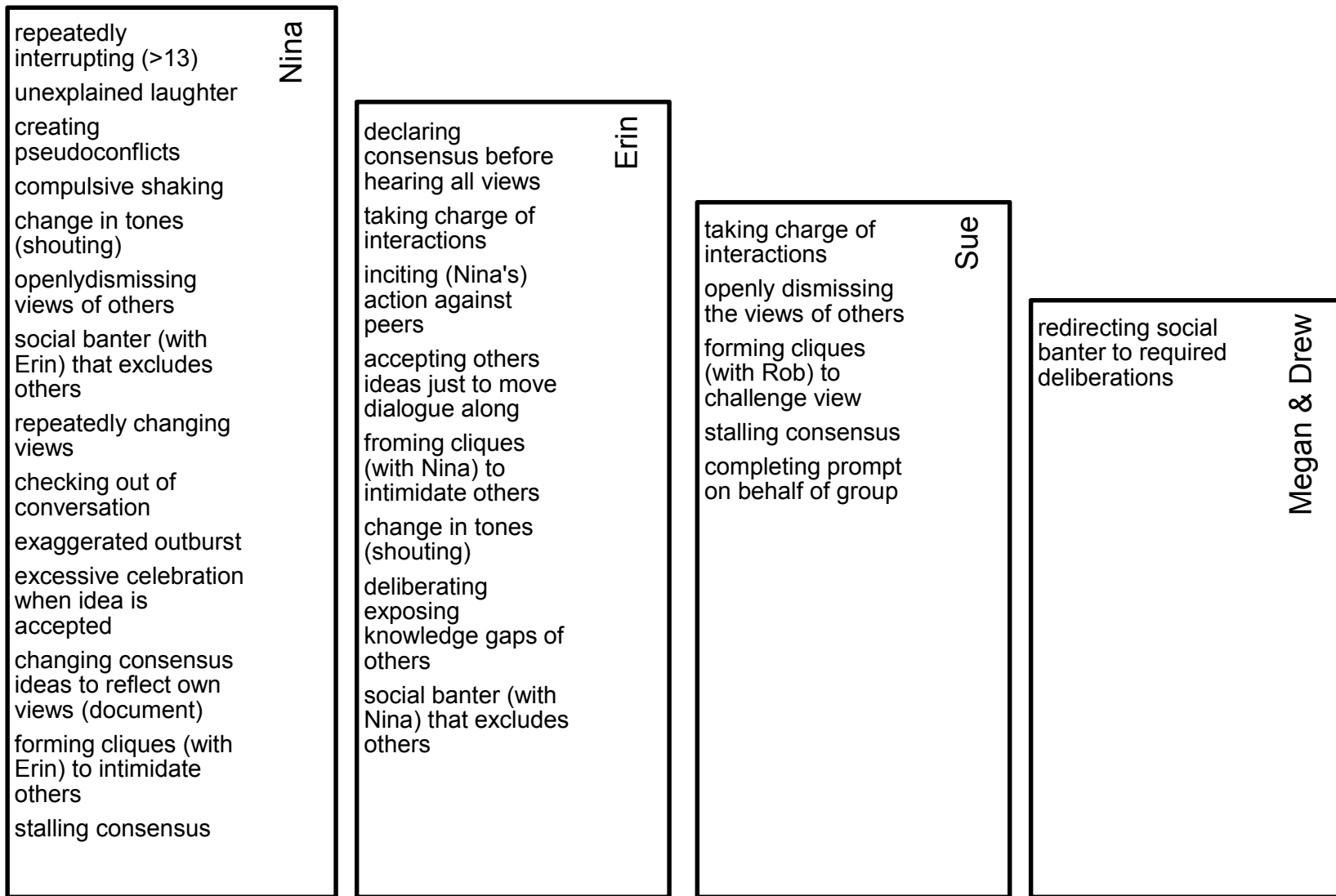


Figure 7-5. Deliberate power strategies employed during interactions.

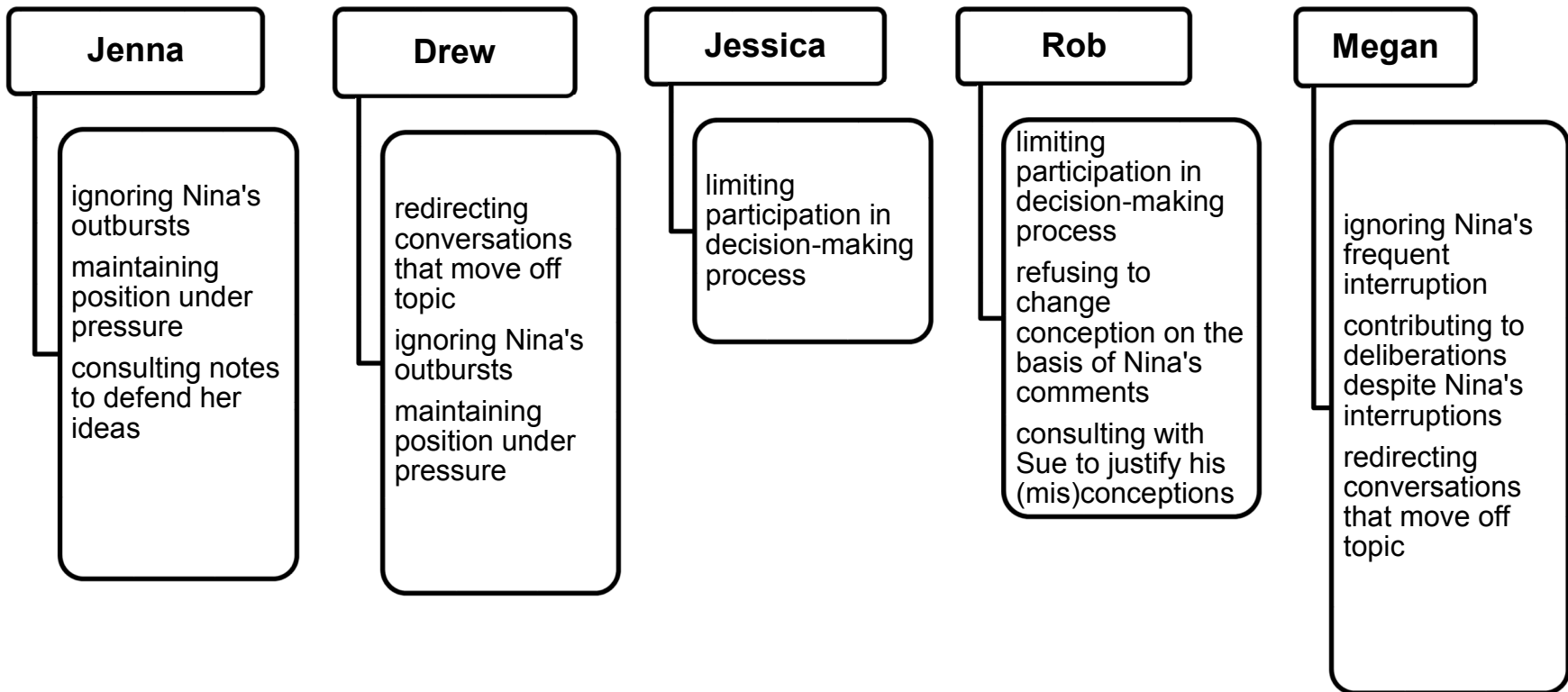


Figure 7-6. Reactive power strategies employed in the PLCs

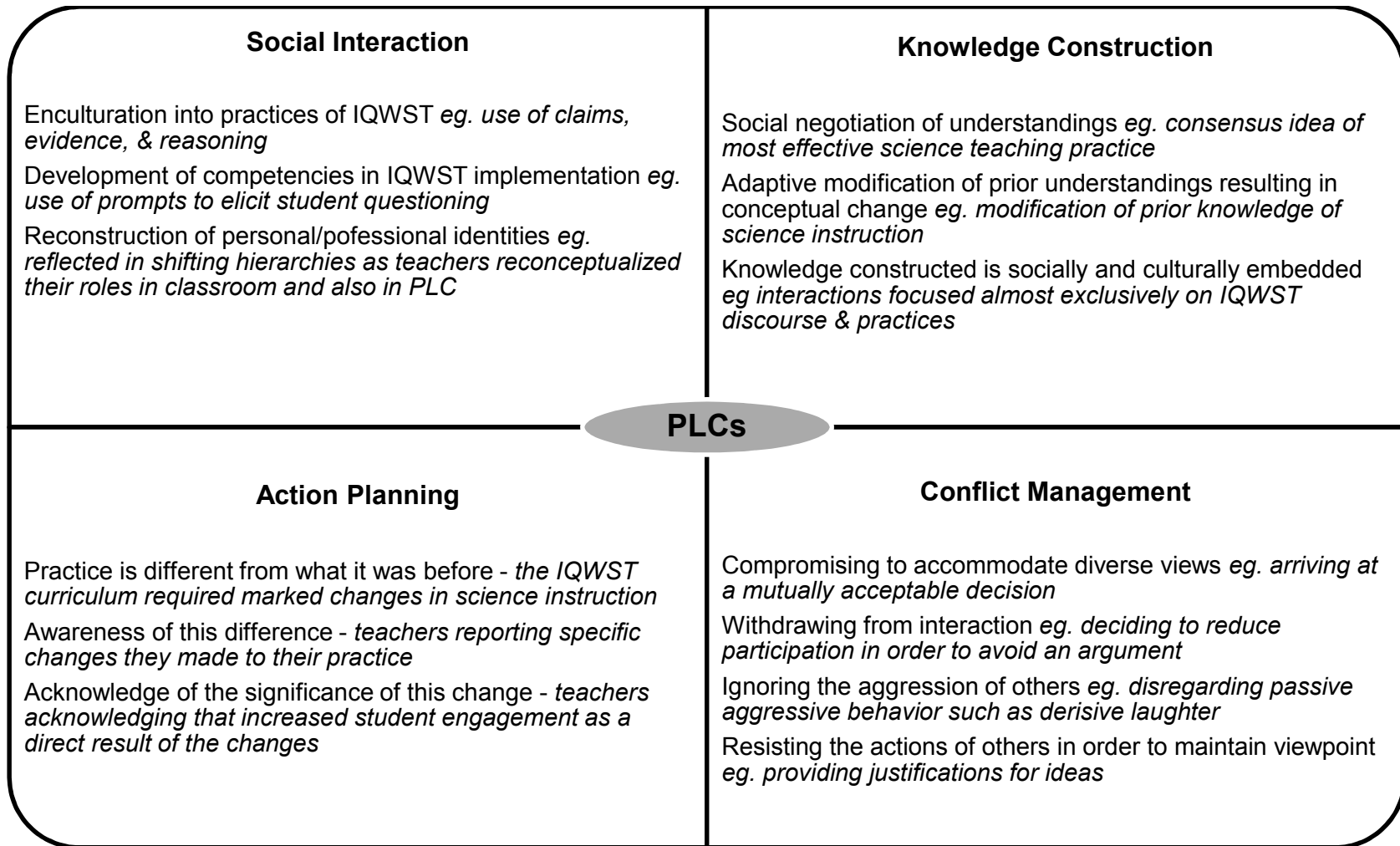


Figure 7-7. Opportunities for professional learning and development in PLCs

CHAPTER 8 IMPLICATIONS OF RESEARCH: AFTER THE GOLD RUSH

What Next?

According to the findings presented in Chapters 5 and 6 and discussed in Chapter 7, specific processes during social interactions in PLCs provided science teachers with numerous opportunities for learning and development. Additionally, the exercise of power enabled and enhanced the learning potential within these PLCs despite the looming possibilities of conflict. What then, does this mean for science teacher development? How can others see the value of these treasures, and find utility in the meanings derived? And what of the process of my inquiry? What can others glean from my experiences during the search for gold? How can this inform future searches for similar treasures? How can my inquiry create a springboard for future study? So important are these questions that I decided that addressing them explicitly would be the only way to achieve closure after a long yet gratifying journey. In this chapter, I will briefly outline what I perceive to be the implications of my findings for science teacher professional development. I will also explore the implications for research before finally sharing possibilities for further study.

What are the Implications for Science Teacher Professional Development?

The findings of this study suggest that the PLCs provided numerous opportunities for science teachers to make sense of the curriculum they were required to teach. Processes that occurred as a result of social interaction contributed to increased understandings as alternative conceptions were surfaced and replaced. Research reveals that science teachers often have alternative conceptions in the discipline they are required to teach (Smith 1997), which limit their ability to help

students develop complete understanding of core ideas in science. It is, therefore, imperative that science teachers be provided with multiple opportunities to extend their own understanding of the concepts they are required to teach. PLCs offer an excellent opportunity for teachers to talk about science content in a way that supports meaningful organization of concepts within the context of teaching and learning. Social interactions with a firm focus on science content could complement didactic methods of instruction aimed at enhancing subject matter knowledge in science teachers. In this way, science teacher professional learning is supported within PLCs comprising science teachers, science teacher educators, and STEM faculty.

The composition of the learning community appears to influence the knowledge constructed within PLCs. Misconceptions can quickly spread in a PLC if there is no one available to identify and address them in a way that will contribute to conceptual change. During science teacher interactions analyzed for this study, several misconceptions emerged that were not adequately addressed because the PLCs were composed solely of teachers, many of whom did not have the pedagogical and theoretical expertise to identify them. As a result, many of the science teachers went back to their classrooms harboring misconceptions that could impact their practice. This observation has implications for the establishment of PLCs for professional learning and development. Participants of the PLC should be carefully and strategically selected to ensure that the resources available meet the learning goals of the group. As such, if PLCs are established to provide a medium for science teachers to negotiate meaning about subject matter, the expertise of STEM faculty should be enlisted to support the process of meaning negotiation within the PLC. Likewise, if the learning goal of the PLC

focuses on effective science teaching strategies, a science teacher educator may be able to offer pedagogical support. By enhancing the cognitive support within the PLCs, science teachers will likely experience more meaningful and profound interactions that could lead to conceptual change, and hence professional learning.

The study indicated that power issues were prevalent in the PLCs. Key to addressing power issues is the establishment of specific norms of engagement in the practices of the group. In other words, professional development providers should consider designing rules and regulations that define the conditions under which interactions should proceed, and those actions that violate such terms. Collaboration among groups of individuals can be particularly challenging if the parties involved are unaware of potential pitfalls associated with the exercise of power in PLCs. Conflict management strategies could alleviate possible problems associated with the exercise of power during social interactions. Successful collaborations rely on the ability of participants to effectively communicate their ideas while being receptive to the perspectives of others. Ideally, university faculty members who interact with teachers in PLCs should relinquish any power status attributed to them by virtue of the disciplinary expertise or qualifications. This may be achieved by simply assuming the position of co-learner rather than dispenser of knowledge (Little 2002). Additionally, understanding that their roles are supportive rather than authoritative, faculty members will likely stimulate productive discussions with more successful outcomes.

If the goal of PLC interactions is to enhance professional learning and development, PLC activities should promote processes that contribute to meaning negotiation. The findings from this study indicate that well-designed activities stimulate

cognitive and active processes including reflection, reconceptualization, and restructuring of classroom learning environments. Professional development providers are encouraged, therefore, to structure learning experiences for science teachers that will create opportunities for professional learning. PLC interactions need to move beyond the mere exchange of teaching experiences to the critical examination of practice with a view to transforming science teaching and learning in a way that is consistent with evidence-based practice. The use of cases, teaching episodes, and peer mentoring should be considered as effective means of providing opportunities for development within the context of teachers' practice.

Research indicates that effective science professional development programs are embedded within the context of the school and teachers' practice (Duncombe & Armour 2004; Supovitz & Turner 2000). Indeed, findings from this study confirmed that the science teachers were able gain an understanding of inquiry within the context of the curriculum they were being prepared to implement. Professional development providers are, therefore, encouraged to situate science teachers' learning experiences within the school context and provide opportunities for them to take ownership of their development. One way to ensure this is to engage middle school science teachers in projects that result in the creation of curriculum materials that would have direct utility in their classrooms. Not only would teachers maintain ownership of the products created, but also the process would likely stimulate deliberate reflection on practice and contribute to overall professional growth. The potential for learning within PLCs can result in transformation of practices in the science classroom.

The actualization of the potential of PLCs is, therefore, key to maximizing learning and development of middle school science teachers. PLCs can be used to support formal learning occurring in graduate programs or science summer institutes. Findings from this study indicate that in PLCs, science teachers attempt to consolidate formal knowledge with prior knowledge as well as the practical knowledge of their peers. Social interactions provided cognitive support for those science teachers who were unable to construct concrete understandings during formal instruction. By exchanging views, teachers not only reinforced their conceptual understandings but also re-conceptualized these understandings within the context of their practice. From this perspective, PLCs may be established to complement formal instruction as well as to promote a deeper understanding of the practices science teachers adopt for their classrooms. In any case, the outcome will be more profound if professional development providers structure a field of action for science teachers that will ultimately guide them in their quest for improved instruction and enhanced student engagement.

What are the Implications for Science Education Research?

The study of social interactions within PLCs in order to unlock the processes that contribute to the efficacy of collaborative professional learning is an important step in maximizing the outcomes of collegial interactions. The findings of this study identified these processes with a view to understanding how PLCs operate as a site for learning and development for middle school science teachers who were implementing an inquiry curriculum. Uncovering these processes is significant to science education research because it demonstrates the value of integrating sustained collaborative interactions into science teacher professional development activities. To date, there is very little research within the field of science education that focuses on unlocking the potential of

collegial interaction for enhancing professional learning and development. Continued research in this field could undoubtedly contribute to enhancements to the design of collaborative activities for PLCs. Science teacher educators are committed to improving science teaching and learning and are constantly refining their strategies to accomplish these goals. This, and future studies of PLCs within the context of science education will play an important role in science teacher professional learning and development.

This study also unlocks the potential of discourse analysis in uncovering the 'what' and 'how' of science teacher learning. Interrogative tools designed for discourse analysis are able to identify, conceptualize, and assess science teacher learning during collaborative interactions. This becomes particularly important as professional development providers turn their attention to improving subject matter knowledge in middle school science teachers. In order to teach science as envisioned by the National Research Council (NRC), science teachers will have to relearn science concepts in a way that allows them to form essential connections among disciplines. Additionally, they have to be exposed to collaborative inquiry as a process to facilitate inquiry based instruction in the science classroom. As such, science teacher professional development will have to be revolutionized to meet the demands of the new framework for science education. Discourse analysis is a powerful tool for science teacher educators who wish to assess gains in science teacher knowledge and skills. This study has demonstrated the utility of discourse analysis in the determination of alternative frameworks, underlying beliefs of science teachers, and possible cognitive shifts during the course of interactions. To date, there are very few science education studies that employ this methodology in the analysis of data. Discourse analysis could play an

important role in evaluating learning outcomes during student-teacher interactions and teacher interactions within PLCs.

This study explored the exercise of power during social interactions in PLCs. This important aspect of collegial interaction is often disregarded in research. Exposing those power strategies typically employed by individuals who attempt to influence the process of collaborative meaning negotiation is key to the design of conflict management plans for PLCs. Power strategies could form the basis of a comprehensive professional development design that proactively addresses conflict in a way that maximizes positive outcomes of cognitive dissonance while minimizing the negative effects associated with strong disagreements. For instance, implementing structured activities aimed at surfacing teachers' misconceptions while establishing a protocol for behavior during interactions. Continued exploration of the exercise of power during collegial interactions will likely provide greater insight into the various ways in which issues of power should be addressed in PLCs to facilitate improved conditions for learning.

Finally, this study has demonstrated the value of theoretical constructs in uncovering hidden gems within data. Foucault's power/knowledge composite played an integral role in exposing subtle actions that could have potentially derailed meaning negotiation in the PLCs. Furthermore, this theoretical lens perceived the exercise of power to be productive with negative, but also positive outcomes. Very few studies in science education employ theories in the analysis of data presumably because theories are perceived to have more utility in social science research. The study of collegial interactions within PLCs, however, represents somewhat of an interdisciplinary approach to research that explores the social component of learning. The

interdisciplinary nature of this research necessitated the use of approaches not typically employed in pure science education research. The depth of analysis that the use of these lenses facilitated in this study begs further exploration of extra-scientific methodologies in the examination of professional learning and development of science teachers.

What Opportunities are there for Further Study?

This inquiry charts a course of study that could establish a platform for future studies in science teacher professional development with special focus on teacher learning. While this study explored collaborative learning among science teachers within a PLC, future studies could explore individual learning of the participants. What did the individual teachers learn as a result of the interaction? How did the interaction facilitate the reorganization of their conceptual frameworks? What are their perspectives of the efficacy of this type of learning? Would they have learned more if they individually read about or interacted with the information? How did social interaction contribute (if any) to individual changes in practice? As studies begin to examine transformations in science teaching, future studies could investigate the translation of learning within PLCs into practice. How did science teacher learning translate into practice? These investigations should be focused on classroom observations rather than teacher reports in order to provide an unbiased perspective of teachers' instructional strategies. Do teachers revert to familiar practices? If so, what factors contribute to this reversion? Are there possible ways to avert this reversion to original, ineffective practices? Are there specific challenges science teachers face when translating newly constructed knowledge into practice? Are science teachers resisting changes in a bid to exercise power? Is there

any value in imposing innovations on science teachers? How can we help science teachers to be creators rather than merely users of science knowledge?

A focus on teacher learning would also require studies on the process of teacher learning within PLCs. While this study identified specific processes that contributed to collaborative meaning negotiation, future studies could determine individual cognitive shifts during PLC activity. Studies of this nature would require an analysis of the origin or content of teacher knowledge and the shifts it undergoes during the course of the interaction. Additional studies should also be conducted of science teachers in the interactive activities of the PLCs. What are some factors that contribute to participation of teachers in collaborative activities? Can participation be considered an indication of learning? Do teachers who limit their participation in PLC activities also limit their scope of learning? What are some strategies that professional development providers may employ to maximize teacher participation? How can we ensure that all participants are provided with equal opportunity to contribute to interaction? Is it necessary that all participants speak during interactions? The future of research on PLCs lies in the determination of strategies to maximize professional learning of science teachers. Enhancing science teacher learning in PLCs while monitoring resultant effects on student learning will further validate collegial interaction as key to science teacher improvement.

What are the Limitations of this Study?

The key limitation of this study is related to the cultural specificity of the findings of the research. The PLC studied comprised middle school science teachers who were in the process of implementing an inquiry curriculum. These teachers were recruited from rural school districts with unique challenges and resources that often shape the

culture of their science classrooms. Additionally, the interactions within the PLC were specific to the implementation of IQWST, which has its own unique features and instructional strategies. The analysis of data during this research was embedded within these unique contexts and as such is not generalizable to other PLCs. This is not to say that the findings are useless. The findings of this research are applicable to the cohort of students within the embedded master's program that formed the basis of this research. Could we draw from these findings in order to design activities for collegial interaction among other science teachers from similar rural districts implementing the same curriculum? Absolutely. Could the findings of this study form the basis of design for activities for collegial interaction among science teachers in urban environments? Not without specific modifications. So this study, despite its limitation with respect to generalizability, can be replicated to the extent necessary to fit the context of the PLC to be established.

CHAPTER 9
EPILOGUE: WHAT IS ENLIGHTENMENT

My Enlightenment

I began this composition by waxing philosophical about my journey toward Enlightenment. Certainly, the expectation is that I have at least caught a glimpse of this elusive 'place' now that I have completed this composition. What exactly is Enlightenment, and why is it so important to me? There are several truth claims regarding Enlightenment, two of which I will share with you because they reflect aspects of my own perspectives and perceptions. Immanuel Kant, a German philosopher characterized Enlightenment as a process that "releases us from the status of immaturity" (Foucault 1984, p. 33). In this characterization, Kant perceives immaturity as a state in which individuals accept someone else's authority in cases calling for personal reasoning or rationalization. For instance, having a doctor decide for me what my diet will be. In other words, forget about personal convictions or reason; just submit to Babylon system. Do not think. Ask no questions. Accept that which you are told to do. Beginning doctoral students often find themselves in this all-familiar state of immaturity. A vulnerable state that oppresses the mind, the spirit, and the soul. According to Kant, maturity is achieved when we are no longer required to obey, to accept, or to acquiesce. Enlightenment then, is the process that leads to maturity.

Michel Foucault, a French philosopher, perceived Enlightenment as a set of cultural, political, and historical events that result in development, transformations, and even 'mutations' in science and technology. Foucault considered the constitution of the self as an autonomous subject as being rooted in the Enlightenment. This search for autonomy is therefore, key to Foucault's characterization of Enlightenment. But can one

achieve absolute autonomy under the Babylon system? Can anyone escape regimes of power that exist to control, direct, or dictate our activities? Can anyone reach the place that Foucault perceives Enlightenment to be? Enlightenment, according to Foucault, is therefore elusive.

What is My Enlightenment?

What, then, is my Enlightenment? It is a state of being, and of mind that frees us from regimes of power or Babylon systems. My journey to that state will never end because I will always be subjected to a Babylon system. From this perspective, Enlightenment does not exist. It remains an elusive dream that periodically infiltrates your subconscious with false promises of autonomy, self-actualization, and self-government. It razzles, dazzles, and frazzles the mind, making you weak with expectations and anticipations that at first seem reasonable yet are totally beyond human accomplishment. The journey, however, is worth taking. For on this path you will find valuable treasures, strange bedfellows, and peculiar personalities. You will learn about people, objects, and most importantly yourself. On this path, I passed the state of immaturity by achieving modest maturity as it relates to conceptualization and rationalization of ideas. Having completed this composition, I will probably be granted legitimacy into an academy of scholars. Then I will be subjected to a different set of rules and regulations, a different regime of power, a different Babylon system. So, is my journey over? Or has it just begun?

APPENDIX A
U-FUTuRES DOCUMENT #1: IQWST DISCOURSE PLAN

U-FUTuRES/Cadre Meeting/10.27

Group members: _____

IQWST Discourse Plan

Step 1: Summarize the science content presented in the lesson segment.

Step 2: Identify two IQWST discourse types that your group wants to incorporate into the lesson segment. Identify the purpose of incorporating each discourse type *in terms of what students will be able to do or know*.

IQWST discourse type #1 _____-The purpose of incorporating this discourse type is

IQWST discourse type #2 _____-The purpose of incorporating this discourse type is

Steps 3 and 4: Develop a list of at least 3 teacher questions to promote the two discourse types you identified in step 2. Identify possible student response for each of the questions you listed.

<p>Questions to promote IQWST discourse type #1</p> <hr/>	<p>Possible student responses:</p>
<p>Questions to promote IQWST discourse type #2</p> <hr/>	<p>Possible student responses:</p>

APPENDIX B
U-FUTuRES DOCUMENT #2: CLASSROOM DISCOURSE

Classroom Discourse

(Adapted from the IQWST Front Matter)

In IQWST, a give-and-take of ideas is the preferred form of classroom discourse. Teacher-led initiation-response-evaluation (IRE) talk should be used sparingly. Instead, classroom talk should center on engagement and *thoughtfulness*. Teachers pose questions that push students to think more deeply about what they have observed, experienced, or read. Students ask questions that arise out of their own interests or confusion—and they ask questions of each other as well as of the teacher.

Brainstorming: Involves sharing ideas without evaluating their validity

Includes prompts such as:

- How does _____ help us think about other times when _____?
- How can we put these 4 ideas together into one process that we might call —the water cycle? What happens 1st, 2nd . . . ?
- What do we know about _____ so far?
- How does this help us think about the driving question?
- Yesterday we talked about ____; how does today’s activity help us think about ____?
- How does this connect to _____?

Synthesizing: Involves putting ideas together, or assembling multiple activities into a coherent whole. May also include generalizing from specific activities to a more general conclusion.

Includes prompts such as:

- How does _____ help us think about other times when _____?
- How can we put these 4 ideas together into one process that we might call —the water cycle? What happens 1st, 2nd . . . ?
- What do we know about _____ so far?
- How does this help us think about the driving question?
- Yesterday we talked about ____; how does today’s activity help us think about ____?
- How does this connect to _____?

Pressing for Understanding: Involves figuring things out or making sense of readings or activities. Pressing for understanding means going deeper, beyond the surface answers.

Includes prompts such as:

- How does X compare with Y?
- How can . . .? How might . . . ?
- How do you know? What evidence supports that idea?
- What does it mean to say . . .?
- Why doesn’t our old model work to explain this new phenomenon?
- Why can’t . . .?
- How could we figure this out?
- What new questions do you have?

APPENDIX C
U-FUTuRES DOCUMENT #3: LEARNING GOALS

U-FUTuRES/Cadre Meeting/10.27

Learning Goal: Develop discourse plans to guide productive classroom discussion consistent with IQWST curriculum

A. Watch the video clip:

<http://www.youtube.com/watch?v=eG5Odw91KIw&feature=related>

B. Evidence and Claims

1. As a group, make two claims about the discourse type observed in the video.
2. Support each of your claims with at least four evidence (observations) from the video.
3. Discuss and note the science content knowledge to ensure familiarity by all group members.

C. Developing the Discourse Plan

1. Select any *two IQWST discourse types*.
2. In groups, discuss and devise a plan to extend the teaching activity to represent the *two IQWST discourse types* (that is, negotiate with your group members and redesign that section of the lesson to reflect teacher questions and possible student responses consistent with the discourse type).
3. Identify the purpose of that lesson segment (What do you hope students do and learn?), teacher questions, and possible student responses.
4. Your group response should be sequenced and include logical development of the science concept.
5. Include much specificity and attention to detail to best communicate the features of the discourse type you have selected.

D. Larger group interaction*

APPENDIX D
CONSENSUS DOCUMENT FOR INTERACTION # 1

U-FUTuRES/Cadre Meeting/10.27

Group members: _____

IQWST Discourse Plan

Step 1: Summarize the science content presented in the lesson segment.

- How does mass affect the rate at which an object swings? (falls)

Step 2: Identify two IQWST discourse types that your group wants to incorporate into the lesson segment. Identify the purpose of incorporating each discourse type *in terms of what students will be able to do or know*.

IQWST discourse type #1 pressing for understanding -The purpose of incorporating this discourse type is make sense of the two activities (pendulum & objects falling) in preparation for synthesis.

IQWST discourse type #2 Synthesizing -The purpose of incorporating this discourse type is tie the two activities together and relate them to scientific principles. Extend thinking beyond recall → tie to real life.

Steps 3 and 4: Develop a list of at least 3 teacher questions to promote the two discourse types you identified in step 2. Identify possible student response for each of the questions you listed.

<p>Questions to promote IQWST discourse type #1</p> <p><u>Synthesizing</u></p> <ul style="list-style-type: none"> Based on the results of the marble/bowling ball demo. ^{pendulum}, how are the two related happening w/ the bowling/marble? Despite the setups being different— why do we see such similarities? 	<p>Possible student responses:</p> <ul style="list-style-type: none"> Marble/ball ^{fall} - same rate light/heavy - swing same rate Still falling & still swinging
<p>Questions to promote IQWST discourse type #2</p> <p><u>Pressing</u></p> <ul style="list-style-type: none"> What evidence do we have that objects with different masses fall or swing at the same rate? How might the activity change with air resistance? View video w/ air resistance. Why doesn't this video follow our model? 	<p>Possible student responses:</p> <ul style="list-style-type: none"> Falling / gravity Air resistance

→ alternative discourse #2 on back

DISCUSSION

* Can you think of any situations where falling objects would behave differently than what we have observed?

* How could we test to see if these examples really do behave differently?

- a feather
- paper

'Do the same thing we did before but with these new objects''

APPENDIX E
EMERGING IDEAS FROM INTERACTION # 2

- Wait time - protocol for class
- Requiring evidence for claims
- Discourse
- Modify each other's work + statement
 - Add, modify, expand
- ② Collaboration - teaching collaboration
- ① Arguementation

LIST OF REFERENCES

- Achinstein, B. (2002). Conflict amid community: The micropolitics of teacher collaboration. *Teacher College Record*, 104(3), 421-455.
- Agger, B. (1991). Critical theory. Poststructuralism, postmodernism: Their sociological relevance. *Annual Review of Sociology*, 17, 105-131.
- Alvesson, M, & Karreman, D. (2000). Varieties of discourse: On the study of organizations through discourse analysis. *Human Relations*, 53(90), 1125-1149.
- American Association for the Advancement of Science [AAAS]. (1993). *Benchmarks for science literacy*. New York: Oxford University Press.
- Andrews, D., & Lewis, M. (2002). The experience of a professional community: Teachers developing a new image of themselves and their workplace. *Educational Research*, 44(3), 237-254.
- Bass, J. E., Contant, T. L., Carin, A. A. (2009). *Teaching science as inquiry*. New York: Pearson.
- Baxter, J. (2002). Competing discourses in the classroom: A poststructuralist discourse analysis of girls' and boys' speech in public contexts. *Discourse Society*, 13(6), 827-842.
- Bevir, M. (1999). Foucault, power, and institutions. *Political Studies*, XLVII, 345-359.
- Bloom, B. S, & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: The classification of educational goals, by a committee of college and university examiners. Handbook 1: Cognitive domain*. New York, Longmans.
- Bikner-Ahsbabs, A., & Prediger, S. (2010). Networking of theories – An approach for exploiting the diversity of theoretical approaches. In B. Sriraman & L. English (Eds). *Theories of Mathematics Education*, pp. 483-512. Springer: Verlag Berlin Heidelberg.
- Bolam, R. (2008). Professional learning communities and teacher professional development. In D. Johnson, & R. Maclean (eds), *Teaching: Professionalization, Development and Leadership*, Springer & Business Media, pp 159-179.
- Bolam, R., McMahon, A., Stoll, L., Thomas, S., & Wallace, M. (2005). Creating and sustaining professional learning communities. *Research Report Number 637, London, England: General Teaching Council for England, Department for Education and Skills*.
- Borko, H. (2004). Professional development and teacher learning: mapping the terrain. *Educational Researcher*, 33(8), 3-15.

- Boud, D., & Middleton, H. (2003). Learning from others at work: communities of practice and informal learning. *Journal of Workplace Learning, 15*(5), 194-202.
- Briscoe, F. (2005). A question of representation in educational discourse: Multiplicities and intersections of identities and positionalities. *Educational Studies, 38*(1), 23-41.
- Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.
- Brown, J. S., & Duguid, P. (1991). Organizational learning and communities-of-practice: Toward a unified view of working, learning, and innovation. *Organization science, 2*(1), 40-57.
- Burr, V. (2003). *Social constructionism*. Routledge: NY
- Capps, D. K., & Crawford, B. A. (2013). Inquiry-based professional development: What does it take to support teachers in learning about the nature of science? *International Journal of Science Education*, doi:10.1080/09500693.2012.760209
- Cheek, J. (2004). At the margins? Discourse analysis and qualitative research. *Qualitative Health Research, 14*, 1140-1150.
- Coburn, C. E. (2001). Collective sensemaking about reading: How teachers mediate reading policy in their professional communities. *Educational Evaluation and Policy Analysis, 23*, 145-170.
- Cochran-Smith, M., & Lytle, S. L. (1999). Relationships of knowledge and practice: Teacher learning in communities. In I.-N. Asghar & P. D. Pearson (Eds), *Review of Research in Education, 24*, pp. 249-305. Washington DC: American Educational Research Association.
- Crawford, B. (2000). Embracing the essence of inquiry: new roles for science teachers. *Journal of Research in Science Teaching, 37*(9), 916-937.
- Crotty, M. (1998). *The foundations of social research: Meaning and perspective in the research process*. Sage: CA.
- Curry, M. (2008). Critical friends groups: The possibilities and limitations embedded in teacher professional communities aimed at instructional improvement and school reform. *Teachers College Record, 110*(4), 733-774.
- Darling-Hammond, L. (1996). The quiet revolution: Rethinking teacher development. *Educational leadership, 53*(6), 4-10.
- Darling-Hammond, L. & Richardson, N. (2009). Teacher learning: What matters? *Educational Leadership, 46*-53.

- DeVita, F. (March 2010). *Light sensitive eye disorders*. Downloaded from: <http://www.livestrong.com/article/82831-lightsensitive-eye-disorders/>
- Deetz, S. (2003). Disciplinary power, conflict, suppression and human resources management. In M. Alvesson & H. Willmot (Eds), *Studying Management Critically*, pp. 23-45. London: Sage.
- Dewey, J. (1929). *The quest for certainty: A study of the relation of knowledge and action*. Minton Balch & Co: NY.
- Diaz-Bone, R., Buhrmann, A., Gutierrez Rodriques, E., Schneider, W., Kendall, G., & Tirado, F. (2007). The field of Foucaultian discourse analysis: Structures, developments and perspectives. *Forum: Qualitative Social Research, NA*. Retrieved from <http://www.qualitative-research.net/index.php/fqs/article/view/234/517>.
- Dooner, A., Mandzuk, D., & Clifton, R. A. (2008). Stages of collaboration and the realities of professional learning communities. *Teacher and Teacher Education, 24*, 564-574.
- Driver, R., Asoko, H., Leach, J., Scott, P., & Mortimer, E. (1994). Constructing scientific knowledge in the classroom. *Educational researcher, 23*(7), 5-12.
- Driver, R. & Erickson, G. (1983). Theories-in-action: Some theoretical and empirical issues in the study of students' conceptual frameworks in science. *Studies in Science Education, 10*(1), 37-60.
- Driver, R., Newton, P., & Osborne, J. (2000). Establishing the norms of scientific argumentation in classrooms. *Science Education, 84*, 287-312.
- DuFour, R. (2004). What is a professional learning community? *Educational Leadership, 1-6*.
- DuFour, R., & Eaker, R. (1998). *Professional learning communities at work: Best practices for enhancing student achievement*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Duncombe, R., & Armour, K. M. (2004). Collaborative professional learning: from theory to practice. *Journal of In-service Education, 30*(1), 141-166.
- Eraut, M. (1977). 'Strategies for promoting teacher development'. *Journal of In-Service Education, 4*(1-2), 10-12.
- Eraut, M. (2000). Non-formal learning and tacit knowledge in professional work. *British Journal of Educational Psychology, 70*, 113-136.

- Eraut, M. (2004). Informal learning in the workplace. *Studies in Continuing Education*, 26(2), 247-273.
- Fairclough, N. (2003). *Analysing discourse: Textual analysis for social research*. New York: Routledge.
- Falk, J. H. (2005). Free-choice environmental learning: framing the discussion. *Environmental Education Research*, 11(3), 265-280.
- Ferguson, C. (2002). Using the revised taxonomy to plan and deliver team-taught, integrated, thematic units. *Theory into Practice*, 41 (4), 239-244.
- Flick, U. (2009). *An introduction to qualitative research*. California: Sage.
- Florio Ruane, S. (1994). The future teachers' autobiography club: Preparing educators to support literacy learning in culturally diverse classrooms. *English Education*, 27, 11-39.
- Foucault, M. (1972). *The archaeology of knowledge*. London: Tavistock.
- Foucault, M. (1979). *Discipline and punish: The birth of the prison*. (A. Sheridan, Trans). New York: Vintage Books. (Original work published 1975).
- Foucault, M. (1980). Truth and power. In C. Gordon (Ed), *Power/knowledge: Selected interviews and other writings 1972-1977*. Hemel Hempstead: Harvester Wheatsheaf.
- Foucault, M. (1982). The subject and power. *Critical Inquiry*, 8, 777-795.
- Foucault, M. (1984). What is enlightenment? In P. Rainbow (Ed), *The Foucault Reader* (pp. 32-50). New York: Pantheon Books.
- Foucault, M. (1988). *Madness and civilization: A history of insanity in the age of reason*. (R. Howard, Trans). New York: Vintage Books. (Original work published 1961)
- Foucault, M. (1990). *The history of sexuality, Vol 2: The use of pleasure*. (R. Hurley, Trans). New York: Pantheon. (Original work published in 1984).
- Fox, N. J. (1998). Foucault, Foucauldian and sociology. *The British Journal of Sociology*, 49(3), 415-433.
- Fox, S. (2000). Communities of practice, Foucault and actor-network theory. *Journal of Management Studies*, 37(6), 855-867.

- Fraser, C., Kennedy, A., Reid, L., & McKinney, S. (2007). Teachers' continuing professional development: contested concepts, understandings and models. *Journal of In-Service Education*, 33(2), 153-169.
- Friedman, M. & Rosenman, R. (1959). Association of specific overt behavior pattern with blood and cardiovascular findings. *Journal of the American Medical Association* 169, 1286–1296.
- Gaventa, J., & Cornwall, A. (2001). Power and knowledge. In P. Reason & H. Bradbury (Eds), *Handbook of Action Research: Participative Inquiry and Practice* (pp. 70-80). London: Sage Publications.
- Gee, J. P. (1990). *Social linguistics and literacies*. London: Falmer.
- Gee, J. P. (2011). *An introduction to discourse analysis: Theory and method*. New York: Routledge.
- Gee, J. P., Green, J. L. (1998). Discourse analysis, and social practice: A methodological study. *Review of Research in Education*, 23, 119-169.
- Gergen, K. (1985). The social constructionist movement in modern social psychology, *American Psychologist*, 40(3), 266-275.
- Gergen, K. (1999). *An invitation to social construction*. London: SAGE
- Goodnough, K. (2010). Teacher learning and collaborative action research: Generating a “knowledge-of-practice” in the context of science education. *Journal of Science Teacher Education*, 21, 917-935.
- Gordon, M. (2009). Toward a pragmatic discourse of constructivism: reflections on lessons from practice. *Educational Studies*, 45, 39-58.
- Graham, L. J. (2005). *Discourse analysis and the critical use of Foucault*. Paper presented at Australian Association for Research in Education. Sydney.
- Grbich, C. (2007). *Qualitative data analysis: An introduction*. Sage: CA.
- Gredler, M. (2009). *Learning and instruction: Theory into practice*. Pearson Education: Upper Saddle River, NJ.
- Greeno, J. G. (1997). On claims that answer the wrong questions. *Educational researcher*, 26(1), 5-17.
- Greensfeld, H., & Elkad-Lehman, I. (2007). An analysis of the processes of change in two science teacher educators' thinking. *Journal of Research in Science Teaching*, 44(8), 1219-1245.

- Groundwater-Smith, S., & Mockler, N. (2009). What learning community? A knotty problem. *Teacher Professional Learning in an Age of Compliance*, 101-111.
- Guba, E. G., & Lincoln, Y. S. (1989). *Fourth generation evaluation*. California: Sage.
- Hall, S. (1997). The work of representation. In S. Hall (Ed), *Representation: Cultural representations and signifying practices*. London: Sage.
- Hall, G. E., & Hord, S. M. (2001). *Implementing change*. Boston: Allyn and Bacon.
- Harcourt, B. E. (2007). An answer to the question: "What is poststructuralism". *Public Law and Legal Working Paper*, 156, 1-31.
- Hardy, C., & Leiba-O'Sullivan, S. (1998). The power behind empowerment: Implications for research and practice. *Human Relations*, 51, 451-483.
- Hargreaves, A., & Dawe, R. (1990). Paths of professional development: Contrived collegiality, collaborative culture, and the case of peer coaching. *Teacher and Teacher Education*, 6(3), 227-241.
- Harrn, A. (May 13, 2011). *What is passive aggressive behavior?* Retrieved from <http://www.counselling-directory.org.uk/counsellor-articles/what-is-passive-aggressive-behaviour>
- Henneman, E. A. (1995). Nurse-physician collaboration: A poststructuralist view. *Journal of Advanced Nursing*, 22, 359-362.
- Hewson, P. W. (2007) Teacher professional development in science. In S. Abell & N. Lederman (Eds), *Handbook of Research in Science Education*, pp. 1179-1203. Mahwah NJ: Lawrence Erlbaum Associates.
- Hirsch, S. (2009). A new definition. *JSD*, 30(4), 10-16.
- Hollins, E. R., McIntyre, L. R., DeBose, C., Hollins, K. S., & Towner, A. (2004). Promoting a self-sustaining learning community: Investigating an internal model for teacher development. *International Journal of Qualitative Studies in Education*, 17(2), 247-264.
- Hook, D. (2001). Discourse, knowledge, materiality, history: Foucault and discourse analysis. *Theory and Psychology*, 11(4), 521-547.
- Hord, S. M. (1997). Professional learning communities: What are they and why are the important? *Issues about Change*, 6(1). Retrieved from: <http://www.sedl.org/change/issues/issues61.html>

- Horn, I. S. (2010). Teaching replays, teaching rehearsals, and re-visions of practice: Learning from colleagues in a mathematics teacher community. *Teachers College Record*, 112(1), 225-259.
- Horn, I. S., & Little, J. W. (2010). Attending to problems of practice: Routines and resources for professional learning in teachers' workplace interactions. *American Educational Research Journal*, 47(1), 181-217.
- IQWST: Investigating and questioning our world through science and technology – Front Matter (p. 6-52). The curriculum was written by a research team funded by NSF <http://www.umich.edu/~hiceweb/iqwst/index.html>. The version of the front matter cited was provided by Joseph Krajcik.
- Jorgensen, M., & Phillips, L. J. (2002). *Discourse analysis as theory and method*. London: Sage.
- Kazemi, E., & Franke, M. L. (2004). Teacher learning in mathematics: Using student work to promote collective inquiry. *Journal of Mathematics Teacher Education*, 7, 203-235.
- Kelly, P. (2006). What is teacher learning? A socio-cultural perspective. *Oxford Review of Education*, 32(4), 505-519.
- Koro-Ljungberg, M. (2008). Positivity in qualitative research: examples from the organized field of postmodernism/poststructuralism. *Qualitative Research*, 8, 217-236.
- Koro-Ljungberg, M., Yendol-Hoppey, D., Smith, J. J., & Hayes, S. B. (2009). (E)pistemological awareness, instantiation of methods, and uniformed methodological ambiguity qualitative research projects. *Educational Researcher*, 38, 687-699.
- Knight, P. (2002). A systemic approach to professional development: learning as practice. *Teacher and Teacher Education*, 18, 229-241.
- Kvale, S. (1995). The social construction of validity. *Qualitative Inquiry*, 1(1), 19-40.
- Langewiesche, W. (May 2013). The man who pierced the sky. *Vanity Fair*. Retrieved from <http://www.vanityfair.com/culture/2013/05/felix-baumgartner-jump-story>
- Lather, P. (1986). Issues of validity in openly ideological research: between a rock and a hard place. *Interchange*, 17(4), 63-84.
- Lather, P. (1993). Fertile obsession: validity after poststructuralism. *The Sociological Quarterly*, 34(4), 673-693.

- Lave, J. (1991). Situating learning in communities of practice. In L. B. Resnick, J. M. Levine, & S. D. Teasley (Eds), *Perspectives on socially shared cognition*, Washington DC: American Psychological Association.
- Lave, J., & Wenger, E. (1991). *Situated learning: legitimate peripheral participation*. New York, NY: Cambridge University Press.
- Law, J. (2004). *After method: mess in social science research*. New York: Routledge.
- Lee, M. & Johnson-Bailey, J. (2004). Challenges to the classroom authority of women of color. *New Directions for Adult and Continuing Education*, 102, 55-64.
- Lenzo, K. (1995). Validity and self-reflexivity meet poststructuralism: Scientific ethos and the transgressive self. *Educational Researcher*, 24(4), 17-23&45.
- Levine, T. H., & Marcus, A. S. (2010). How the structure and focus of teachers' collaborative activities facilitate and constrain teacher learning. *Teaching and Teacher Education*, 26, 389-398.
- Lima, J. A. (2001). Forgetting about friendship: Using conflict in teacher communities as a catalyst for school change. *Journal of Education Change*, 2, 97-122.
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. California: Sage.
- Little, J. W. (1987). Teachers as colleagues. In V. Richardson-Koehler (Ed), *Educators' Handbook: A Research Perspective*, pp. 491-518. Longman: NY.
- Little, J. W. (1990). The persistence of privacy: Autonomy and initiative in teachers' professional relations. *Teachers College Record*, 91(4), 509-536.
- Little, J. W. (1993). Teachers' professional development in a climate of educational reform. *Education Evaluation, and Policy Analysis*, 15(2), 129-151.
- Little, J. W. (2002). Locating learning in teachers' communities of practice: opening up problems of analysis in records of everyday work. *Teacher and Teacher Education*, 18, 917-946.
- Little, J. W. (2003). Inside teacher community: Representations of classroom practice. *Teachers College Record*, 105(6), 913-945.
- Little, J. W., & Curry, M. W. (2008). Structuring talk about teaching and learning: The use of evidence in protocol-based conversation. In L. M Earle & H. Timperley (Eds), *Professional learning conversations: Challenges in using evidence for improvement*. Springer Science & Business Media.

- Lorsbach, A., & Tobin, K. (1992). Constructivism as a referent for science teaching. In F. Lorenz, K. Cochran, J. Krajcik, & P. Simpson (Eds) *Research Matters...to the Science teacher. NARST Monograph, Number Five*. Manhattan, KS.
- Loucks-Horsley, S. & Matsumoto, C. (1999). Research on professional development for teachers of mathematics and science: the state of the scene. *School Science and Mathematics, 99*(5), 258-271.
- Louis, K. S. & Kruse, S.D. (1995). *Professionalism and community: Perspectives on reforming urban schools*. Thousand Oaks, California: Corwin Press.
- Louis, K. S. Marks, H. M. (1998). Does professional community affect the classroom? Teachers' work and student experiences in restructuring schools. *American Journal of Education, 106*, 532-575.
- Luke, A. (1995). Text and discourse in education: An introduction to critical discourse analysis. *Review of Research in Education, 21*, 3-48.
- Lumpe, A. (2007). Research-based professional development: Teachers engaged in professional learning communities. *Journal of Science Teacher Education, 18*, 125-128.
- Lyotard, J. (1984). *The postmodern condition*. University of Minnesota Press: MN.
- Marlow, M. P., Wright, J. L., & Hand, J. D. (2003). A paleontology network inquiry consortium: impact on practice. *Journal of Geoscience Education, 51*(3), 317-321.
- Martin, L. M. (2004). An emerging research framework for studying informal learning and schools. *Science Education, 88*(Suppl. 1), S71-S82.
- Maxwell, J. A. (1992). Understanding and validity in qualitative research. *Harvard Educational Review, 62*(3), 279-300.
- McHoul, A., & Grace, W. (1997). *A Foucault primer: Discourse, power, and the subject*. NYU Press: NY.
- McLaughlin, M. W., & Talbert, J. E. (1993). Introduction: New visions of teaching. *Teaching for understanding, 1-10*.
- McNamee, S. & Gergen, K.J. (1999). *Relational responsibility: Resources for sustainable dialogue*. Thousand Oaks, California: Sage Publications.
- McNeill, K. L. & Krajcik, J. (2007). Inquiry and scientific explanation: helping students use evidence and reasoning. In J. Luft, R. Bell, & J. Gess-Newsome (Eds), *Science as inquiry in the secondary setting*, (pp. 121-134), NSTA press.

- Michaels, S., Shouse, A. W., & Schweingruber, H. A. (2008). *Ready, set, science: putting research to work in K-8 science classrooms*. Washington, DC: National Academy.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: an expanded sourcebook (2nd)*. Thousand Oaks, California: Sage.
- Minner, D. D., Levy, A. J., Century, J. (2010). Inquiry-based science instruction – what is it and does it matter? Results from a research synthesis years 1984 to 2002. *Journal of Research in Science Teaching*, 47(4), 474-496.
- Morse, J. M., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). *International Journal of Qualitative Methods*, 1(2), 13-22.
- National Research Council [NRC]. (2012). *A framework for K-12 science education: Practices, cross cutting concepts and core ideas*. Washington DC: Academies Press.
- Nicholls, D. A. (2009). Putting Foucault to work: an approach to the practical application of Foucault's methodological imperatives. *Aporia*, 1(1), 30-40.
- Olssen, M. (2003). Structuralism, post-structuralism, neo-liberalism: Assessing Foucault's legacy. *Journal of Education Policy*, 18(2), 189-202.
- Palinscar, A. S., Magnusson, S. J., Marano, N., Ford, & Brown, N. (1998). Designing a community of practice: principles and practices of the GIsML community. *Teacher and Teacher Education*, 14(1), 5-19.
- Paavola, S., Lipponen, L., & Hakkarainen, K. (2004). Models of innovative knowledge communities and three metaphors of learning. *Review of Educational Research*, 74(4), 557-576.
- Parker, I. (2004). Discourse analysis. In U. Flick, E. Von Kardoff, I. Steinke, A *companion to qualitative research*, pp 308-312. Thousand Oak, California: Sage.
- Potter, J., & Wetherall, M. (1987). *Discourse and social psychology: Beyond attitudes and behavior*. London: Sage.
- Powers, P. (2007). The philosophical foundations of Foucaultian analysis. *Critical Approaches to Discourse Analysis across Disciplines*, 1(2), 18-34.
- Rehm, M. & Allison, B. (2006). Positionality of teaching culturally diverse students: Implications for family and consumer sciences teacher education programs. *Family and Consumer Sciences Research Journal*, 34(3), 260-275.

- Rennie, L. J., Feher, E., Dierking, L. D., & Falk, J. H. (2003). Toward an agenda for advancing research on science learning in out-of-school settings. *Journal of Research in Science Teaching*, 40(2), 112-120.
- Rennie, L. J., & Johnston, D. J. (2004). The nature of learning and its implications for research on learning from museums. *Science Education*, 88(1), S4-S16.
- Richardson, L. (2000). Writing: A method of inquiry. In, N. K. Denzin and Y. S. Lincoln (Eds) *Handbook of Qualitative Research (2nd Edition)*, pp. 923-948.
- Rodgers, R., Malancharuvil-Berkes, E., Mosley, M, Hui, D., & O'Garro Joseph, G. (2005). Critical discourse analysis in education: A review of the literature. *Review of Educational Research*, 75(3), 365-416.
- Roseberry, A. S., & Puttick, G. M. (1998). Teacher professional development as situated sense-making: A case study in science education. *Science Education*, 82, 649-677.
- Roseberry, A. S., & Warren, B. (1998). *Interanimation among discourses: one approach to studying learning in teacher research communities*. Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.
- Rosenholtz, S. (1989). *Teacher's workplace: The social organization of schools*. New York: Longman.
- Rowe, M. B. (1972). *Wait-time and rewards as instructional variables, their influence in language, logic, and fate control*. Paper presented at the National Association for Research in Science Teaching, Chicago, IL, 1972. ED 061 103.
- Sandoval, W., & Reiser, B. (2004). Explanation-driven inquiry: Integrating conceptual and epistemic scaffolds for scientific understanding. *Science Education*, 88, 345-372.
- Savery, J. R., & Duffy, T. M. (1996). Problem based learning: An instructional model and its constructivist framework. In B. G. Wilson *Constructivist learning environments: case studies in instructional design*, pp. 135-148.
- Scheurich, J., & McKenzie, K. (2005). Archaeology and genealogy. In N. Denzin & Y. Lincoln (Eds). *The Sage Handbook of Qualitative Research*, 841-868. California: Sage Publications.
- Scribner, J. P., Sawyer, R. K., Watson, S. T., & Myers, V. L. (2007). Teacher teams and distributed leadership: A study of group discourse and collaboration. *Educational Administration Quarterly*, 43(1), 67-100.

- Senge, P. (1990). *The fifth discipline: the art and practice of the learning organization*. London: Random House.
- Shulman, L. S. (1986). Those who understand: knowledge growth in teaching. *Educational Researcher*, 15(2), 4-14.
- Shulman, L. S., & Shulman, J. H. (2004). How and what teachers learn: a shifting perspective. *Journal of Curriculum Studies*, 36(2), 257-271.
- Smith, R. G. (1997). "Before teaching this, I'd do a lot of reading" Preparing primary teachers to teach science. *Research in Science Education*, 27(1), 141-154.
- Snow-Gerono, J. L. (2005). Professional development in a culture of inquiry: PDS teachers identify the benefits of professional learning communities. *Teaching and Teacher Education*, 21, 241-256.
- Sondergaard, D. M. (2002). Poststructuralist approaches to empirical analysis. *International Journal of Qualitative Studies in Education*, 15(2), 187-204.
- Sprague, D., & Dede, C. (1999). Constructivism in the classroom: If I teach this way, am I doing my job? *Learning & Leading with technology*, 27(1), 6-9.
- Stahl, Robert J. (1990). *Using "think-time" behaviors to promote students' information processing, learning, and on-task participation. An instructional module*. Tempe, AZ: Arizona State University.
- Stoll, L., Bolam, R., McMahon, A., Wallace, M., & Thomas, S. (2006). Professional learning communities: A review of the literature. *Journal of Educational Change*, 7, 221-258.
- Templin, T. J. (1988). Teacher isolation: A concern for the collegial development of physical educators. *Journal of Teaching in Physical Education*, 7, 197-205.
- Thayer-Bacon, B. (2003). Pragmatism and feminism as qualified relativism. *Studies in Philosophy and Education*, 22, 417-438.
- Thomas, G., Wineburg, S., Grossman, P., Myhre, O., & Woolworth, S. (1998). In the company of colleagues: An interim report on the development of a community of teacher learners. *Teaching and Teacher Education*, 14(1), 21-32.
- Tobin, K. (1987). The role of wait time in higher cognitive level learning." *Review of Educational Research* 57.69-95.
- Tobin, K. & Tippins, D. (1993). Constructivism as a referent for teaching and learning in *The Practice of Constructivism in Science Education*. Washington:AAAS.

- Van Driel, J. H., Beijaard, D., Verloop, N. (2001). Professional development and reform in science education: The role of teachers' practical knowledge. *Journal of Research in Science Teaching*, 38(2), 137-158.
- Vescio, V., Ross, D., & Adams, A. (2008). A review of research on the impact of professional learning communities on teaching practice and students learning. *Teacher and Teacher Education*, 24, 80-91.
- Vick, M. (2006). Poststructuralist theory and methodology: A complementary approach to road safety research. *Proceedings of the 2006 Road Safety Research, Policing, and Education Conference, Gold Coast*.
- Webster-Wright, A. (2009). Reframing professional development through understanding authentic professional learning. *Review of Educational Research*, 79(2), 702-739.
- Wilson, S. M., & Berne, J. (1999). Teacher learning and the acquisition of professional knowledge: An examination of research on contemporary professional development. In I.-N. Asghar & P. D. Pearson (Eds), *Review of Research in Education*, 24, pp. 173-209. Washington DC: American Educational Research Association.
- Wineberg, S. & Grossman, P. L. (1998). Creating a community of learners among high school teachers. *Phi Delta Kappan*, 79, 350-353.
- Wood, D. R. (2007). Professional learning communities: Teachers, knowledge, and knowing. *Theory into Practice*, 46(4), 281-290.
- Yilmaz, K. (2008). Constructivism: its theoretical underpinnings, variations and implications for classroom instruction. *Educational Horizons*, 161-172.

BIOGRAPHICAL SKETCH

Cheryl McLaughlin graduated from the University of the West Indies, Mona Campus in 1994 with a Bachelor of Science in Zoology. After graduating, she spent a year as a research assistant with the Tropical Metabolic Research Unit (TMRU) at the University Hospital of the West Indies. She was involved in a project that investigated the impact of poor nutrition on the academic performance of elementary school children in the rural parishes of Jamaica. At the end of her contract period, Cheryl received a scholarship from the Petroleum Corporation of Jamaica to pursue graduate studies in energy and environmental studies. In 1998, she graduated from the University of West Indies with a Master of Philosophy (MPhil) in Botany with a specialization in environmental studies. The MPhil is an advanced postgraduate degree, which was granted to Cheryl after several years of original research into the environmental impact of biofuel production in Jamaica. After her postgraduate studies, Cheryl was immediately employed by the Petroleum Corporation of Jamaica to conduct further research in the bioenergy department. At the end of her contract period, she was employed as an instructor at the Bahamas Baptist Community College in Nassau, Bahamas. While employed to the Community College, she taught college prep biology and chemistry, college biology, and science content courses in the education department. She also served as chair for the natural sciences department.

In 2008, she enrolled in a graduate degree program at St John's University in New York. After two years of study, she graduated with a Master of Science in Education and immediately enrolled at the University of Florida to pursue a PhD program in curriculum and instruction with a concentration in science education. Cheryl graduated from this program in 2014 and was appointed as a postdoctoral researcher at

the University of Florida where she works collaboratively with the College of Education and the Florida Museum of Natural History. She continues her research in science teacher professional development, specifically developing and testing models aimed at engendering transformative pedagogies and enhancing student learning.