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NEW SCIENCE TEACHERS' DESCRIPTIONS OF INQUIRY ENACTMENT

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by

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ABSTRACT

This phenomenological study demonstrates the influence that affective factors have on beginning teachers' ability to enact instructional practices. Through narratives shared in interviews and web log postings, two beginning science teachers' emotional engagement with their instructional practices, especially that of implementing inquiry-based instruction, and the resulting impact these emotions had on professional decision-making were evidenced. Anxiety emerged as the most significant impacting emotion on instructional decision-making with the participants. Through their stories, the two participants describe how their emotions and views of self influence whether they continue using inquiry pedagogy or alter their lesson to adopt more didactic means of instruction. These emotions arise from their feelings of being comfortable teaching the content (self-efficacy), from the unpredictability of inquiry lessons (control beliefs), from how they perceive their students as viewing them (teacher identity) and from various school constraints (agency). This research also demonstrates how intertwined these aspects are, informing each other in a complex, dialectical fashion. The participants' self-efficacy and professional identity emerge from their interactions with the community (their students and colleagues) and the perceived agency afforded by their schools' curricula and administration. By providing descriptions of teachers' experiences enacting inquiry pedagogy, this study expands our understanding of factors that influence teachers' instructional practices and provides a basis for reforming science teacher preparation.

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DEDICATION

This dissertation is dedicated to the love of my life, Tanya Dreon.

CHAPTER 1: INTRODUCTION

Inquiry pedagogy is not a new concept in science education. John Dewey (1910), writing almost a century ago, criticized teaching science as “an accumulation of ready-made material with which students are to be made familiar.” Dewey instead proposed teaching science as inquiry to help students develop “a method of thinking, an attitude of mind, after the pattern of which mental habits are to be transformed.” Throughout the 1900’s, other influential scholars echoed these sentiments and developed curricula to help promote inquiry pedagogy in schools (Rutherford, 1964; Schwab, 1958). With the release of *Benchmarks for Scientific Literacy* (1993), *National Science Education Standards* (1998) and *Inquiry and the National Science Education Standards* (2000), organizations like the American Association for the Advancement of the Sciences (AAAS) and the National Research Council (NRC) joined those calling for the reform of science education and the inclusion of inquiry science pedagogy. Since the release of these documents, many schools of education across the country have developed programs to prepare science teachers to teach science as inquiry (e.g. Windschitl, 2002). Despite these efforts, however, the state of science education remains relatively unchanged. Welch et al (1981) write that “the widespread espoused support of inquiry is more simulated than real in practice” (p. 40). While these sentiments were written almost thirty years ago, the current status of inquiry use in America does not appear to have changed much (Anderson, 2002; Smith & Gess-Newsome, 2004; Tobin et al., 1994; Wells, 1995). Despite efforts promoting inquiry pedagogy, science is still being taught in many classrooms though “inculcation and exercise,” where learning occurs through the “rhetoric of conclusions, omitting all evidence, interpretation, doubt and debate” (Schwab, 1958, p. 375).

Traditionally, educational organizations have relied upon new teachers to help carry reforms to schools. As Davis et al (2006) write,

New teachers are crucial for enacting and spreading reforms—many learn about current reform movements in their teacher education programs and thus seem most likely to be able to adopt and promote reform-oriented instruction. (p. 608)

Although they are relied upon to be critical components for the transmission of educational reforms, new teachers may be ill prepared to navigate the culture of schools and fill this role. For example, new teachers may find enacting inquiry pedagogy challenging. Although many teacher preparation programs present the National Science Education Standards and inquiry pedagogy with the hopes of aiding the reform movement, there is not a widely-established operational definition of inquiry pedagogy (Abd-El-Khalick et al., 2004). This can frustrate a beginning teacher in knowing how to enact inquiry pedagogy in a classroom setting. Additionally, since many practicing science teachers have not adopted the reforms outlined in the NSES, new teachers may find little support when implementing inquiry pedagogy within the science curriculum in their schools. These factors may influence a beginning teacher's ability to enact inquiry pedagogy within the existing culture of a school and impact a new teacher's long-term commitment to its use. These challenges form the context of the research presented here.

This dissertation helps to fill a specific gap in the research regarding new science teachers identified by Davis et al. (2006). After conducting a comprehensive review of the challenges that new teachers face, Davis and her colleagues report that “the standards emphasize inquiry-oriented science teaching, yet our review of the literature tells us very little about new teachers' understandings of inquiry, how they teach inquiry, or what specific challenges they face in doing so”(p. 636). While they identify a great deal of research that studied different aspects of new

teachers, most of the research tended to focus on new teachers' cognitive abilities and examined, for example, teachers' subject matter knowledge (eg. Appleton & Kindt, 2002; Tabachnick & Zeichner, 1999) and their understanding of the nature of science (eg. Lawson, 2002; Windschitl, 2003). Little research was identified that focused on new teachers' experiences using inquiry pedagogy or the development of "personal characteristics" such as identity, self-efficacy or agency.

In response to these areas, this dissertation examines the following research question: How do beginning science teachers describe their experiences enacting inquiry science pedagogy? Utilizing a hermeneutic phenomenological approach, this dissertation focuses on the lived experiences on two new science teachers and details how the individuals describe their experiences enacting inquiry pedagogy within the culture of schools. This dissertation demonstrates the influence that affective factors have on beginning teachers' ability to enact instructional practices. Through the narratives collected from various sources (interviews, weblogs, etc), two beginning science teachers' emotional engagement with their instructional practices, especially that of implementing inquiry-based instruction, and the resulting impact these emotions had on professional decision-making were evidenced. Anxiety emerged as the most significant impacting emotion on instructional decision-making with the participants. Through their stories, the two participants describe how their emotions and views of self influence whether they will continue using inquiry pedagogy or alter their lesson to adopt more didactic means of instruction. These emotions arise from their feelings of being comfortable teaching the content (self-efficacy), from the unpredictability of inquiry lessons (control beliefs), from how they perceive their students as viewing them (teacher identity) and from various school constraints regarding their role as a professional teacher (agency). This research also

demonstrates how intertwined these aspects are, informing each other in a complex, dialectical fashion. The participants' self-efficacy and professional identity emerge from their interactions with the community (their students and colleagues) and the perceived agency afforded by their schools' curricula and administration. By providing descriptions of teachers' experiences enacting inquiry pedagogy, this study expands our understanding of affective factors that influence teachers' instructional practices. These findings also communicate important implications for those individuals charged with preparing, employing or studying new science teachers. For example, teacher preparation programs need to include more inquiry-based content courses and field experiences to help new teachers become more comfortable teaching science through inquiry. These courses and experiences need to include reflective opportunities to aid new teachers in the recognition and reification of their professional identities. On the district level, schools need to include induction experiences that not only socialize new teachers into the community but also support the emotional and personal aspects communicated in this dissertation. For researchers studying new science teachers, this dissertation details the influence that affective dimensions have over new teachers' instructional practices and communicates the need to expand the lens to include these factors when studying teachers' use of inquiry pedagogy.

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CHAPTER 2: REVIEW OF LITERATURE

The research presented in this dissertation focuses on the experiences of two beginning teachers enacting inquiry science pedagogy in their classrooms. Throughout the chapters in this dissertation, I use terms such as “inquiry” and “identity.” Although these terms are used in our everyday language, it is important to know what these words mean not just in a colloquial sense, but also within the rich historical nature of the research communities from which these terms emerge. In this chapter, I explicate each of these terms within their respective research areas and present literature that have been critical influences on my work. I outline the history of inquiry pedagogy in the United States and the research that focuses on beginning science teachers and professional teacher identity. I conclude this chapter by situating this dissertation within the existing scope of research and describing how it builds upon prior work.

Inquiry Science Pedagogy

Over a decade ago, the American Association for the Advancement of Sciences (AAAS) published *Benchmarks for Scientific Literacy* (1993) in an effort to communicate to schools what students should know and be able to do in science, mathematics and technology. A focus of this publication was developing students’ understanding of the nature of science through their engagement in scientific inquiry. Although an explicit definition of scientific inquiry is never provided within the document, the authors propose involving students in “investigations that more closely approximate sound science” (AAAS, 1993, p. 9). These investigations, the authors suggest, will help students understand how scientists develop explanations through their

observations. This theme spans across the grade-level benchmarks without any comprehensive discussion of how the process would be implemented in actual classroom practice.

Building upon this work, the National Research Council (NRC) published *National Science Education Standards* (1998) which posits the AAAS benchmarks into standards for teaching. A central theme to the standards is scientific inquiry, which the authors define as:

“a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already know in light of experimental evidence; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predications; and communicating the results.” (NRC, 1998, p. 23)

Viewing inquiry from this perspective, the authors suggest, takes inquiry “a step beyond ‘science as a process’ in which students learn skills, such as observation, inference, and experimentation” (NRC, 1998, p. 105). Instead, the focus becomes the “processes of science” which requires students to “combine processes and scientific knowledge as they use scientific reasoning and critical thinking to develop their understanding of science” (NRC, 1998, p. 105). In addition to providing a more explicit definition of scientific inquiry than the AAAS Benchmarks, the NSES provides a detailed list of how the emphases of a scientific classroom needs to change to better cultivate student learning through inquiry. One of the most significant changes, the authors write, is decreasing the emphasis on “knowing scientific facts and information” and increasing the emphasis on “understanding scientific concepts and developing abilities of inquiry” (NRC, 1998, p. 113).

Anderson (2002) identifies that the NSES actually presents three distinct views of inquiry within its standards: scientific inquiry, inquiry learning and inquiry teaching. The standards related to *scientific inquiry* involve students developing an understanding of how science functions. The NSES also includes *inquiry learning* standards which involves students actively building understanding through their experiences. *Inquiry teaching*, however, is communicated much less coherently and the NSES provides few concrete examples to assist practicing teachers in incorporating *inquiry teaching* into the culture of a science classroom. While attempting to reform science education in the United States, the NSES provides goals for science teachers without giving concrete recommendations on how to enact the goals. The NSES provides a broad theoretical definition of inquiry without offering an operational definition for science educators to enact (Abd-El-Khalick et al., 2004).

Several years later, the NRC published *Inquiry and the National Science Education Standards* (NRC, 2000). Attempting to fill the gaps in its earlier publication, this document provides what the NRC views as essential features to classroom inquiry. These features include:

- Learners are engaged by scientifically oriented questions.
- Learners give priority to evidence, which allows them to develop and evaluate explanations that address scientifically oriented questions.
- Learners formulate explanations from evidence to address scientifically oriented questions.
- Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding
- Learners communicate and justify their proposed explanations.

(NRC, 2000, p. 25)

In addition to identifying these features, this publication provides vignettes of classroom inquiry as well as a more comprehensive rationale for the pedagogical use of inquiry in science classrooms. Using scientific inquiry benefits students, the authors argue, because there are “strong parallels between how research says students learn important science concepts and the processes of scientific inquiry that are used in inquiry based teaching” (NRC, 2000, p. 115).

To anyone knowledgeable of the history of science education in America, the proposed reforms in the *National Science Education Standards* and *Inquiry and the National Science Education Standards* seem to echo the sentiments shared by John Dewey, Joseph Schwab, and F. James Rutherford. For instance, in a presentation given to the AAAS in 1909, Dewey argued that science teaching often emphasizes the learning of scientific information over the development of scientific processes. In an article published the following year, Dewey writes:

“Science has been taught too much as an accumulation of ready-made material with which students are to be made familiar, not enough as a method of thinking, an attitude of mind, after the pattern of which mental habits are to be transformed.” (Dewey, 1910, p. 122)

Although Dewey’s writing was published almost a century before the release of the NSES, it provides a solid foundation for incorporating inquiry in the science classroom. Even in 1910, Dewey discusses the parallels between learning and inquiry, writing:

“Such knowledge never can be learned by itself; it is not information, but a mode of intelligent practice, an habitual disposition of mind. Only by taking a hand in the making of knowledge, by transferring guess and opinion into belief authorized by inquiry, does one ever get a knowledge of the method of knowing.” (p. 125)

One may wonder why it took almost a century after Dewey's prompting for the science education community to incorporate inquiry as a critical facet of classroom practice. In reality, however, many influential scholars have made attempts over the years to promote inquiry pedagogy in science classrooms. In the 1950's and 1960's, Joseph Schwab argued that schools needed to alter its approach to teaching science to better reflect the nature of science. "The formal reason for a change in present methods of teaching the sciences," Schwab writes, "lies in the fact that science itself has changed. A new view concerning the nature of scientific inquiry now controls research" (1958, p. 374). Science teaching, Schwab argues, has become tantamount to "inculcation and exercise," where learning occurs through the "rhetoric of conclusions, omitting all evidence, interpretation, doubt and debate" (1958, p. 375). To Schwab, teaching science in this manner communicates to students that science is comprised solely of irrevocable truths. To combat developing this impression with students, Schwab proposes the teaching of science as inquiry. His conceptualization involves an "inquiry into inquiry," where teachers present science as a process of inquiry by using inquiry teaching to help students learn (Schwab, 1966). While Schwab enunciated several challenges to this approach to teaching science, his ideas influenced curriculum reform as well as the development of the instructional materials for the Biological Sciences Curriculum Study (Bybee, 2000).

In the 1960's, the push for inquiry pedagogy continued through the work of F. James Rutherford. Much like Schwab, Rutherford viewed inquiry as both scientific content to teach and an instructional method to employ in the teaching of science. Considering the state of science education, Rutherford writes:

"When it comes to the teaching of science it is perfectly clear where we, as science teachers, science educators, or scientists, stand; we are unalterably

opposed to the rote memorization of the mere facts and minutiae of science. By contrast, we stand foursquare for the teaching of the scientific method, critical thinking, the scientific attitude, the problem-solving approach, the discovery method, and, of special interest here, the inquiry method.” (1964, p. 80)

Rutherford explains, however, that although the science education community opposes teaching science as the accumulation of facts, this belief is not reflected in practice. The contradiction between practice and belief will continue, Rutherford argues, until science teachers acquire “a rather thorough grounding in the history and philosophy of the sciences they teach” (p. 84).

Without this preparation, Rutherford writes, “not much progress toward the teaching of science as inquiry can be expected” (p. 84). Rutherford’s assessment on the state of inquiry in science classrooms was validated empirically years later through a NSF-funded study called *Project Synthesis* (Harms & Kahl, 1980). Drawing data from national case studies, assessments, and surveys regarding the status of science education in America, *Project Synthesis* compared the “desired states” of science instruction in several content areas to the “actual states” in schools (Harms & Kahl, 1980). One major section of the study focused on scientific inquiry. In a summary published the following year, Welch et al. (1981) write that “the widespread espoused support of inquiry is more simulated than real in practice” (p. 40). Describing the status of inquiry pedagogy, the authors write:

“There has been an emphasis on inquiry by the leaders in science education, especially for the last 20 years. Curriculum reform and teacher education have received much attention in this regard. In fact, the education leaders expected the new curricula and the revised teacher preparation programs to have demonstrable impact on classroom practice and student achievement. However, the results of our

study show that these expectations are far from being realized.” (Welch et al., 1981, p. 41)

Besides detailing the lack of widespread use of inquiry pedagogy in classrooms, the authors identify critical barriers to teachers’ support of inquiry. These barriers include: the perceived difficulty of inquiry, classroom discipline, the desire to adequately prepare students for college, teachers’ allegiance to teaching science as facts, and teachers’ desire to follow role models of their collegiate science professors. (Welch et al., 1981) Although the science education community had advocated inquiry pedagogy, the authors write that “there is legitimate confusion over the meaning of inquiry in the classroom” (Welch et al., 1981, p. 40).

A few years later, Rutherford, in conjunction with the AAAS, developed Project 2061 in an attempt to reform K-12 education and detail what students should be able to do and learn in science, technology and mathematics. The formation of Project 2061 led to the publication of *Science for All Americans* (F. James Rutherford & Ahlgren, 1989) and the aforementioned *Benchmarks for Scientific Literacy* (AAAS, 1993) These documents helped to construct the foundation upon which the *National Science Education Standards* were eventually built.

After almost a century of influential scholars and reform groups advocating inquiry instructionally, where is science education today? What does the literature say about the current status of inquiry in science classrooms? Despite the efforts of the NRC to better define its use, there is still some confusion over what the term “inquiry” actually means within the science education community. Currently, inquiry teaching is often used in a variety of manners to describe a host of teaching practices (Abd-El-Khalick et al., 2004; Anderson, 2002; Luehmann, 2007). Abd-El-Khalick (2004) cautions against providing a vision of inquiry enactment that is “too exclusive or restrictive to have little value for educational settings” or one that is so

inclusive that it includes “any and all images of instructional activities in precollege science classrooms” (p. 415). Considering the different visions of inquiry pedagogy present in current literature, Luehmann (2007) writes:

“Common to most uses of the term in science education is a focus on engaging students in using creativity and taking ownership of their learning by asking scientifically oriented questions, using and giving priority to evidence in the construction and evaluation of explanations especially in light of alternatives, and communicating and justifying these explanations.” (p. 825)

Although these common features provide some guidance to the enactment of inquiry pedagogy, few science teachers are currently incorporating the reform-based teaching presented in the NSES (Anderson, 2002; Tobin et al., 1994; Wells, 1995). Surprisingly, despite the publication of several influential reform documents, the current status of inquiry use in America is not much different than that described by Welch et al. almost thirty years ago.

Looking at the state of inquiry use from the perspective of preservice and beginning teachers, however, several challenges emerge. Although many teacher preparation programs present the National Science Education Standards and inquiry pedagogy with the hopes of aiding the reform movement, the lack of a coherent definition can frustrate a beginning teacher in knowing how to enact inquiry pedagogy in a classroom setting. Additionally, since many practicing science teachers have not adopted the reforms outlined in the NSES, new teachers may find little support when implementing inquiry pedagogy within the science curriculum in their schools. These factors may influence a beginning teacher’s ability to enact inquiry pedagogy within the existing culture of a school and impact a new teacher’s long-term commitment to its use.

Beginning Teachers

Davis et al. (2006) suggests that the key to understanding why inquiry pedagogy is not incorporated in more science classrooms may be found by researching the experiences of beginning teachers and the challenges they face early in their careers. They write:

“New teachers are crucial for enacting and spreading reforms—many learn about current reform movements in their teacher education programs and thus seem most likely to be able to adopt and promote reform-oriented instruction.” (p. 608)

Since the adoption of the National Science Education Standards, many teacher education programs have incorporated inquiry pedagogy into their methods classes (e.g. Windschitl, 2002). While these programs promote the use of inquiry teaching in science classrooms, several studies have researched factors that are pertinent to beginning teachers’ ability to enact such reform-based practice. For instance, in their study of beginning teachers, Fuller and Bown (1975) write that most new teachers are focused on simply surviving their first years of teaching and coping with the stress of classroom management and lesson preparation. Lortie (1975) writes about the “apprenticeship of observation,” where beginning teachers are socialized into the profession through their years as students. Teachers, Lortie writes, model their instruction on the instructional procedures they encountered as students. While these studies are relevant to the study of beginning teachers, this dissertation focuses on the experiences of new teachers as they enact inquiry pedagogy as promoted through the National Science Education Standards. As such, in the remaining portion of this chapter, I provide an overview of more recent research that focuses on factors broadly related to beginning teachers and their ability to enact inquiry teaching in classroom settings.

Beginning teachers' knowledge

While a multitude of studies have focused on beginning teachers' subject matter knowledge, few recent studies relate this to actual classroom practice or to inquiry pedagogy. Carlsen (1993) studied four beginning biology teachers and their use of classroom talk for different topics. After recording several lessons for each participant, Carlsen found that when teachers saw themselves as being knowledgeable about a particular topic, they were more likely to open the class to more student discussions. When teachers felt less knowledgeable about a topic, the lessons were mostly teacher-dominated with lower cognitive level questions being asked of students. In Appleton and Kindt's (2002) study of nine early career elementary teachers, the authors find that the participants avoided science lessons in which they were unknowledgeable and seldom incorporated activities they had not personally experienced. When planning science lessons for their students, the teachers rarely opted for "risky" activities that did not have predictable outcomes. Trumbull (1999) completed a longitudinal study of six beginning biology teachers who completed an MAT program after receiving a degree in their field. Through extensive observations and interviews conducted over an eight-year period, Trumbull found that despite participants' educational background, the teachers worried about their understanding of the content and their ability to incorporate student-centered activities. Tabachnick & Zeichner (1999) completed a study of 22 preservice teachers and their ability to enact lessons that incorporated conceptual change components. Through interviews and observations with the participants, the authors found that while the teachers became adept at eliciting students' prior knowledge they were unable to plan lessons that built upon this information. The authors attribute this inability to the teachers' lack of deep conceptual knowledge. It is important to note that while these studies relate teachers' subject matter

knowledge to their classroom practice, all of the studies rely on participants self-assessing and reporting their perceived knowledge base rather than measuring it through some diagnostic means. While this observation in no way criticizes these studies on methodological grounds, it helps to illuminate an additional factor (identity) that may have affected the studies which will be discussed later in this chapter.

In addition to subject matter knowledge, possessing knowledge of the nature of science may aid teachers in enacting inquiry pedagogy (Davis et al., 2006; Windschitl, 2002). Several recent studies have examined teachers' knowledge of the nature of science and how it relates to enacted classroom practice. Lawson (2002) studied 22 preservice biology students and their ability to construct arguments. In a methods course focused on developing inquiry-related teaching skills, the participants were given a series of complementary measures that assessed their argumentation skills. The research found that the participants had difficulty identifying faulty arguments and constructing hypotheses that relied on indirect data. Considering the connection for these skills to inquiry pedagogy, the authors write:

“If it is assumed that effective teaching requires prior understanding, then it follows that these future teachers have yet to develop adequate hypothesis-testing skills and sufficient awareness of the nature of science to teach science in the inquiry mode advocated by reform guidelines.” (Lawson, 2002, p. 237)

Utilizing a multicase study, Windschitl (2003) examined six preservice secondary science teachers and their classroom practice after participating in a two-month inquiry research project. Through analysis of reflective journals, discussions, observations, and interviews, Windschitl found that the research projects helped participants develop a more authentic view of scientific inquiry and helped participants become more enthusiastic about incorporating inquiry into their

teaching. When the participants eventually entered their field experiences, however, this knowledge and enthusiasm often did not translate into inquiry teaching. Only those participants who had previous research experience either in their undergraduate program or in a previous career were able to enact inquiry pedagogy regularly in a classroom setting.

While these studies suggest that subject matter knowledge and an understanding of the nature of science relates to a teacher's instructional practice, none of the studies focused directly on the act of teaching science through inquiry. Each of the articles presented in this section were chosen due to their focus on factors broadly related to the essential features of classroom inquiry identified in the NSES (identified earlier in this chapter). While these studies communicate important findings that impact the research presented in this dissertation, there are certainly gaps in the research conducted to date. As Davis et al. (2006) note in their recent review of research on challenges new science teachers face, "the standards emphasize inquiry-oriented science teaching, yet our review of the literature tells us very little about new teachers' understandings of inquiry, how they teach inquiry, or what specific challenges they face in doing so"(p. 636). This review provides the foundation for work like this dissertation that phenomenologically describes the experiences of new teachers enacting inquiry pedagogy.

Sociocultural Factors

Beginning teachers enter schools that have existing cultures and societal norms. These factors can influence the instructional choices that a teacher makes and ultimately how a lesson is planned and enacted. Several recent research studies outline these factors and the influence they have on classroom practice. Simmons et al (1999) studied 69 beginning science teachers over a three-year period at the start of their careers. Through observations and interviews, the authors used a grounded theory approach to find that there was a discrepancy between teacher

beliefs and their practice. While many of the participants described themselves as “student-centered,” their instructional approaches were often observed to be “teacher-centered.” As teachers became more experienced, the participants’ use of student-centered instruction diminished. The authors credit this decrease to teachers’ “enculturation within the school” in addition to concerns related to “control of the classroom and tenure” (Simmons et al., 1999, p. 946). These factors can be powerful influences over a teacher’s instructional decision making and their ability to enact their beliefs in practice.

In Eick’s (2002) case study narrative of two beginning science teachers who shared a teaching position at a school, the participants describe themselves as feeling isolated within the building and feeling pressure from the administration to be more didactic instructionally. Despite their intentions to include student-centered inquiry lessons in their classes, the teachers adopt more teacher-dominated modes of instruction in response to the assistant principal’s evaluations. The teachers observed that he was less critical in his written evaluations when they taught with a well-structured, whole class approach. Due to his tendency to make unannounced visits, the teachers began using more frequent teacher-centered lessons in order to receive positive evaluations. Bulloughs and Knowles (1990) report similar findings in their study of a first-year science teacher who entered the teaching profession after years in another career. Over time, the teacher abandons inquiry-oriented modes of instruction to gain more class control and to better reflect the textbook-dominated curriculum promoted by his colleagues. Despite his initial desires to have a student-centered classroom, the teacher opts for more lecture-based lessons to better police his students and to focus more on the content in the textbook. The cultural norms of a school, whether explicitly communicated by colleagues or implicitly promoted through evaluations, can affect a beginning teacher’s choice of instruction. Reviewing

the recent research regarding beginning teachers, Davis et al. (2006) write:

“The field needs more research on how new science teachers learn about their schools and communities...For example, how do new science teachers learn about the norms in their schools regarding how teachers use (or do not use) standards documents?” (p. 633)

This provides tremendous opportunities for researchers studying new science teachers and their use of inquiry pedagogy.

Also shown in Bullough and Knowles’ work is the powerful influence that a school’s curriculum can have on a beginning teacher and the instructional decisions she makes. Haney and MacArthur (2002) studied four preservice science teachers and found that adherence to the local curriculum was a strong influence on the style of teaching the participants employed. Participants were conflicted between teaching in student-centered, constructivist manners and teaching to cover the entire local curriculum to prepare students for testing. Returning to Trumbull’s (1999) narratives of beginning teachers, several participants describe obstacles presented by the local curriculum and how it constrained their instructional decisions. Trumbull found little local support for the NSES and more focus on high stakes testing in schools’ curricula. The teachers describe how these factors influenced the style of instruction and methods of assessment that they employed. In their study of two preservice chemistry teachers, Geddis et al. (1993) found that the participants struggled to understand the scope of the local curriculum and knowing the depth to which to address certain concepts. In response to this, teachers adopted transmission styles of instruction to “push on” and cover the entire curriculum. It is evident through this research that a school’s curriculum influences not only what is taught in a beginning teacher’s classroom, but the manner in which it is taught as well.

While the local curriculum can influence new teachers' instructional decision making, research also suggests that beginning teachers have difficulty managing the day-to-day tasks of being a teacher. In Gess-Newsome and Lederman's (1993) study of ten preservice biology teachers, the participants describe that their concerns for day-to-day planning and classroom management influenced their lessons more than their desire to demonstrate dominant themes of biology. Adams and Krockover (1997) studied eleven beginning teachers and found that issues related to time management and classroom control dominated the teachers concerns more than the act of teaching. Collegial support, however, can help new teachers manage these influences and promote more risk-taking instruction. Returning to Appleton and Kindt's (2002) work with early career elementary teachers, those participants who described their colleagues as being supportive were more likely to incorporate lessons they had not tried previously. These participants were able to "bounce ideas" off of more experienced teachers, a process which ultimately aided in their day-to-day planning. It is important to note that these recent studies seem to reinforce the descriptions of first-year teachers as presented by Fuller and Bown decades ago. Missing in these studies, however, is the specific impact of the NSES on beginning teachers and their practice (Davis et al., 2006).

Perceptions of Self

Up to this point in this chapter, I have explored several areas of research that are critical to studying beginning teachers and their use of inquiry pedagogy. I have outlined the history of reforms in science education that have called for incorporating inquiry in science classrooms and detailed current research that relate to a beginning teacher's ability to enact those reforms in practice. To fully understand the challenges that new teachers face, the science education community must come to a better understanding of how new teachers view themselves and their

abilities within the communities of schools and how they can use these perceptions of self to enact their beliefs. This construct, called professional teacher identity, is a critical influence over beginning teachers and their ability to enact reform-based practices (Luehmann, 2007). As Davis et al (2006) write, “personal characteristics, such as reflectiveness, identity, personal history, and self-efficacy, matter a great deal. Yet there is relatively little research on how some of these characteristics develop” (p. 633). In the remaining portion of this chapter, I will first detail the construct of identity generally and then highlight the specific research on professional identity that relates to the study of beginning science teachers.

Identity

Over the last several decades, identity has emerged as a critical field of study with regard to learning and development. With the adoption of situated cognition and sociocultural perspectives with regard to education, many researchers are seeking new ways to approach individual learning that incorporates social interaction and participation. While present views of identity afford a lens to study learning and development within groups, historically, identity has been researched from a much different perspective. Erikson (1968) studied individuals across their life spans and proposed eight stages of identity development. In his model, individuals progressed through a stage after encountering a crisis (trust vs. mistrust, etc). From this perspective, identity is conceptualized as a series of sequential, progressive steps rooted in psychological and physical development where growth is initiated by the resolution of emotionally significant events. Regardless of race, class, or gender, a person could theoretically be identified as existing on one of the eight stages. While well researched, this perspective focuses mainly on the identity development of individuals as they develop into adults and offers little direction when examining a teacher’s professional identity or its development over a

teacher's career.

People rarely work or learn in isolation. Individuals communicate and participate in various communities that utilize unique language patterns, tools and objects (Gee, 2005). From a situated and social constructivist perspective, learning is not individualistic in nature. Learning is an active, social process that occurs through participation in communities (J. S. Brown et al., 1989; Lave & Wenger, 1991). Viewed in this light, knowledge is not static information stored in an individual's head, but exists in and is distributed amongst the actions of the community (A. L. Brown et al., 1993; Gee, 2003). As an individual learns, she takes on new roles of participation within the group. This participation not only can transform the community but also can transform the individual in the process, shaping her identity through her involvement with the group (Wenger, 1998). This view of identity offers a more dynamic lens of how individuals act contextually and links identity not to a person's psychological or physical state but instead ties it to how she performs and is identified in society. (Gee, 2000). In Gee's definition of identity, the key is being able to "enact a particular sort of socially recognizable identity" within a "Discourse" with a capital "D" (Gee, 2005, p. 21). Gee defines a Discourse as the "ways of combining and integrating language, actions, interactions, ways of thinking, believing, valuing, and using various symbols, tools, and objects." (Gee, 2005) From this perspective, learning is not based on the acquisition skills or knowledge but the development of a recognizable identity of participation within a Discourse.

While this view of identity may appear to be more theoretical than Erikson's stage model, it affords researchers with new opportunities to study identity development and learning. By looking at the Discourse modes (language, actions, etc) that an individual utilizes as she participates in a group, researchers have been able to describe important features of identity

development. For example, by studying the language patterns of African-American medical students, Nasir and Saxe (2003) found that identities develop depending on an individual's position with respect to three different domains: local interactions, developmental time, and social history. From this work, a person's identity within a group depends on her face-to-face interactions in the here and now in conjunction with her other actions and interactions with the group previously. These two factors are also positioned with relation to the historical development of the group itself to form the person's identity within that community. This work supports Lemke's proposition of identity development over time (2000). In his view, identity "requires integration across timescales: across who we are in this event and that, at this moment or the other, with this person or another, in one role and situation or another." (Lemke, 2000, p. 283)

Besides timescales, trajectory is another factor that can influence a person's identity development within a group (Wenger, 1998). In his detailed study of claims processors, Wenger found that workers had identities of participation that followed different pathways depending on their individual choices and the interaction of other members of the group. These identity trajectories are not fixed pathways in the physical sense, but rather are continuously renegotiated and redefined as an individual participates within a group. Identity develops through a "layering of events of participation and reification by which our experience and its social interpretation inform each other" (Wenger, 1998, p. 151) Reification involves the individual giving form to her experience by realizing and perceiving the meaning of her participation within the group (Wenger, 1998). This perspective on identity trajectory assumes that the individual plays some role in the meaning making process of her participation (whether occurring consciously or

subconsciously) and that the individual has some agency over the pathway through which that participation develops.

In addition to timescales and trajectory, identities emanate from different sources within a community. Gee (2001) proposed that the source of a person's identity within a group can be attributed to four different aspects: Nature, Institution, Discourse, and Affinity. Natural qualities outside of a person's control are the primary forces that describe a person's Nature-Identity (N-Identity). For any aspect to afford a particular identity, it must be recognized as meaningful within the group. For instance, being short is a natural quality that may not be meaningful within a group of physics teachers but it may be recognized as important on a basketball team and help to shape a player's N-Identity in that group. Institutional titles help to shape the Institution-Identity (I-Identity) within a community. For instance, being a professor at a university helps a person be recognized within that institution in a certain way and will define her I-Identity much differently than it would within another group (her family, a gym, etc.). In Gee's Discourse Identity (D-Identity), discourse descriptors are used to define a person's identity. For example, a person can be described as being "sarcastic" only through her interaction within a group. Like any D-Identity, being sarcastic is a socially constructed description based on the discourse or dialogue with others. Shared cultural practices within a group are the source of an Affinity-Identity (A-Identity). For example, if a person identifies herself as a middle school teacher, she affiliates herself not only with a specific group of people but the cultural practices and shared experiences of that group. In conjunction, these different identity components help to shape who a person is recognized as within a Discourse.

These perspectives present a much more dynamic, socially contextualized view of identity than the categorical, sequential construct presented by Erikson. To better qualify this

sociocultural conceptualization of identity, Brown, Reveles, and Kelly (2005) developed the term “discursive identity”. In their view, discursive identity involves “the act of communicating identity via discursive interaction” (B. A. Brown et al., 2005, p. 783) with language being the primary artifact of a person’s identity. Brown (2004) used this perspective to research different identity domains of minority students as they learn to incorporate the language of science into classroom practice. In their study of high school baseball players, Brown and Kelly (2007) found that the appropriation of specialized discourse practices with different communities (athletics and physics) and the construction of identity within those communities can develop and support each other. In their work with third grade African American students, Varelas and her colleagues (2007) widened the lens of discursive identity to include “nonlinguistic modalities” and activity as artifacts of identity within a discursive group. Besides looking at the language students used during an activity, the researchers examined mediating materials and goals to find that identity “transcends various interconnected activities and mediates across them.” (Varelas et al., 2007, p. 241) Nasir and Hand (2004) also examined activities as they studied the sequence of basketball drills that players experienced in practice. As players mastered simpler drills, the activities would gradually increase in complexity. By achieving success through a sequence of supported, low-stakes activities, individuals began to develop identities of themselves as players related to their success. This scaffolded process, Nasir and Hand suggest, can be applied to the learning of mathematics and possibly other learning communities as well.

Sociocultural views of identity has steered the focus away from psychological surveys or paper-and-pencil tests but it has also created some discussion about the role of language as expressions of identity. While Brown, Reveles and Kelly (2005) viewed language as an artifact

of identity, other researchers have taken a different perspective. Based on their work with immigrant students in Israel, Sfard and Prusak (2005) proposed that the narrative regarding an individual was not merely an expression of her identity, but exists as her identity itself. Sfard and Prusak define identity as “a set of reifying, significant, endorsable stories about a person.” (p. 14) Although narratives have a rich history in identity work (Holland et al., 1998; Kerby, 1991; Mishler, 1999), to conclude that identity exists solely in the stories people tell about individuals or themselves neglects other possible representations within the Discourse and the shared repertoire within a community. To focus solely on the narratives within a community disregards other discursive means with which a person can be recognized. Revisiting Gee’s (2005) conceptualization, identity is how a person is recognized by self or others within a Discourse. While this recognition occurs primarily through the use of language and the stories one tells, it can also involve other discursive means including actions, interactions and ways of thinking.

Another unique perspective presented in Sfard and Prusak’s work is their view of learning and identity development. In their view, learning closes the gap between one’s actual identity and her designated identity (Sfard & Prusak, 2005). A person’s actual identity consists of the narratives about the “actual state of affairs” told by herself or “other significant narrators” in the group. A person’s designated identity, however, consists of the stories “presenting the state of affairs expected to be the case” either now or in the future (Sfard & Prusak, 2005). Learning, they write, “is our primary means for making reality in the image of fantasies”(p. 19). In their view, institutional narratives that emerge through obtaining awards, certificates, or degrees help to transform a person’s designated identity and help to close the gap between identities. While identities may change in this manner, little is said regarding the actual

processes that assist in renegotiating these narratives. Returning to Gee (2001), Nasir and Saxe (2003), and Wenger (1998), identity emerges from specific sources, is impacted by multiple timescales, and have trajectories of development through participation. Although these perspectives on identity do not necessarily oppose Sfard and Prusak's work, they provide a framework which better describes the processes that guide identity development. While Wenger (1998) proposed participation and reification as two processes vital to a person's identity formation, Gee (2005) proposes "recognition work" as critical to how a person's identity develops within a group. Luehmann (2007) embraces all of these traditions and processes when she writes: "Although participation is essential for learning, learning as identity work occurs in the interpretation, narration, and thus recognition of that participation (by self and others)" (p. 828). This view not only recognizes the role of the individual and the community in identity development but also the processes that guide this development.

Professional Teacher Identity

Teachers present an ideal area for identity research due to their participation in a highly specialized community with repertoires that have developed through history. Also, teachers' participation within the larger school community occurs through different stages of development (high school student, collegiate student, student teacher, etc.) that can impact their future identities as teachers. The terms "professional identity" or "teacher professional identity" are often used to situate the discussion within the school Discourse. Luehmann argues that focusing on teacher identity development offers "the field of teacher education a more inclusive construct that extends teachers' knowledge and skills" (Luehmann, 2007, p. 828). Rather than approaching teacher preparation from cognitive or psychological perspectives, teacher education programs that focus on identity development can offer different types of support as new teachers navigate

and negotiate their initial participation within the education community. Developing a professional identity as a teacher is a critical component to future job satisfaction, commitment to the profession, and adherence to professional norms of practice. (Hammerness et al., 2005)

Much like the broader identity field, teacher professional identity has been defined in a variety of manners. Beijaard, et al. (2004) conducted a comprehensive analysis of teacher professional identity research and found that many studies fail to operationalize professional identity in their work. Some researchers take an approach to teacher professional identity much like Erikson would, using surveys and tests to characterize groups of teachers in some fashion. For example, in their study of eighty experienced secondary school teachers, Beijaard et al (2000) used questionnaires to examine teachers' professional identities. They proposed that a teacher's professional identity could be viewed as being comprised of three dominant sub-identities: pedagogical identity, didactical identity, and subject matter identity. In this conceptualization, a teacher's pedagogical identity relates to a teacher's view of her role in students' emotional, social and moral development. A teacher's didactical identity involves her beliefs about teaching and learning. Subject matter identity relates to a teacher's views of content-specific knowledge and skills. From this work, they were able to identify five groups of teachers based on their professional identities: didactical experts, subject matter experts, pedagogical experts, balanced groups, or "high on two aspects" (Beijaard et al., 2000). Their work also suggests that teachers' professional identities may change over their careers, with less experienced teachers identifying themselves as "subject matter experts" and more experienced teachers identifying themselves as "didactical" or "pedagogical experts." Much like early identity research, however, this work on teachers' professional identity examines individuals

without regard to the larger educational community and fails to identify the importance of powerful sociocultural aspects at work.

Other researchers, however, have approached their study of professional identity conscious of these factors. In their case study of two English teachers in Africa, Samuel and Stephens (2000) identified three forces that impact the development of new teachers' professional identities: inertial, programmatic, and contextual. Inertial forces relate to an individual's biographical educational experiences. Programmatic forces emanate from an individual's teacher preparation program. Contextual forces emerge from the macro-educational policy of the state and the micro-educational context of the schools. Samuel and Stephens concluded that these factors contribute to teachers' professional identities being "deconstructed, constructed, and reconstructed" as they begin their careers (p. 476). Unlike Beijaard and his colleagues who obtained most of their data through survey work, Samuel and Stephens used a variety of qualitative techniques (observations, journals, interviews, etc) to develop comprehensive narratives to represent each student teacher's professional identity. This work appears to echo Sfard and Prusak (2005), Gee (2001), and Nasir and Saxe (2003) when they conclude that professional identity can be represented through descriptive narratives, results from multiple sources, and develops across multiple scales of time and interaction.

Building on these concepts, Eick and Reed (2002) found that learning histories contributed to teachers' professional identities. Utilizing a comparative case study analysis of two secondary science teachers, they found that learning histories not only influences teachers' identities but also impacts their views of learning and their methods of teaching. For example, when a teacher's prior experiences consisted mostly of lecture-based instruction, she viewed her role and professional identity from this perspective. Missing in their work, however, is an

operationalized definition of professional identity. Rather than use narrative to represent the participants' professional identities as Samuel and Stephens had, Eick and Reed used interviews and reflective journals to identify teachers as having "stronger" or "weaker" identities. These descriptors were based on participants possessing "strong beliefs about teaching and learning, and the role of the teacher, supported by vivid and consistent past personal histories" or lacking "a consistent vision of their image as teacher" (2002, p. 403). They conclude by saying that preservice teachers with "stronger" professional identities were able to implement inquiry-oriented pedagogy aided by "supportive teacher education" programs. While this work identifies the effect of a larger community on an individual's identity development, most of its focus is in the characterization of teachers' identities through arbitrary, researcher-defined means. Lee (2007) writes that this perspective on teacher professional identity ignores:

"how learning and identity are actually constituted moment-by-moment during everyday practices, in classrooms. Instead of decontextualized reports of learning and identity, as filtered through predetermined concepts of the analyst, what we are failing to grasp are the first-person accounts given by the participants themselves about their own learning and identity." (p. 263)

Flores and Day (2006) build upon this work by focusing on fourteen new teachers in Portugal as they worked through their first two years of teaching. Utilizing several different data sources (surveys, interviews, and teacher and student reflections), they highlight the "powerful interaction between personal histories and the contextual influences of the workplace" (p. 230). Like Samuel and Stephens (2000), Flores and Day identify three main factors that influence the "construction, deconstruction, and reconstruction" of teachers' professional identities: prior influences, initial teacher and training practices, and contexts of teaching. Flores and Day

conclude that “despite the strong connections between personal biography and... identity, it is clear that in most if not all cases, history was mediated by context” (p. 230) and the culture in which one taught. This research supports the notion that teachers’ professional identities develop through the negotiation of one’s experiences, through local interaction and across developmental time (Nasir & Saxe, 2003). Much like identity development of other individuals, teachers “are caught in the tensions between past histories that have settled in them and present discourse and images that attract them or somehow impinge upon them” (Holland et al., 1998, p. 4)

In her study of five secondary science teachers, Helms (1998) used interviews, observations and audiotaped discussions to propose that a teacher’s professional identity emerges from four different dimensions: a) actions; b) institutional and cultural expectations; c) values and beliefs; and d) a person’s future view of self. These dimensions interact as a teacher’s professional identity develops through interacting with a community and incorporating the past and the future as they negotiate the present. This work helps to detail the source of teachers’ professional identities as well as describe factors influencing the trajectory of its development.

In their work, Cooper and Olson (1996) explored contextual factors that contribute to differing and contradictory identities in teachers. By examining narratives written by new teachers, Cooper and Olson expanded the perspective of school community to include the “larger historical and cultural story of education” (p. 85) They approached teacher identity as existing a “multiplicity of selves” which can be influenced and suppressed by a “discourse which has spanned centuries and take action within our institution” (p. 87). While lacking a strong empirical foundation, this work reflects research by Lemke (2000) and Nasir and Saxe (2003) to view teacher professional identity not only as emerging from a teacher’s own developmental history, but from the political, cultural and social nature of the school community as well.

Lasky (2005) further examines these sociocultural factors on teacher identity but also links them to a teacher's practice and emotions within the classroom setting. Employing a longitudinal, mixed method approach to study four teachers facing accountability initiatives in their schools, Lasky finds that mediational means such as new curricula and reforms have a large impact on teachers' identities and sense of agency. The reform initiatives altered how teachers conceived their roles in the classroom and constrained the teachers' ability to make instructional decisions. The reform also impacted the teachers' vulnerability in their classroom and their willingness to take instructional risks with their students. Looking at the influence on teachers' view of self, she writes "that external mediational systems have a deeper or more enduring impact on the formation of teacher identity, than on reshaping professional identity that is securely established" (p. 912). Lasky's work focuses on teachers' identity and practice resulting from increased teacher accountability. As beginning teachers enter schools, however, they are likely to face competing reforms from a variety of sources. This dissertation studies the experiences of beginning teachers enacting inquiry science pedagogy within the culture of schools as they negotiate local and state reforms alongside those proposed by the NSES.

As can be seen in this overview of identity research, scholars have used a variety of methods to study teacher identity (surveys, narratives, reflective journals, etc) depending on how they view and operationalize the construct of teacher identity. In this dissertation, I view teacher identity as how one is recognized by self and others as a certain type of teacher (Gee, 2005; Luehmann, 2007). This definition of teacher identity evolves from the synthesis of several key understandings about identity and teacher identity.

- Teacher identity is socially constructed. How one sees herself is dependent on her interactions with others. (Gee, 2005)

- Teacher identity develops across different timescales and different trajectories of participation. (Lemke, 2000; Wenger, 1998)
- Teacher identity is impacted by a variety of sources. (Gee, 2005)
- Teacher identity is constituted in interpretations and narrations of experience. (Sfard & Prusak, 2005)

While the main focus of this research is to study the experiences of two beginning science teachers enacting inquiry pedagogy, aspects of their teacher identities emerge through the narrative descriptions they provide. These aspects not only communicate how they see themselves within the community of the schools in which they teach but also their perceptions of their ability to enact inquiry pedagogy.

Conclusion

In this chapter, I have outlined the history of inquiry pedagogy in the United States and the research that focuses on beginning science teachers and professional teacher identity. As I outline the methods, findings and implications in the following chapters, the pertinent literature reviewed here describes the theoretical and empirical foundations that impacted my research. This review of literature, however, also situates this dissertation within those fields to better explicate how a hermeneutical phenomenological study of beginning teachers' experiences enacting inquiry pedagogy is a necessary research endeavor. While many believe that beginning teachers are critical in transmitting reforms to schools (Davis et al., 2006), previous research on new teachers' ability to use of inquiry has mainly focused on cognitive aspects (understanding of nature of science, content knowledge, etc). This dissertation, however, examines the lived

experiences of two new teachers to better understand the factors that influence their ability to enact inquiry pedagogy within the culture of schools.

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CHAPTER 3: RESEARCH METHODOLOGY

What does it mean to know something? This question is an excellent place to start as I outline the methodological foundations of this dissertation. From my experience as an undergraduate physics major, I came to believe that only that which could be experimentally tested could be truly known. In science, we test hypotheses through controlled experimentation and quantitative measurement and base theories and claims only on that which is testable. While this epistemological viewpoint certainly forms the basis of scientific claims, it fails to recognize much of the knowledge acquired through human existence. How does one experimentally test “love” or “passion?” How does one verify “respect?” Can some tool measure “good parenting” or even “good teaching?” As human beings, we know when we are loved or respected. We can easily identify friends or family members as being “good parents.” Each of us has stories about great teachers who helped us learn and grow. If my goal is to better understand these types of claims and how this knowledge is formed, my background in the physical sciences cannot help me. If my focus is to study teachers’ experiences, it is important that I select a research tradition that identifies and values human experience as an epistemological foundation.

In this chapter, I discuss the historical development of phenomenology and outline my decision to use hermeneutic phenomenology as a research method. I also detail the specific research steps I employed in this study and describe participant sampling considerations and the process of data collection, management and analysis. The chapter concludes with biographical profiles of the research participants.

Phenomenology

Let's imagine a fictional researcher who chooses to study bicycles. To do this, the researcher could choose many different research traditions, whether interpretivist or positivist, to complete a study of bicycles. Obviously, bicycles are concrete objects that exist in nature. The researcher could easily choose to quantitatively measure different aspects of bicycles, possibly determining how tire size has changed historically. The researcher, however, could have a different interest in bicycles. Possibly the researcher wants to study people's experiences with bicycles, hoping to elicit the essence of what it means to ride a bicycle or own a bicycle. In this type of study, measuring the physical aspects of the bicycle would not provide the rich descriptions that a person's lived experiences would. This example may be elementary but it is intended to provide an important distinction at the onset of this discussion of phenomenology: the difference between physical objects and our experiences with objects. Immanuel Kant presents a similar distinction between *noumena* and *phenomena* (as summarized in Roche, 1973). *Noumena* are the things themselves, the physical, concrete, unchanging things as compared to the *phenomena*, our experiences with things. Returning to our fictional researcher, the bicycle itself is the noumenon, and our experiences of the bicycle (the phenomenon) is how we perceive that bicycle. While different research traditions focus on the noumena, phenomenology is the study of phenomena, our experiences of things. From a phenomenological standpoint, human experiences are not separate actions that exist outside of the physical world. All human consciousness is *intentional*, meaning that every human action is related to some concrete object. As van Manen (1997) writes,

“all thinking (imagining, perceiving, remembering, etc.) is always thinking about something. The same is true for actions: grasping is grasping for something, hearing is hearing something, pointing is pointing at something” (p. 182).

Some may argue that this presents some inherent difficulty in how phenomenology functions. Each person’s experiences with objects are different. For example, recalling my experience with bicycles conjures memories of freedom during summer vacation. Another person may describe a horrific bicycle accident that left her in a hospital for several weeks. This intersubjectivity of experiences is not only *identified* within the field of phenomenology, it is *embraced*. Each of us has unique lived experiences. The universality of the human condition insures that those people who express their lived experiences and those who understand are connected by a common human consciousness that makes understanding possible (Ray, 1994). In fact, it is this intersubjectivity and universality that makes phenomenology powerful. As van Manen (1997) writes, the phenomenological researcher “needs the other in order to develop a dialogic relation with the phenomenon, and thus validate the phenomenon as described” (p. 11) Here, van Manen is not only referring to the informant in the study who describes the experience but the reader who identifies with the experience as it is described. Through phenomenological research, I do not need to have lived through a horrific bicycle accident in order to identify with the experiences of someone who has. The universality of the human experience helps me validate and understand the experiences of others (Gadamer, 1989).

So far in this chapter, I have referred to phenomenology as if it were a single research tradition incorporating only one research method. In fact, using the term “phenomenology” represents more of a philosophical stance than a methodological approach. Van Manen (1997) writes:

“While it is true that the method of phenomenology is that there is no method, yet there is a tradition, a body of knowledge and insights, a history of lives of thinkers and authors, which, taken as an example, constitutes both a source and a methodological ground for present human science research practices” (p. 30).

To understand phenomenology methodologically, one must understand the philosophical development of the field and see how different traditions have evolved historically. Spiegelberg (1982) divides the development of phenomenology into three phases: the preparatory phase, the German phase, and the French phase. The preparatory phase involves the work of Franz Brentano (1838-1917) and his student Carl Stumpf (1848-1936). Although he had originally been ordained as a priest, Brentano continued his academic pursuits by studying philosophy and psychology, eventually withdrawing from the priesthood completely. Brentano developed “descriptive phenomenology” with the hope of making philosophy and psychology more empirical in nature and to provide answers that organized religion could not supply (Moran, 2000). Brentano was the first to introduce the concept of intentionality, identifying consciousness and experience as the critical components for understanding and classifying acts and mental practices (Moustakas, 1994). Stumpf developed “experimental phenomenology” in an effort to discover the connection between physical elements (such as sound and light) and our resulting experiential perceptions (Cohen et al., 2000).

Spiegelberg (1982) identifies Edmund Husserl (1859-1938) and his student Martin Heidegger as the main figures in the German phase of phenomenology’s development. Although Husserl was originally trained as a mathematician, he had lived through two world wars and became skeptical of the objective, positivistic science of the day. Science, Husserl (1970)

argues, excludes those “questions of the meaning or meaninglessness of the whole human existence” (p. 6). Assailing science on its epistemological assumptions, Husserl (1970) writes:

“Can the world, the existence in it, truthfully have a meaning if the sciences recognize as true only what is objectively established in this fashion, and if history has nothing more to teach us than that all the shapes of the spiritual world, all the conditions of life, ideals, norms upon which man relies, form and dissolve themselves like fleeting waves, that it always was and ever will be so, that again and again reason must turn to nonsense, and well-being into misery?” (p. 7)

Dismissing science for its positivism, Husserl turned to Brentano’s work and began focusing on lived experiences. Husserl believed that by studying everyday experiences, philosophy could “encompass science, comprehend it and become the basis for...all knowledge” (Barritt et al., 1985, p. 20). To study lived experiences, Husserl proposes setting aside preconceptions and any *a priori* categories of knowing and go to the things themselves (Barritt et al., 1985). Drawing on the mathematical process where one separates a part of an equation from the rest of the operands, Husserl calls this setting aside of preconceptions *bracketing*. By bracketing one’s prejudices and personal commitments, Husserl believes, any action can be studied through intuition and meaningfully described. Through reflection, individuals could illuminate pure consciousness, removed from any contextual nature, and reveal the mystery of experience. Ultimately, this reflective process continues until an *eidetic reduction* is reached, where the experience is reduced to its essential meanings. Because it relies on that which can be discovered through reflection, Husserl’s form of phenomenology is often called *transcendental phenomenology* (Moustakas, 1994).

As one of Husserl's students, Martin Heidegger agrees with Husserl's claim that human experience forms the basis of knowledge generation. Heidegger differs from his mentor, however, in the role that interpretation plays in human understanding. Human consciousness, Heidegger believes, is not separate from the world of human existence. Rather than seek to describe pure, cerebral consciousness as Husserl suggests, Heidegger argues that we must interpret the essential structures of human experience within the context of the world we live in, physically, culturally and historically (Polinghorne, 1989). Heidegger's focus is "Being-in-the-world," attempting "to explicate the meanings as we live them in our everyday existence, our lifeworld" (van Manen, 1997, p. 11). Heidegger argues that understanding is a reciprocal activity and proposed the concept of the "hermeneutic circle" to illustrate this reciprocity (Alvesson & Skoldberg, 2000). Drawing on work by Wilhelm Dilthey (1833-1911), the hermeneutic circle involves an interrelationship between:

"the direct conscious description of experience and the underlying dynamics or structures that account for the experience (which) provides a central meaning and unity that enables one to understand the substance and essence of the experience"
(Moustakas, 1994, p. 9)

By incorporating hermeneutics, the interpretation of texts, into the study of lived experiences, Heidegger develops a form of phenomenology that is mindful of the descriptive and the interpretive. This hermeneutic phenomenology, van Manen (1997) writes, is

"a descriptive methodology because it wants to be attentive to how things appear, it wants to let things speak for themselves; it is an interpretive methodology because it claims that there are no such things as uninterpreted phenomena." (p. 180)

While some may argue that a contradiction exists between a described lived experience and one that is interpreted, hermeneutic phenomenology acknowledges that every human experience is already interpreted by those who lived it and who express it in language.

Returning to Spiegelberg's description of the development of phenomenology, Maurice Merleau-Ponty (1908-1961) stands out as the primary figure of the French phase. Merleau-Ponty (1962) further describes the "lifeworld" introduced by Heidegger by identifying four fundamental existentials through which all human beings experience the world: spatiality, corporeality, temporality, and relationality. These aspects form the existential ground through which all human activity is experienced (Barritt et al., 1985; van Manen, 1997). Due to the focus on these aspects, this form of phenomenology is often called *existential phenomenology*.

Through their philosophical foundations, these three phenomenological traditions (transcendental, hermeneutic and existential) diverge from one another. The traditions, however, share a common goal in understanding human experience as it is lived. Regardless of the specific type of phenomenology one employs, a researcher conducting a phenomenological study must be mindful of the philosophical differences and commonalities that exist between these different traditions (van Manen, 1997).

Why choose hermeneutic phenomenology?

The focus of this dissertation is to describe the experiences of two new science teachers as they enact inquiry science pedagogy in their classrooms. Since I am interested in understanding the lived experiences of other individuals, the choice to use phenomenology as a research tradition seems logical. But which phenomenological tradition fits most appropriately to my specific goals? As I began this research, I felt as though the answer to this question could be easily found in some research handbook. I believed that by opening a book on

phenomenology I would see a section where it said “Choose hermeneutic phenomenology if...” The reality, however, was that these types of methodological decisions were not going to be found in a research manual or in some journal article. Instead, the answers to these research questions needed to be found within myself and needed to be coordinated with what I believed.

I chose hermeneutic phenomenology because I believe that we as human beings exist in and are shaped by the world. At the same time, however, we shape the world we live in. This transaction occurs contextually, historically, and socioculturally. We cannot remove the person from the world or an individual experience from the context in which it was lived. Hermeneutic phenomenology as a research tradition identifies the contextual nature of our human experiences (Dilthey, 1985; van Manen, 1997).

My goal with this dissertation is to understand the experience of others through the development of a rich description of their experience. To describe another’s experience, I need to discuss the event with those who have actually lived it. Conveying a human event in words is fundamentally an interpretive process. The words one chooses attempt to represent the experience as it is lived. I think about how often I have struggled to choose the “right word” to describe something and I realize that this process captures one of the critical aspects of hermeneutic phenomenology. This is also evident as I listen to another person’s description. As a person vocalizes a lived experience, I am interpreting those spoken words to create my own understanding of the event. Interpretation is an active process where we as human beings describe our lived experience through interpreted words so that others can understand the description accurately through their own interpretations. Some may wonder whether research that relies so heavily on interpretation can be accepted. My belief is that hermeneutic

phenomenology simply acknowledges the interpretive nature of language that other traditions may overlook.

Another area I must consider as I move forward with my decision to use hermeneutic phenomenology is the issue of bracketing. When I first read Husserl's position on bracketing, I was confused with how I, as a researcher, could reach a state where I was able to set aside my prejudices or presuppositions where they no longer influenced my judgment. I believe that human beings exist in the world and are shaped by the world. How can I bracket the world away? How can I remove the influence of my schooling, my history, and my life? I found the task overwhelming. As I read, though, I realized I was not the only one who has struggled with this concept. I found comfort in the writings of van Manen (1997) and Gadamer (1989) who suggest that bracketing is not accomplished through setting aside these contextual influences but by recognizing them. Gadamer (1989) argues that it is through our prejudices that we are able to determine what is intelligible in a situation. It is impossible to remove these contextual influences. As a researcher, however, "one needs to overcome one's subjective or private feelings, preferences, inclinations, or expectations that would prevent one from coming to terms with a phenomenon or experience as it is lived through" (van Manen, 1997, p. 185).

Phenomenological research should not be polemical. Phenomenologists must be conscious of their presuppositions and not try to use data to detail what they already believe. Rather, they must suspend their own beliefs and allow the informants to describe the events. This view of bracketing seems much more natural for me and is congruent with my belief system. As a teacher, I have always tried to interact with my students without prejudice or presuppositions. Even after a negative exchange with a student, I have tried to bracket these emotions away and

approach the student as if he had a fresh start each day. To apply these same beliefs and tendencies to my research seems like a natural extension for me.

Researcher Role: A Negotiation of Identities and Experiences

As I began this work, I needed to suspend phenomena that I have experienced in my life and roles that I have played with the participants. First, this research focuses on the experiences of two beginning teachers as they enact inquiry science pedagogy in their teaching. As a former science teacher, I experienced a difficult first year of teaching. At times, I had colleagues who were not very supportive and I felt isolated. I tried to incorporate new ideas into my classroom but was often told by my mentor and others “That’s not how we do things here.” I had been hired to replace Mr. Smith (a pseudonym), who had died suddenly at the end of the previous school year. Mr. Smith had been involved in many extracurricular activities and was loved by students and staff alike. Some students assumed I would replace Mr. Smith in all of his functions at the school, taking over the Outdoors Club and the Photography Club for example. As I tried to develop my own role in the school, I often encountered people who said “Mr. Smith never did things like that.” After a while, I resorted to avoiding areas of the school where others would congregate socially and kept to myself. I constantly struggled with my role at the school and considered quitting several times. Two years later, I left the district to take another teaching position closer to where my wife was employed. Undoubtedly, those difficult first years of teaching still guide and influence my work as a researcher and as a teacher educator. Those experiences shaped my decision to study teacher education at the doctoral level and to focus on the experiences of new teachers in this dissertation. I have tried to suspend these influences as I interviewed the participants in this study. I wanted to allow the participants to describe their

experiences on their own, free from the prejudices I have developed through my own experiences.

Recalling my first year of teaching, another area that affected my success was my level of comfort with the subject matter I was teaching. Although I majored in physics in college, I now had to teach the subject to high school students, which required a very different level of understanding. I created detailed lesson plans that acted as scripts for my classes. Because of this lack of comfort, my classes were often lecture-driven presentations that could have been conducted in an empty room without students even in attendance. I utilized laboratory investigations, but these were often verification types of activities where students completed calculations to prove something had occurred. In these early days of teaching, I do not recall asking students to think critically about the content or to develop their own explanations about an event. Since I had never experienced these types of activities in my own educational history, inquiry pedagogy was foreign to me. While these experiences may be similar to ones that the participants describe, I have tried to remain conscious of the fact that their experiences are their own. I have avoided prescribing my own history upon them and allowed the participants to detail their lived experiences.

Another area that I needed to be conscious of as I began conducting this research was my role with the Invisible College for Inquiry Science Study (ICISS). Being one of the founding members of ICISS, I am an advocate for the group's work and for inquiry science pedagogy's use more broadly. The participants in this study were both mentored by the ICISS group and are still active members in the group's activities (retreats, meetings, etc). Although I have an interest in the success of the group, I view this research not as proving whether ICISS is effective or not, but as an opportunity to understand ways in which ICISS can evolve to support new teacher's

growth and development. By better understanding the experiences of those who have lived them, the group can better support new teachers as they enter their first year of teaching.

Besides being a member of ICISS, I am also a teacher educator. I have read research concerning new teachers navigating their beginning years of teaching and some of the pitfalls that they encounter. While this knowledge has guided my work with ICISS and my work as a teacher educator, this research was developed to study the unique experiences of beginning teachers utilizing inquiry pedagogy. These experiences may or may not relate to experiences of other new teachers. My goal with this research is not to verify previous work or to offer data that stands in opposition to prior published research. Instead, I chose to study the participants' experiences to better understand how these individuals encountered their first years of teaching. Like any phenomenological study, these experiences will be unique to those who have lived them (Amy and Jennifer) but also communicates to people who have similar experiences in their lives.

The last role I believe I need to be concerned with is my relationship with the participants. Although I use pseudonyms in naming them and I often refer to them as "participants," I view both individuals as colleagues and as friends. Over the last two years, I have watched them grow as teachers and as individuals and I am invested in their success. This investment, however, does not outweigh my commitment as a researcher to collect and analyze data responsibly. In a way, my friendship with the participants was beneficial in this research. Because of our friendship, these informants were willing to share their experiences openly, possibly more openly than with a researcher with whom they have had no prior contact.

While these experiences and roles may create the possibility of bias, I have been committed to allowing the individuals to tell their own stories and to analyze these descriptions

with an open mind. While it may be philosophically impossible to approach research with such a detached consciousness, my goal was to be open to where the research took me and be mindful of the themes that emerged.

Data Collection, Management and Analysis

Consistent with phenomenological research methodology, I generated data from multiple sources. Through the collection of data, Field and Morse (1985) write, it is critical to “understand the phenomenon through the voices of the informant.” Each of the data sources used in this dissertation help to develop an understanding of the experiences that the participants had as new teachers enacting inquiry pedagogy in their classrooms. The data sources were selected due to being complementary and detailing experiential information vocalized by the two participants. This next section describes the data sources and how each was collected, managed, and analyzed for this study.

Interviews

Each informant participated in three interviews over the course of this study. The first interview with each participant was conducted in February 2006. This interview followed a semi-structured yet conversational approach where participants were asked to describe their life histories as students (Kvale, 1996). The second interview was conducted in March 2006. This second interview was also conversational in nature, but focused specifically on the participants’ experiences with scientific inquiry as students. At the time of these interviews, one participant (Jennifer) had completed her student teaching and was substitute teaching. The other participant (Amy) was in the midst of completing her student teaching experience.

The third interview was conducted in November 2007. At this point, both participants had graduated from their respective teacher preparation programs and were working in full-time

positions as science teachers at public schools. The third interview was more phenomenological in nature with the participants describing specific instances where they have used inquiry in their classrooms as teachers (van Manen, 1997). This interview was an informal, interactive process and the conversation varied as the participants detailed their experiences. As Barritt et al. (1985) write, “An interview can’t be turned into a formula. It is a social encounter that will go its own way if done well” (p. 55). Each phenomenological interview focused on the participant’s personal life stories with inquiry pedagogy as teachers, attempting, as Van Manen (1997) writes, “to stay as close to experience as lived” (p. 67).

Each of these interviews lasted approximately 60 minutes and each interview was digitally recorded, either through videotaping (interviews 1 & 2) or audio recording (interview 3). I personally transcribed each interview verbatim and completed this transcription within two weeks of the date of each interview (Patton, 1990). During the transcription process, the participant names were replaced with pseudonyms and any personal references (school district information, colleague names, etc) were altered to protect the identities of the informants.

Classroom Observations

In November 2007, I conducted classroom observations of each of the participants. I observed three separate classes for each teacher and collected detailed field notes during these observations. As I observed these classes, I focused on the classroom environment within which each teacher was working. For example, I took notes on the participants’ interactions with students and the physical classroom layout (Barritt et al., 1985; Patton, 1990). These observations were conducted before the phenomenological interview with participants and helped to situate me in the contextual arena that each participant was working and to better understand their lifeworld (van Manen, 1997). After the observations were completed, I used

word processing software to convert my written field notes to more descriptive narrative accounts.

Online Journal Posts

Another source of data came from the participants' experiences and reflections described in online journals (van Manen, 1997). During the participants' student teaching experience, I created an online journal for each individual to reflect on their teaching. These journals were part of a password-protected online space that was only accessible by the participants and four other ICISS members. Besides the student teachers' online journals, the space housed a discussion board for ICISS members and documents (journal articles, papers, etc) related to ICISS work.

For their journal reflections, originally the participants were given a general topic as a prompt on which they were to reflect. The original prompt asked the participants to describe an inquiry event they had experienced during the week and explain what about the event made it inquiry-related. Over the course of the participants' fifteen-week student teaching experience, the journal posts evolved and became a place for general reflection, storytelling, and the venting of emotions. In total, each participant posted over twenty reflections to their online journals.

After the participants had completed their student teaching, the individual journal posts were downloaded from the online space and a comprehensive journal for each individual was compiled. The dates of the journal posts were used to organize the reflections sequentially in order to maintain their chronological nature. Any biographical information was removed from the journal posts to protect the informants' identities and the confidential and personal nature of their reflections (Patton, 1990).

Audio-taped Conversations

The last source of data that was used in this dissertation was audio-taped conversations between the participants and other ICISS members. For example, during their student teaching experiences, the participants met with their mentor teacher, Brad (a pseudonym), to discuss lesson planning. While the intended nature of these conversations was curricular and pedagogical, often these discussions became places where the individuals shared personal narratives. Since these conversations often took place spontaneously without a predetermined schedule, the discussions vary in length from 15 to 45 minutes. Over the course of their field experience (either Fall 2005 or Spring 2006), a total of twelve conversations were recorded with the participants and their mentor teacher. I transcribed eight of these conversations myself and paid a student worker to transcribe the others. To validate the accuracy of the student worker's transcription, I personally listened to each recording to insure that the conversations were transcribed verbatim.

During their involvement with the ICISS group, the informants participated in numerous retreats. Many of the group discussions at these retreats were recorded. Each of these audio-taped conversations was transcribed by a student worker whose work I personally validated and corrected. Although six discussions were recorded and transcribed, only those portions where the informants participated were included in the corpus of data for this dissertation.

Data Analysis

Moustakas (1994) presents horizontalizing as an important beginning step in phenomenological analysis. In this process, each statement or utterance relevant to the topic and question is regarded as having equal value. Moustakas (1994) explains that in horizontalization

“there is an interweaving of person, conscious experience, and phenomenon. In the process of explicating the phenomenon, qualities are recognized and described; every perception is granted equal value, nonrepetitive constituents of experience are linked thematically and a full description is derived” (p. 94).

During the analysis of this data, I looked for utterances from the participants related to enacting inquiry pedagogy. Regardless of the length of an utterance, each relevant statement provided by the participants was viewed as having equal significance. Each expression was tested for two requirements: 1) Does the expression contain a necessary and sufficient constituent for understanding the experience (enacting inquiry pedagogy)? 2) Is it possible to abstract and label the constituent? (Moustakas, 1994)

Setting out to identify and code relevant statements, I found that by using nVivo, a qualitative analysis program, I could approach this process more methodically and easily move from one piece of data to another. nVivo also allowed me to organize any identified relevant statements and to look these statements across data sources and participants. This program became a vital tool for the analysis process and was critical to the development of the themes in this dissertation.

Returning to the analysis process, van Manen (1997) presents three approaches to developing themes from data. In the *wholistic* or *sententious approach*, entire passages are read and a single phrase is formulated that attempts to capture the meaning of the text as a whole, condensing an entire relevant passage down to a single, meaningful phrase. In the *selective reading approach*, individual statements are highlighted that express the essential meaning of the entire passage. In the *detailed reading approach*, passages are read line-by-line and themes are identified within individual sentences. Rather than viewing these approaches as individual or

competing methodologies, van Manen (1997) suggests using the three approaches in tandem to isolate thematic aspects of a phenomenon.

As I began isolating themes from any identified relevant passages, I chose at first to use the selective reading approach. I chose this approach initially because I wanted to allow the participants to speak for themselves rather than try to force some external statement upon their words as the sententious approach suggests. I read each relevant passage and attempted to isolate a statement which captured the essential meaning expressed by the participant. After a set of initial statements were found, I attempted to look for thematic patterns that would help me develop a thick description of the experience of enacting inquiry pedagogy, one that could capture the experience from the perspective of the informants in its fullest and richest complexity (Denzin, 1989; Geertz, 1973). Although these isolated statements provided a starting point, I found myself returning to the transcripts because other statements helped bring the participants' descriptions into focus. Unknowingly, I was encountering Geertz's description of the hermeneutic circle firsthand. Of this process, Geertz (2000) writes that analyses involve a cyclical rhythm "a continuous dialectical tacking between the most local of local detail and the most global of global structure in such a way as to bring them into simultaneous view" (p. 69). To further analyze this data, I needed to explicate the local detail to help bring the global into focus.

To focus on the local detail contained within the data, I turned to the detailed reading approach (van Manen, 1997). As I re-read each section of the data, I asked myself: "What does this sentence or sentence cluster reveal about the phenomenon or experience being described?" (van Manen, 1997, p. 93) This question, although appearing elementary, helped to situate my analysis within the phenomenological realm. Returning to the data, I asked myself what each

sentence (or cluster) revealed about the nature of a new teacher's experiences enacting inquiry pedagogy. Using nVivo, I attached descriptive phrases to each portion of data, allowing me to not only code and organize the data, but to look for common descriptions across data sources and participants. Segmenting and coding data in this manner helped me to decontextualize and recontextualize statements, allowing me to reduce and expand the data in new forms and with new patterns of organization. (Coffey & Atkinson, 1996)

From these codes, I set out to develop themes that captured the essence of the experience of enacting inquiry pedagogy. A theme, van Manen (1997) writes, "refers to an element which occurs frequently in a text" (p. 78) In phenomenological research, themes represent the experiential structures that make the experience what it is. In determining these experiential structures, "our concern is to discover aspects or qualities that make a phenomenon what it is without which the phenomenon could not be what it is" (van Manen, 1997, p. 107). To develop themes, I used the descriptive codes I had developed from my detailed reading of the data and organized them into thematic codes. These thematic codes represented patterns that emerged across the participants' descriptions in the various data sources. Through this analysis and organization, I was able to identify three themes which captured the experiences of the participants as they enacted inquiry pedagogy in their classrooms. For each of these themes, sub-themes emerged which helped to give meaning to the theme and how these meanings were constructed contextually.

From these themes and sub-themes, I developed narratives in an attempt to reduce the data and demonstrate the key sub-themes through composite stories of the participants. In developing these narratives, I sought feedback from a host of individuals, including my advisor and other teaching colleagues. This feedback helped the development of these phenomenological

descriptions by allowing “other participants (to) share their views of the way the description does or does not resonate with their own experiences” (van Manen, 1997, p. 100). This feedback proved invaluable as I revised the descriptions to clearly articulate the experience as it was lived by the participants so that others could identify with it. (Gadamer, 1989) These themes and sub-themes are presented in Chapter Four of this dissertation.

Research Participants

The participants in this study are two female science teachers, Amy and Jennifer (not their real names). Amy and Jennifer had both completed their student teaching experience during the 2005-2006 school year at a rural school 150 miles from the university’s main campus with Brad, an experienced chemistry teacher who was also a member of the ICISS group.

Amy and Jennifer were chosen as a central focus for this study based on several criteria. First, both individuals actually experienced the phenomenon being studied in this dissertation. Moustakas (1994) identifies this as a crucial component in selecting research participants in a phenomenological study. While many individuals may fit the criterion of being a new teacher using inquiry pedagogy, Amy and Jennifer also present themselves as units of study due to possessing similar prior knowledge regarding inquiry pedagogy. While the National Research Council (NRC) has presented a model of classroom inquiry that involves engaging students in scientifically based questions and having students use evidence to formulate and communicate explanations (NRC, 2000), research has found that teachers confuse inquiry with other experimentally-driven methods such as hands-on instruction or discovery learning (Abd-El-Khalick et al., 2004). Since Amy and Jennifer both encountered similar training through their methods classes and their field experiences with Brad, their perceptions of the enactment of inquiry pedagogy should be similar. While their later experiences as first year teachers may be

different, their prior experience with ICISS provides a common discourse that can be drawn upon during interviews. Also, their continued involvement with ICISS demonstrates an interest in understanding the nature and meanings of the phenomenon being studied, which Moustakas (1994) outlines as being an essential criterion for research participants in a phenomenological study.

Jennifer

Jennifer is a white female who grew up in a suburban community outside a major Northeastern city. Jennifer describes her high school as “a really good place to get an education.” The school “offered a lot of like advanced placements and honors classes” and “activities that you could be involved with.” Her high school, Jennifer reflects, “did prepare me for college really well, cause I went into college and I did really well.” Jennifer describes herself as a successful student both at the collegiate and high school level. When asked about her academic ability, Jennifer answers: “I don't want to brag or anything, I graduated with a 4.0 in high school.” Jennifer completed her student teaching in Fall 2005. After graduating with a degree in chemistry education, Jennifer began substitute teaching at various schools before accepting a long-term substitute position at a rural high school teaching chemistry. At the time of the phenomenological interview (November 2007), Jennifer had a permanent position teaching middle school life science in the same rural district she had worked the prior year.

Amy

Amy is a white female who grew up in a suburban community outside a small Northeastern city. Amy describes the high school she attended as having “strong math and science, strong English. I think all their areas are pretty good.” Amy had taken advanced

placement courses in high school and did well in college. After obtaining a bachelor's of science degree in chemistry, Amy worked briefly in a collegiate research laboratory before deciding to enroll in a graduate education program to obtain a teaching certification. Amy completed her student teaching placement with Brad the semester in Spring 2006.

After graduating, Amy accepted a position teaching chemistry in an urban high school. Of this experience, Amy says "I was showing up everyday and trying to teach them but it was more emotional from my end because I had such behavior problems." In November 2006, Amy got into a bad car accident and did not return to the school. Amy returned to her hometown and, after a few months recuperating, began substitute teaching in neighboring suburban districts. At the time of the phenomenological interview (November 2007), Amy was teaching chemistry in the high school she had attended as a student.

Concluding Remarks

I am drawn to this work due to my own experiences as a first year teacher. As I have conveyed earlier in this chapter, I had a great deal of difficulty negotiating the culture of my new school and struggled to develop my own identity. While these experiences influence my work as a researcher and guide my work as a teacher educator, I must be mindful to suspend these factors and to allow the participants' words to speak for themselves. In developing this dissertation, it was my goal to responsibly collect and manage data that represents the participants' stories yet also protects their anonymity. During analysis, it was my desire to be open to where the research took my and to allow themes to emerge that describe Amy and Jennifer's experiences as they were lived.

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CHAPTER 4:

THE EXPERIENCES OF NEW TEACHERS ENACTING INQUIRY PEDAGOGY

How does a new teacher describe the experience of enacting inquiry pedagogy in her classroom? When I use the term “enacting,” I mean to include not only the actual process of teaching using inquiry pedagogy, but also the planning of inquiry lessons within the culture of schools. Although I am a former teacher who taught science for almost fifteen years, my own background will not help me describe this experience. Over the years, my memory has faded and I have forgotten what it is like to be a new teacher in a new school developing lessons for the first time. Time has also changed my perspective. Although I may be able to recall some specific lessons that I attempted as a new teacher, I would now view some of the contextual influences of my own teaching in a different light and would describe those lessons much differently than I would have a decade ago. To better understand the experiences of new teachers, I need to look outside my own life and history and turn to those who are encountering these events now.

To develop the descriptions of enacting inquiry pedagogy presented in this dissertation, I worked with Jennifer and Amy, two science teachers who were in their second year of teaching. My involvement with Jennifer and Amy actually began in the summer of 2005, when both individuals became members of a group called the Invisible College for Inquiry Science Study (ICISS). At that time, Amy and Jennifer were preparing to student teach with Brad, another ICISS member. During their student teaching placements, Amy and Jennifer agreed to post weekly reflections in an online journal that focused on their experiences with inquiry pedagogy. Besides these reflections, I have collected other complementary data to better understand how

Amy and Jennifer have experienced enacting inquiry pedagogy. The entire corpus of data analyzed in this dissertation includes classroom observations, weblog and discussion board posts and transcripts from interviews and audiotaped ICISS meetings.

When analyzing the data, I looked for Amy and Jennifer's descriptions of enacting inquiry lessons in their teaching. Across the different data sources, I found that Amy and Jennifer described their experiences in several ways. From these different descriptions, however, themes emerged that helped to convey what the experience of enacting inquiry pedagogy is like for a new teacher. These themes include: *being in a hot spot*, *letting go*, and *negotiating constraints*. In this chapter, I detail each of these themes and the sub-themes that emerged. To demonstrate these, I have included verbatim quotes from Amy and Jennifer to clearly present the participants' own words and their point of view. Although I present the themes as being discrete entities, interrelations and overlap exist amongst the themes which will be demonstrated over the course of this chapter. Often, quotes are re-used to demonstrate the themes. By using verbatim quotes, I hope to demonstrate the richness of the participants' words without parsing out a specific section that demonstrates an isolated theme or sub-theme. After each quote, I present short passages that discuss the participants' words in depth. I have included these passages to help the reader not only understand how Amy and Jennifer describe their experiences but to demonstrate how I have interpreted their words as a researcher. By discussing my interpretations openly, I hope to provide more transparency regarding my own prejudices and background.

Being in the "hot spot"

During an interview, Jennifer outlines a lesson where she attempts to use inquiry with a class but decides to change the lesson after the students have difficulty.

I did it with one of the classes and it didn't work. They were just even more confused than they ever have been. So I thought "Okay, I'm going to change it for

the other class” and I just took a step back. And it was more me lecturing them through it and discussing the idea with them.

(Interview, November 2007)

During the original inquiry lesson, several students struggled with the activity so she modified the lesson significantly. Rather than continue to use inquiry with the remainder of her classes, Jennifer chose to lecture to the students instead. Describing this decision, Jennifer later explains that it was based not only on students’ learning, but on her emotions as well. Reflecting on the emotions she felt as the students were having difficulty, Jennifer describes it as being in a “hot spot.”

I like to know that I can help them out as much as possible. I don’t like to be in a hot spot. I don’t like to have pressure put on me or be in a situation where I don’t really think I’m in control of.

(Interview, November 2007)

Jennifer describes being in a “hot spot” as having “all this pressure pushing down on me and it makes me flustered and I can feel my face getting red.” As new teachers attempting to use inquiry with their students, Amy and Jennifer present an emotional state (a “hot spot”) where they navigate feelings of anxiety, stress and self-doubt. Where do these feelings come from? Looking at Amy and Jennifer’s responses, they describe the hot spot as emanating from two critical sources: a) feeling uncomfortable teaching the content and b) perceiving students’ reactions to inquiry. Through their descriptions of inquiry lessons, it appears that this emotional hot spot influences the teachers’ decision to use inquiry pedagogy in their classes.

Feeling uncomfortable teaching the content

Across the different data sources, Amy and Jennifer use the term “comfortable” extensively when discussing their experiences enacting inquiry pedagogy in their classrooms. For instance, early in her student teaching placement, Amy is asked about using inquiry rather

than a more prescribed instructional technique for a particular lesson. She explains that she has some reservations, due to what she perceives as the spontaneity of inquiry lessons.

I guess I'm also worried that I'm going to say something wrong or that it will continue a misconception. I just don't want to do that because I don't even understand it well enough myself. And I feel bad that I'm cheating the kids that way. I think part of being able to be spontaneous is feeling comfortable enough yourself with what you're saying, or going to say or your understanding that you're not worried about that.

(Discussion with Brad, January 2006)

In Amy's mind, her choice to use inquiry pedagogy is not solely an instructional decision, but is tied directly to her "feeling comfortable." The American Heritage Dictionary (2000) defines being "comfortable" as feeling "free from stress or anxiety; at ease." As apparent in this passage, Amy's feelings of comfort are related to her perceived content knowledge and her ability to convey that content knowledge to her students. She describes not only being "comfortable...with what you're saying" but also being comfortable with "your understanding." From this, it appears that Amy is struggling not only with her perceived level of content knowledge but also her ability to utilize that knowledge in an inquiry lesson. She fears saying something wrong or reinforcing a student's existing misconception and does not feel that she understands the content "well enough" to be spontaneous. In a recent interview, Amy describes why she experiences anxiety in inquiry situations.

With inquiry, you need to come up with a question for them every time they hit a dead end or every time they hit up against a wall. You need to come back to them and say "Well, how does this work? Think about this." And it requires a really deep conceptual understanding of the topics you're teaching and I'll admit, I don't always have that and so, that's what causes me a little bit of anxiety

(Interview, November 2007)

Here, Amy clearly links her feelings of anxiety with her perceived lack of "deep conceptual understanding" of the content she is teaching. In this passage, Amy further describes that she views an inquiry lesson as being "spontaneous" in nature. In her mind, teachers using inquiry

pedagogy need to guide students by asking questions. This requires a level of understanding that she feels she “doesn’t always have” which creates discomfort and anxiety.

Jennifer describes similar feelings due to her content knowledge. In her student teaching journal, Jennifer reflects on her first lessons using inquiry in the classroom.

I just feel like the students are missing out on so much by me not being prepared with the content. And sure, I could just give the students a handout and have them fill in the information, but then where does the inquiry fit in? If I want the lesson to be some sort of discussion rather than a lecture, I have to be extremely comfortable with the content and be prepared for where the discussion might go.

(Blog Post, October 2005)

Here, Jennifer identifies being “comfortable with the content” as influencing her instructional decision-making for a class. If she is not “prepared with the content,” handouts or lectures could be used to avoid “where the discussion might go” in an inquiry lesson. When Jennifer feels “extremely comfortable with the content,” however, she is more open to having “some sort of discussion” rather than employ didactic forms of instruction. With regard to her content knowledge, Amy views inquiry lessons in much the same way. Here, Amy describes how her content knowledge affects her instructional decision making.

If I feel really comfortable with the topic and I really understand it myself then I think inquiry comes a little easier. But if I don’t then I tend to be very didactic. Here’s the information. Here’s what you need to know.

(Interview, November 2007)

Both Amy and Jennifer site their lack of content knowledge as being critical influences in their choice to enact inquiry pedagogy with a class. When they feel “comfortable with the content,” they are more open to using inquiry pedagogy. When they do not feel this level of comfort, they fear navigating the “hot spot” and the anxiety that arises from their perceived lack of content knowledge within a spontaneous instructional setting.

It is important to remember that Jennifer and Amy were both trained in science and chemistry. Both teachers also describe themselves as successful students in high school and college. Looking at Amy and Jennifer's background as students, one may have difficulty understanding how their success as students could lead to their perceptions of inadequate ability as new teachers and the resulting anxiety they experience. In their eyes, however, their current content knowledge relates more to the way they learned as students rather than to how successful they were academically. Here, Amy describes her experiences as a student and how it now impacts her views of learning and teaching.

I thought that I learned best by going home, sitting at my desk, and copying things out of a textbook and writing them down and memorizing them. But, that's what it was. It was memorizing. It was not conceptual at all. That's become manifest as I've tried to teach some of this stuff because I've memorized facts and I can spout off some terms. But I don't know what they mean. And I've realized that. And so it's really made me wonder, you can memorize facts that way, but do you learn anything conceptually that way?

(Interview, February 2006)

As a student, Amy describes succeeding through memorization. Now, as a teacher, she realizes that she knows facts and terms related to chemistry, but identifies that she needs a different level of understanding in order to teach the subject using inquiry. Also in this passage, Amy mentions again that she feels that she lacks a "conceptual" understanding of chemistry, one that is not just based on "memorized facts."

In describing her background as a student, Jennifer discusses similar experiences. She was a successful science student who excelled by "memorizing things for the test."

In high school, you pass the test. You do really well on the test. I don't want to brag or anything. I graduated with a 4.0 in high school. I had the system down. I knew how to work it. I felt like they prepared me for college really well, because I went into college and I did really well. But, I don't know necessarily anymore that just because you know something for a test means that you've learned it. Learning to me more now means that your opinions have changed about things you've already previously come to realize or things like that. So it's not so much

memorizing things for the test and then forgetting it a year later. It's actually learning how to use that information to keep building off of it.

(Interview, February 2006)

Much like Amy, Jennifer attributes her success as a student to her ability to memorize information. Due to her experiences as a teacher, however, she now views learning not as committing discrete facts to memory, but as being able to “build off” of previously learned information. Amy and Jennifer’s new views of learning contribute to their desire to navigate a “hot spot” and enact inquiry pedagogy. Here, Amy describes her decision to continue using inquiry pedagogy with a class, even though she is uncomfortable with it due to her perceived lack of content knowledge.

I reached the conclusion that while I was comfortable with the style of lecture-based learning I had experienced all through high school and college (it being really all I have ever known) the bottom line is that it doesn't work, and I am living proof of that. I got my way through my chemistry education by memorizing lecture notes and not learning a whole heck of a lot. I concluded at that point that I owed it to myself (and to the kids) to try something else.

(Blog Post, February 2006)

Even though she experiences anxiety in inquiry lessons, Amy feels she “owes it” to her students to use a different form of instruction that could aid in their learning. Amy believes that the teaching method she is “comfortable with” does not lead to the deep conceptual understanding that she hopes to develop in her students. In this passage, Amy identifies that her comfort with “lecture-based learning” may also be due to the fact that it is all she has “ever known.” The anxiety that Amy and Jennifer experience when enacting inquiry pedagogy results from their perceived lack of content knowledge which developed through a lifetime of lecture-based instruction. Since they have had few experiences as students with inquiry pedagogy, they do not always feel comfortable teaching the content in this manner. Again, even though they experience anxiety in inquiry situations, Amy and Jennifer express a willingness to navigate a

“hot spot” to benefit their students. Here, Amy describes her choice to use inquiry with her classroom, even though she is not always comfortable with using it.

The teaching style I'm comfortable with is all I've ever known and because of that, it's hard for me to let go of it. And I realize how much I didn't retain with that teaching style and so, I realize that teaching style is not the best, even though it's what I'm most comfortable with.

(Interview, February 2006)

Although she is comfortable with lecture-based instruction, she realizes that it is not “the best” teaching style and that inquiry pedagogy, even though it creates anxiety, might be better at developing conceptual understanding that can be “retained.”

Perceiving students' reactions to inquiry

When using inquiry in their classroom, Amy and Jennifer identify an anxious “hot spot” that develops during the lesson. As presented earlier in this chapter, the anxiety they feel relates to their perceptions of their knowledge and expertise as teachers. These emotions, however, are also related to their perceptions of the students' reactions to using inquiry. For many students, inquiry pedagogy is a new instructional technique which requires them to participate in a much different way than in a lecture-based classroom environment. Some students have difficulty with this style of teaching and their reactions (as perceived by Amy and Jennifer) create anxiety for the teachers. Here, Amy describes an inquiry lesson that she had originally planned to leave open-ended. After seeing some students becoming frustrated, she chose to give the students the answer rather than have them continue with the activity.

In terms of when I break down and when I just tell them the answer? You know level one kids and they want the right answer. And they feel really frustrated if they don't. And it's hard to have them be mad at you for a little while if you don't give them the right answer. So, that causes me a little bit of anxiety.

(Interview, November 2007)

This open-ended approach frustrates the students, which Amy perceives as anger at her and her teaching ability. Amy feels that the students just want the “right answer” and she struggles with having the students be “mad” at her. She feels a level of anxiety because of the students’ emotions and “breaks down,” returning to more lecture-based instruction. It is not clear whether the students were actually “mad” at her or not. The important motivator, however, is that Amy believed the students to be angry, which caused her to “break down.” In this instance, the “hot spot” that Amy experienced was a result of her perceptions of students’ reactions.

Jennifer also describes the students’ reactions as being powerful influences over her emotions during an inquiry lesson. Here, Jennifer describes an inquiry lesson she used with her students and how she perceived the students as reacting to this style of teaching.

It was hard for them. It was so hard. They had no idea how to go about doing something on their own and it was just killing them. They just would sit there with these dumb-founded looks on their faces like “What do we do next? Where’s the procedure? What are we supposed to do? What are we supposed to write down?” And for me just telling them to go to it, just do whatever you think you need to do next or, come up with your list of materials. They just had no clue how to work through it themselves. It was difficult. They just kept asking so many questions.

(Interview, November 2007)

Here, Jennifer describes students wanting a “procedure” and wanting to know exactly “what to do.” While she wants the class to use more inquiry-oriented skills, the students have “no idea how to go about doing something on their own.” Jennifer describes this as being “hard” for her students and “difficult” for her as a teacher because they “kept asking questions.”

When Amy and Jennifer are navigating the “hot spot,” their decision to continue using inquiry hinges how they perceive their students reacting to the class and their teaching at that moment. As Amy writes in her student teaching journal,

I was beginning to wonder whether or not leaving things open-ended like this is really worth it, especially if kids leave the room feeling really frustrated and feeling like the class is a waste of time.

(Blog Post, February 2006)

When students encounter “open-ended” procedures, Amy views her students as being “frustrated” and thinking that the class is a “waste of time.” Again, these reactions are perceived by the teachers, but can still influence the teachers, their instructional decisions, and how the teachers’ view themselves. Through the students’ reactions to inquiry lessons, Amy and Jennifer perceive their students as viewing them and their ability in a negative manner. Here, Jennifer describes an inquiry lesson that did not work the way she had planned and how she feels the students reacted. In Jennifer’s mind, students are evaluating her and her teaching ability, especially when they struggle with an inquiry lesson.

I feel like they’re looking at me like “Oh, she’s just some young teacher. She doesn’t really know what she’s doing or anything.” And for those high school students to respect me they have to see that, yes, I do know what I’m doing. I’m in control. I know how to manage a class. And maybe that particular lab, I felt like the impression that they had of me may have changed a little bit. That’s probably just me being self-conscious the way that I am. Or lacking some of the confidence maybe that I needed but I can’t say that I observed anything.

(Interview, November 2007)

Here, Jennifer describes that the students view her as “just some young teacher” who “doesn’t really know anything.” Jennifer realizes that she probably just perceives these reactions and that it is just her being “self-conscious” or “lacking confidence.” Nonetheless, these perceptions are powerful motivators and feed into the teachers’ level of comfort with the content and influence their desire to enact inquiry pedagogy.

Letting go

During our interview, Amy describes an inquiry lesson she had planned with her cooperating teacher (Brad) during student teaching.

We told them that instead of us telling them the amounts of zinc and sulfur that we were going to use, they were going to have to tell us the amounts to use to get the best reaction and this particular mixture makes rocket fuel so we were going to light it on fire. The typical student response is just use the same number of grams of each and we did get that response. And Brad talked about that before I did it, how it was going to end and that I should go ahead and do that, which I did and it didn't do very much...So eventually through more discussion, some kids suggested that we use the number of moles, and we get one mole of something off of the periodic table, the gram amount on the periodic table. So I felt like that was inquiry because you sort of guided them and you provided scaffolding for what they needed a couple days prior but you didn't tell them at that particular point in time how to do it.

(Interview, November 2007)

In this lesson, Amy describes her role in which she guides the students without providing a step-by-step procedure or solution. In this lesson, she allows the students to present different ideas and shows a demonstration of each idea for the class. Reflecting on her role and the perceived success of the lesson, Amy remarks:

I think with inquiry you do have to let go a little bit and you have to be okay with not knowing exactly what kids are going to say.

(Interview, November 2007)

When she “lets go” of the class, the direction of the lesson is dictated to a large degree by the involvement and thoughts of the students. As demonstrated in her description, Amy has some preconceived ideas of possible pathways that students may suggest and is not actually letting students decide the path of the entire lesson. “Letting go” of the lesson, however, opens the class to students’ ideas which Amy sees as crucial to enacting inquiry pedagogy.

Looking across the different data sources, Amy and Jennifer describe “letting go” in several different ways: a) giving up control, b) cultivating student ownership, and c) weathering unpredictability. Each of these descriptions detail what it means for the teachers to “let go” when enacting inquiry pedagogy in their classrooms.

Giving up control

When discussing using inquiry lessons with her students, Amy describes personality traits that make it difficult for her to use inquiry as an instructional technique.

I'm a perfectionist and I like things to fit in a box and I like to know what I'm going to say, when I'm going to say it, and that's not how inquiry is. And you have to let go a little bit.

(Interview, November 2007)

As seen here, Amy views an inquiry lesson from a position of control. She likes “things to fit in a box” and likes to know where a lesson is going to go. She realizes that this is due to her being a “perfectionist” which may not be conducive to an inquiry lesson. Here, Amy writes in her student teaching journal about her reservations with inquiry pedagogy.

I think that this is, at least in part, a personality thing. I have perfectionist tendencies and I have a hard time letting go of knowing exactly where the discussion is going to go. I'm trying to learn to let that go, and not worry so much about having control and knowing exactly what to say to the kids when they ask me a question for which I just don't have an answer. It's still hard for me to do that because of my innate desire to have every thing planned out and predicted.

(Blog Post, March 2006)

Amy sees herself as a perfectionist and describes having an “innate desire” to have everything “planned out and predicted.” To enact inquiry pedagogy, she realizes that she has to learn “let go” and not “worry so much about having control.”

Jennifer also describes inquiry lessons with respect to control and personality. Here, Jennifer describes a lesson where she had planned to guide students to discover a scientific relationship, but one student announced the relationship at the start of class.

Even in my personal life, I have a set plan of things I'm going to get done, and when people throw a loop in there and get me off schedule, I get all flustered and I don't know what to do. I don't like when someone messes up my schedule and my plan. I knew where I wanted to go with this activity, and by him just completely barging in it and saying the end result just messed me up, big time. I

think it's something I'm going to have to deal with as long as I'm teaching. I can work at it to make it not so uncomfortable for me. Just kind of by being prepared and not being so rigid in my structure and just kind of letting things go where the class takes it, and not so much have this set of goals that I feel I have to accomplish by the end of that period.

(Discussion with Brad, October 2005)

Jennifer comes to class with a personality where she has a “set plan of things” that she is going to get done. This personality translates into having a “rigid” lesson structure where she has a “set of goals” that she feels she has to accomplish during a class. Student participation, at least in this situation, is viewed as “barging in” and “messing me up” rather than helping to direct the lesson. Jennifer realizes that she needs to “work at it” so she is not so uncomfortable with “letting things go” and is more open with “where the class takes it.” Jennifer realizes that her resistance to “letting go” is due not only to her personality but also her experiences as a science student.

Throughout my education, we were so set on getting a certain number of things accomplished that we just went with what they said and we didn't add any extra details or nitty-gritty stuff in, and we just got done what needed to get done. So in that respect, it's like my education. But yet, my own personal life, it has an effect on it, too. I'm trying to change that because people have commented on that. That if they interrupt my day or anything, I flip out, I'm like, 'You know, I'm supposed to be here now, and move on.' And I've tried to work on that.

(Discussion with Brad, October 2005)

Jennifer realizes that her personality has a large effect on her role as a teacher. She “flips out” when there are interruptions that may deviate her from her schedule. In this passage, however, she also identifies that part of her resistance to letting go and giving up control might be due to her prior learning experiences. In her experience, teachers were “set on getting a certain number of things accomplished” and students “just went with what they said.” A student's role was not to “add any extra details” but to just “get done what needed to get done.” These experiences influence how Jennifer views her role as a teacher and how she views the role of students in her

class. She realizes that she needs “to work on that” to overcome her resistance to “letting go” of the lesson due to her personality but also due to her learning history.

Cultivating ownership

During one of our interviews, Jennifer describes an inquiry lesson where she had planned to lecture to the class but instead decided to open the class to more student-centered investigations based on a student’s question.

It's just kind of a spur of the moment thing. I think that's kind of how it happens best is some student might bring up a good point and that might an excellent place for a teacher to say “Alright. Well, let's look deeper into that.” And you might totally go away from where your original plans were, and that's okay.

(Interview, March 2006)

Here, Jennifer decides to change her lesson for the day and deviate from her original plans. This is a decision that Jennifer reports that she struggles with at times. It was a “spur of the moment thing” where a student had made a suggestion and Jennifer decided to “look deeper into that.” This decision allows students to take control of the lesson and help direct the class. In describing why she changed the lesson, Jennifer explains that “letting go” of the class helped to develop student ownership of the lesson. Because they played a role in deciding how the lesson would progress, students took more responsibility for the activity which promoted student interest and learning. Jennifer discusses this in one of our interviews:

The students felt almost that they had ownership of it. They were developing the ideas and developing the formulas from what they had found in lab. So they were actually seeing this take place right in front of them, rather than just being told “Well, this is what happens.” So, they were really able to gain a much deeper understanding of what that equation actually says than just seeing two letters written on a piece of paper.

(Interview, February 2006)

In this lesson, students were “developing the ideas” and “developing the formulas.” By involving them in this manner, Jennifer feels that the students have more ownership over the

material. She relates this ownership with helping to promote students' gaining a "deeper understanding" of the content.

Although she believes that she has difficulty giving up control of the lesson due to her personality, Amy also recognizes the benefit to using inquiry pedagogy. As Amy writes in her student teaching journal,

Ownership is a key part of the inquiry experience. Students should feel as though they have a stake in what they are doing, and that there are several novel ways at achieving an answer or obtaining a result. In this way, students feel that they have some autonomy over what is being done. I have seen how this motivates otherwise half-interested students to get involved, to ask questions, and ultimately, to learn.

(Blog Post, May 2006)

Here, Amy identifies "ownership" as a product of an inquiry experience. She realizes that by letting go of the lesson and giving more control to her students she can motivate them "to get involved, to ask questions," and "to learn." By letting go of the lesson, her students will feel that "they have a stake in what they are doing." Jennifer identifies some of the same results to letting go of the lesson and giving students more control. In her student teaching journal, Jennifer writes:

Overall, most of the students said that they really enjoyed presenting their posters to their classmates. One student, who failed this course last year, made the comment that he appreciated the fact that the experiments were their own and that there was no correct answer trying to be reached. This was really great to hear, because Brad and I have been stressing the fact that we are not concerned with the final answer, but more of the process taken to reach a conclusion. Also, it was nice to see the kids take ownership of their investigations, and have a great deal of confidence when presenting their information.

(Blog Post, November 2006)

In this lesson, students were allowed to design their own experiments to reach a conclusion. Jennifer was not concerned with the "final answer" but wanted the students to develop "the

process taken to reach a conclusion.” Jennifer identifies that students took “ownership” over their investigations because they were “their own.”

Weathering unpredictability

Both participants identify “letting go” of the lesson as a critical feature of an inquiry lesson. In their view, giving up control of the lesson cultivates a sense of ownership amongst students. By “letting go” of the lesson, they can help to motivate students and promote student learning. Giving up control, however, opens up the lesson to more unpredictability which both participants find difficult to manage. As Jennifer discusses in an interview:

But that’s what makes it so hard to plan for, you just never know what’s going to come out of their mouths and what they might think of based on the discussion that you’re having with the class.

(Interview, March 2006)

Jennifer realizes that it is “so hard to plan” when she never knows “what’s going to come out of their mouths.” Amy also identifies the unpredictability of lessons as difficult to manage. Amy links this difficulty not only to her personality but also to her content knowledge. In an ICISS group meeting, Amy remarks:

It was hard for me, and I think the hard thing was that I’m used to having everything planned out and, whenever I give any type of lesson in any type of venue, I want to have it scripted out. That’s just my personality and inquiry doesn’t operate like that. And, for good reason, but it was hard for me to let go of the scripted dialogue, and just kind of take what the students were saying and weave in the concepts I needed to and you know build off of what they were saying and, still have focus. I don’t know it’s just hard and I think that required a really good firm grasp of the content and I felt like I didn’t have that a lot of the time. I think that’s what made it hard, and uncomfortable. So, I think it got better and it will get better as I try to do it more. But for me, that was hard.

(ICISS Meeting, June 2006)

Here, Amy recognizes that part of her difficulty with the unpredictability of an inquiry lesson comes from her personality where she is “used to having everything planned out.”

Amy identifies that it was hard to “let go of the scripted dialogue” and that inquiry

lessons require her to “take what the students were saying” and “build off” of it. To do this, Amy realizes that she needs a “firm grasp of the content” and that she feels she “didn’t have that a lot of time.” In a recent interview, Amy also links her decision to weather the unpredictability of an inquiry lesson to her experience as a teacher.

Especially as a young, inexperienced teacher, you have to be okay with not knowing what kids are going to say. That’s always a tough thing for me because I wanted things very prescribed. Here’s the right answer and this is how you do it. So, I think you have to let go a little bit, but that particular lesson I felt comfortable enough with the material and with the concept cause I understood the concept really well. I was okay with that particular lesson but there have been lessons that I wasn’t as comfortable.

(Interview, November 2007)

Here, Amy discusses both her personality and her level of experience as being possible obstacles to “letting go.” She wants lessons to be “prescribed” where she gives the students “the right answer” and a set procedure. But Amy also realizes that part of her resistance comes from her lack of experience, especially as it relates to her content knowledge. When she feels “comfortable enough with the material,” she is more likely to “let go a little bit” and open the class to more inquiry experiences.

In a recent interview, Jennifer outlines the factors that impact her decision whether to use inquiry for a particular lesson.

I think another thing definitely is the content knowledge. If the student gives you an idea, you have to know in the back of your mind what is going to happen from their idea. Just to make sure it’s safe. You know different things like that. And when you don’t know, you’re taking a big risk by letting the students do it, because you never know what might happen from it, so having that content knowledge ready at all times is something that’s really, really important.

(Interview, November 2007)

Much like Amy, Jennifer identifies “content knowledge” as being a critical influence over her instructional decision-making. When a student gives her an idea, she must assess whether the

suggestion is safe. If she does not have a strong content knowledge, she worries that she is taking “a big risk” by giving the students control of the lesson and trying out their ideas.

For Amy and Jennifer, when they feel that they possess a strong knowledge base for a particular lesson, they are more likely to use inquiry and let the students have control of the lesson. Whenever they perceive gaps in their knowledge base, they are less likely to “let go” of the lesson and use inquiry pedagogy. As Amy reflects in her journal,

I think I am starting to see why teachers tend to steer away from real inquiry-based teaching where kids are asking questions and where you as the teacher don't really know exactly where the conversation or lab activity could turn next. It is because you have to be so comfortable with the content yourself that you don't become anxious when things don't go as planned or when a kid asks you a question that you hadn't anticipated. Honestly, its just so much easier to have a very cook-book-type protocol for what you want to have happen that day because it is safe and because there are right and wrong answers and you as the teacher know exactly what those answers are. I guess what I'm trying to say is that I used to just bash teachers who would stand up there and lecture to kids, but now I understand why they may do it. It's not that I am condoning bad practice. It's just that now I am beginning to appreciate the difficulty that is associated with teaching in a more inquiry and conceptually-driven way when you don't feel like you have a good command of the subject matter yet. Sometimes, it's just easier to give the kids the answers.

(Blog Post, February 2006)

Because she perceives that she lacks a strong content background, Amy becomes “anxious” in inquiry situations where students “are asking questions” and she may not know “where the conversation or lab activity” could ultimately go. As a new teacher, Amy finds weathering the unpredictability difficult to manage, especially when she does not feel she has “a good command of the subject matter yet.” She could choose to use “cook-book-type” activities where there are “right and wrong answers.” While Amy views these types of lessons as “bad practice” and she “used to bash teachers” for doing this, she realizes that more predictable activities would not open the lesson up to “a question (she) hadn't anticipated.”

Negotiating constraints

In one of her interviews, Amy discusses being disappointed with the amount of inquiry that she has been able to bring into her classroom. Describing this disappointment, Amy says:

I have this standard but I'm not really living up to it and I'm doing the best that I can with the time and the resources that I have and the constraints that I have, but I know that I don't want to teach so didactically forever.

(Interview, November 2007)

In Amy's mind, she would like to use inquiry more in her classroom but has difficulty negotiating certain "constraints" that impede her enactment of inquiry pedagogy. Looking across the data sources, Amy and Jennifer describe negotiating three different constraints when they enact inquire pedagogy: a) navigating the curriculum, b) working with colleagues, and c) managing resources.

Navigating the curriculum

When discussing enacting inquiry pedagogy at her school, Amy says:

There is a mandated curriculum that you have to get through in a certain amount of time and there are a specific number of days for each topic and if you don't get through it then, it's not a good thing.

(Interview, November 2007)

Here, Amy struggles with navigating a "mandated curriculum" created by her local school district that influences not only what is taught, but dictates in some degree how it is taught as well. This influence comes through a policy of defining a "specific number of days" within which "each topic" needs to be taught. If she decides to use inquiry for a particular lesson, Amy realizes that she risks falling behind the district's mandated schedule.

With inquiry, it takes a little more time to get kids to understand something without telling them every single answer, like "Here's the information" kind of thing. It takes less time to just give them the information and they learn it. And that's kind of how it is here.

(Interview, November 2007)

In her mind, inquiry lessons take “more time” than a lecture-based lesson where a teacher would “just give them the information.” The district’s curriculum policy creates an environment where Amy is hesitant to use inquiry lessons because she fears falling behind the schedule.

In Jennifer’s school, there is not as restrictive of a curriculum policy as Amy’s district. While this would presumably allow her to have more flexibility with planning, Jennifer must also negotiate curricular constraints that influence her enactment of inquiry pedagogy.

Even though there’s not an actual, set curriculum per se, there are two other teachers that teach each of my preps, so they all try to stick together. And so I have to try to move at a pace that suits them so that all the students are kind of kept at the same place. That’s difficult just because they’ve taught this for how many years, the same thing over and over and over again and so they know exactly what they’re going to do every day they have it planned out. Whereas for me, I don’t know how long things are going to take. So I’ve already fallen behind, so I’ve already been trying to think of ways where I might be able to catch up a little bit.

(Interview, November 2007)

Instead of navigating a district-mandated curriculum, Jennifer must navigate the curricular constraints presented by her colleagues. Jennifer identifies that there are “other teachers that teach each of my preps” and that they try to “stick together.” Rather than meeting a prescribed curriculum as Amy does, Jennifer must “move at a pace” that suits her colleagues so that “all of the students are kept at the same place.” Rather than encountering a mandate that emanates from the district office, teachers in Jennifer’s school communicate that curricular consistency needs to exist across different sections of the same course, regardless of an individual’s style of teaching. While Jennifer has some autonomy over the day-to-day planning of her classes, she also realizes that she may risk “falling behind” if she opens her classroom to more student-centered approaches like inquiry pedagogy. In one of her interviews, Jennifer describes an inquiry lesson that she incorporated spontaneously after students asked to conduct experiments on a demonstration she had shown the class.

It wasn't in the plans, didn't match up with what the other classes were doing, but that's awesome if they want to experiment with that and keep it going. So we took two or three days to just stop what we were supposed to be doing and ran those different experiments and then had all the groups present to the class what they found so that we could make an overall conclusion of what exactly was taking place.

(Interview, November 2007)

Jennifer weighs the instructional benefits of having students be engaged in an inquiry lesson versus being consistent with other teachers in her school. Even though it “didn't match up with what other classes were doing,” Jennifer decides to allow the students to experiment. Jennifer, however, sees this spontaneous inquiry lesson as being outside of what her class is “supposed to be doing” which is staying “matched up” with other teachers' classes. This pressure for curricular consistency creates an implicit constraint on Jennifer's instructional decisions. Here, Jennifer discusses how her colleagues' desire for curricular consistency affects even how she interacts with students:

I'm under the pressure where I have to get through a certain amount of material and keep moving but yet, I don't just want to say [to a student] “your questions aren't important.” So, it's difficult there to find a happy medium.

(Interview, November 2007)

In her mind, Jennifer feels pressure to “keep moving” and “get through a certain amount.” Although Jennifer identifies that the school does not have a mandated curriculum, curricular consistency is enough of a constraint that Jennifer finds it “difficult to find a happy medium” with regard to her interactions with students.

Besides the constraints due to the curriculum of the schools in which they work, Amy and Jennifer also face district and state initiatives that constrain the curricular decisions they make in their classrooms. In a recent interview, Amy discusses working in her district which has adopted an initiative called Learning Focused Schools which dictates specific content to teach as well as instructional techniques to employ. Here, Amy discusses how she plans her lessons.

I look at the concept map, the learning map. For Learning Focused Schools, we have learning maps and essential questions and then vocabulary and concepts that we have to teach. I look at that and look at the time frame I have to teach it in.

(Interview, November 2007)

In the Learning Focused Schools (LFS) program, teachers are given “concept maps” upon which they are to base their instruction. In the LFS model, each lesson is guided by an “essential question” which must be posted in the classroom during the lesson for students to view. In conjunction with her school’s curriculum, Amy views the LFS program as dictating specific vocabulary and concepts she must teach. While Learning Focused Schools does not specifically oppose inquiry pedagogy, Amy finds it to be important enough to base her instructional decisions upon their model.

While Jennifer does not work in a school that has adopted the LFS model, she does identify the state assessment (PSSA – Pennsylvania System of State Assessments) as being a motivator for her instructional decisions, especially with regard to the content she must teach.

There is a certain amount of material that I was told that I need to cover especially because PSSA is coming this year.

(Interview, November 2007)

The school has presented the impending state assessment as the reason for her to “cover” a “certain amount of material.” While Jennifer does not say that the school has mandated how she teaches specific content, it affects her decision-making. In a way, she becomes more focused on what is taught than how it is taught. Here, Jennifer discusses what a teacher must consider when deciding to enact inquiry pedagogy.

Another thing would be definitely a teacher who isn't so concerned with covering this and that material for a test, who's willing to kind of stem away, and if the conversation and the discussion goes in a different direction than what they had planned on, they're able to work with that, and just to kind of go with the flow and see what happens. As long as they still stay structured and they're getting some information out of it. Having the ability to kind of go astray and go off path a

little bit is hard for a lot of people because they're so concerned with what material they have to cover, what standards they have to deal with.

(Interview, March 2006)

While every teacher encounters a curriculum to teach, Amy and Jennifer view their schools' policies and initiatives in some way as constraining their decisions and their ability to incorporate inquiry lessons into their classrooms. To enact inquiry pedagogy, Jennifer believes, teachers must not be "so concerned with what material they have to cover" or the "standards they have to teach." To Jennifer and Amy, however, the district policies that define specific content so rigidly constrain their ability "to go off path" and incorporate inquiry lessons in their classroom.

Working with colleagues

In addition to navigating a mandated curriculum, Amy's instructional decisions are also influenced by the colleagues in her school. Being new to her school, Amy was assigned a mentor to assist her as she transitions into her new position. Amy and her mentor teach many of the same courses and he provides her with instructional materials she can use in her classroom.

Here, Amy discusses her mentor's role:

He's a really good guy, and he helps me out with the day-to-day planning. But it's a curriculum that's there and we're expected to teach it. He helps me to teach the curriculum that's there with PowerPoints and labs and worksheets.

(Interview, November 2007)

While the mentor's role may be intended to aid a new teacher in her development, in Amy's case, the mentor communicates the mandated curriculum of the school as well as appropriate instructional techniques that can help her meet these curricular expectations. Amy sees her mentor as assisting her with "day-to-day planning" but also realizes that his role is to help her "teach the curriculum that's there." Although Amy does not view her mentor as a sinister entity who overtly controls her instructional choices, he influences her instructional decisions through

his helpful manner of sharing lessons which are couched within the district's curriculum. Amy describes her mentor's lessons as being comprised of "PowerPoints and labs and worksheets" which communicate to her effective ways of meeting the district's curricular expectations.

In a recent interview, Jennifer also describes her relationship with mentor. Jennifer was assigned another chemistry teacher as her mentor. Even though they taught some of the same classes, Jennifer explains, "we really didn't have that much communication with one another." Jennifer describes her relationship with her mentor as being strained after she communicated her desire to use less didactic forms of instruction.

It was an interesting relationship, because he was assigned to me to be my mentor but we really didn't have that much communication with one another. We would talk every now and then as far as where we were in a section or what material we were covering. But that was really about it. He and I were very different in our philosophies of teaching. He was the type of teacher that would stand up in the front of the class. He has the overhead and would give notes for an entire period and maybe do a lab once a week. Whereas I was the type of teacher that every single lab period that they had, which was every other day, they were doing a lab no matter what. And, I didn't like to stand up in the front of the room and talk a lot. So, that was a challenge because here I am, fresh out of college, new teacher coming in and doing things my own way. That's just crazy, some people thought. And he was one of those people that didn't necessarily think that my way of teaching was bad, but realized that it was different and wasn't going to agree to it. Or help me out in any way just because it was it wasn't his way.

(Interview, November 2007)

As a new teacher, Jennifer feels some pressure to model her instruction on her peers and her mentor. She says that "some people" thought she should not be "doing things (her) own way." When she chose to incorporate more student-centered discussions in her classroom, she identifies being isolated, not only through her mentor's lack of communication but also through his resistance to "help (her) out in any way." Jennifer's choice to make instructional decisions that did not match the teaching philosophy of her mentor affected their relationship and her mentoring experience.

As apparent through these passages, Amy and Jennifer identify working with their colleagues as a powerful constraint to their ability to enact inquiry in their classroom as new teachers. These collegial relationships can influence instructional decision-making. Here, Amy struggles with the didactic teaching she employs as a result of the school's curriculum and her mentor's guidance.

To tell you the truth, I'm still figuring out where I fit like in terms of how much inquiry to use and how much direct instruction to use. And what that means for the curriculum that's here and what I'm expected to teach. There are days that I know that I'm teaching in a very didactic way and I don't like it.

(Interview, November 2007)

Being in a new school, Amy is learning to navigate the curriculum as communicated by the school and her colleagues. She is trying to figure out "how much inquiry to use and how much direct instruction to use" and balance it with what she is expected to teach. While Amy is disappointed with her inability to enact inquiry pedagogy within the constraints of the school, she still maintains that using inquiry is the "standard" to which she aspires.

I still hold that as a standard. And I'm generally not pleased with how I'm teaching right now. But it's what I can manage. It's what I can do with where I am at right now. So that inner voice is saying 'you know you should've just let them figure that out' or 'this is the better way to teach it, you should've taught it this way' but again, there's a lot of other factors. There's the curriculum and you need to get through it in a certain amount of time.

(Interview, November 2007)

Amy realizes that there are "a lot of other factors" that influence her instructional decision-making. While she is "generally not pleased" with her instructional decisions, she identifies inquiry as the standard but realizes that "how (she is) teaching right now" is all she can manage within the constraints of the school.

Managing resources

Besides curricular and collegial constraints, Amy and Jennifer also encounter obstacles to enacting inquiry pedagogy due to the resources they are provided by their schools. As new teachers, they must manage these resources to be able to incorporate inquiry lesson into their classroom. Here, Amy talks about the amount of planning time that she is given and how it affects her ability to plan inquiry lessons.

And the day to day, every day, you know what it's like being a teacher? There's just a ton of stuff to get done. Planning and copies and filling out forms and all this stuff that just drags you down. That's why I think it's hard. I have this standard but I'm not really living up to it and I'm doing the best that I can with the time and the resources that I have and the constraints that I have, but I know that I don't want to teach so didactically forever.

(Interview, November 2007)

Amy says she is “doing the best (she) can” considering the resources she has. Being relatively new to the profession, she is seeing “what it's like being a teacher” and that there is “a ton of stuff to get done.” Besides planning lessons for her class, she is learning to manage the other tasks of being a teacher, such as “filling out forms” and making copies. These other tasks infringe on the time that Amy has to plan lessons. With this resource being impacted, she resorts to teaching didactically. The resource of planning time does not just affect Amy's ability to incorporate inquiry lessons into her classroom. It also affects her ability to collaborate with her peers and discuss ways of bringing inquiry into their lessons. Here, Amy discusses whether she has ever talked to her mentor about using inquiry pedagogy.

In terms of like us talking about inquiry, we haven't really done that because there are just so many other things that get in the way. I guess I haven't really had time to sit down and have a discussion with him about his philosophies on inquiry yet. It just seems like there are a lot of other things that take precedence. You've got to have something for the kids when they come in the next day. What are you going to do? And we don't have time to talk about our philosophies in terms of what inquiry is and what it looks like.

(Interview, November 2007)

Amy identifies that she does not have the time “to sit down and have a discussion” with her mentor about incorporating inquiry lessons into their classrooms. There are “other things that take precedence,” she says. She has to manage her planning time so she will be able to “have something for the kids when they come in the next day.”

While Jennifer does not specifically discuss having difficulty managing planning time, she does identify other resources as impacting her ability to plan inquiry lessons for her students. Here, Jennifer discusses how difficult it is to plan a science lesson in a classroom that was not designed to be a science lab.

I have no place really where I can fit 32 students where they're working comfortably and not standing on top of one another. Yet everything's so spread out that I can't be everywhere with them. So, it's hard to keep them all on task. And just not having the materials that I would really like to have, the facility of having a simple thing as a sink or water, you know, that's tough. It's manageable but it's tough.

(Interview, November 2007)

In Jennifer's classroom, she does not have the ability to have students work in laboratory situations easily. The classroom was originally designed as a lecture room to be used by another subject area. As such, the room lacks basic materials and facilities that would allow Jennifer to teach science effectively. While Jennifer says that the lack of these resources is “tough” and “manageable,” they influence her ability to enact inquiry pedagogy in her classroom. Here, Jennifer compares her former chemistry classroom with the middle school classroom in which she now teaches.

It was really nice there, not only with the lab facility but having the actual materials to do the lab. With all of the chemicals that were there, there's a lot of like the everyday materials that I had purchased myself you're able to do so much more, and even if you're having a discussion and the student brings up an idea you can say 'Okay, I'll go get that and we'll run it right now and just see what happens.' So, I was able to kind of base my instruction off of them more last year, because I had that all at my fingertips. You know now if a student makes a

suggestion to me, I have to say, “Okay, well I’ll see if I can find that and then maybe we’ll do it later in the week or something.” And so that kind of puts a stop to their thinking process. It just stops them in their tracks.

(Interview, November 2007)

In her current classroom, Jennifer instructional decisions are limited due to her ability to “base (her) instruction off” of her students. When she taught in a science classroom, she had the ability to have a discussion and run a demonstration or an experiment when a “student brings up an idea.” Her options now are limited due to not having materials “at (her) fingertips.” While basing the lesson off of student involvement may empower a sense of ownership, in her current classroom, it “puts a stop to their thinking process” and “stops them in their tracks.” To a great degree, her instructional decision making is influenced by the resources and teaching environment to which she has access.

Conclusion

This chapter presents the experiences of two beginning science teachers as they enact inquiry pedagogy in their classroom. I became interested in the lives of new teachers through my own experiences as a practicing teacher. Thinking back to my first years of teaching, I can remember how I struggled developing daily lessons and feeling comfortable with the culture of the school. In many ways, those early years of teaching has set into motion the entire trajectory of my career, including my decision to enter a doctoral program and work as a teacher educator. After encountering the National Science Education Standards (1998), I wondered how different those first years of teaching would have been if I was also attempting to use inquiry pedagogy with my students. How successful would I have been if I tried to incorporate open-ended approaches into my lessons? Would I have struggled encouraging my students to develop evidentiary-based explanations?

Looking at how Amy and Jennifer have described their experiences enacting inquiry pedagogy, it appears that this instructional approach could be challenging for new science teachers. Amy and Jennifer describe lacking the content background necessary to weather the unpredictability that emerges in inquiry lessons. They describe being influenced by their learning experiences as students which taught them that science education occurs through structured lectures. They also describe the anxiety that results from teaching an inquiry lesson where they fear possibly exposing themselves as unknowledgeable novices to their students. Amy and Jennifer also describe navigating the school culture, where their instructional decision making is influenced by their colleagues, by mandated curricula and through their access to resources. Through these descriptions, one can see how the experience of enacting inquiry pedagogy is lived by Amy and Jennifer.

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CHAPTER 5:

IMPLICATIONS

This dissertation focuses on the experiences of two new science teachers (Amy and Jennifer) as they enact inquiry science pedagogy within the culture of their schools. To develop the descriptions presented in this dissertation, I had each participant tell stories of lessons in which they enacted inquiry pedagogy. From these narratives and other complementary data sources, three central themes emerged: 1) being in the hot spot, 2) letting go and 3) negotiating constraints. For each of these themes, several sub-themes emerged which help to explicate what it is like to be a new science teacher enacting inquiry pedagogy.

Emergent themes and sub-themes

Theme 1: Being in the hot spot

- Feeling uncomfortable teaching the content
- Perceiving students' reactions to inquiry

Theme 2: Letting go

- Giving up control
- Cultivating student ownership
- Weathering unpredictability

Theme 3: Negotiating constraints

- Navigating the curriculum
- Working with colleagues
- Managing resources

Each of these themes and subthemes detail the challenges that new teachers face as they enact inquiry pedagogy in their schools. Through their stories, the participants perceive

themselves as unprepared to teach science through inquiry and describe the anxiety they experience when teaching inquiry lessons. These feelings have a strong influence over their instructional decision-making and lesson planning. When enacting inquiry in their classrooms, Amy and Jennifer see their students as judging their teaching ability and fear that inquiry in some way exposes their perceived lack of content knowledge to their students. When they experience this emotional “hot spot,” they often alter their lesson to rely more on didactic, predictable means of instruction.

Amy and Jennifer also describe their difficulty with “letting go” of the class and giving the students control over the direction of classroom discussions and activities. While they see the benefits of using inquiry pedagogy, they fear the unpredictability of inquiry lessons and see these lessons as opening themselves to student questions to which they may not know the answers. They also describe how their past experiences as chemistry students influence how they approach instructional decisions in their classroom. Since inquiry pedagogy stands in stark contrast to their own learning histories as science students, Amy and Jennifer describe being uncomfortable using inquiry pedagogy. Although both participants encountered an inquiry-oriented teacher preparation program and field placement, they describe the emotional difficulty they have when enacting these teachings in practice.

The participants also describe the constraints they experience as they enact inquiry pedagogy, whether emerging from collegial influences, competing curricular and reform initiatives, or the lack of classroom resources. These sociocultural factors impact the participants’ feelings of control over the direction of their classroom and their ability to enact inquiry pedagogy. Amy and Jennifer describe avoiding using inquiry pedagogy to maintain curricular consistency with colleagues and stay on a schedule mandated by district and building

administrators. They also describe lacking the time and space to use inquiry pedagogy with their students. Both participants describe local reforms arising from accountability initiatives that influence their instructional decision-making.

Through Amy and Jennifer's descriptions of their experiences, this dissertation communicates important findings for the study of new science teachers. Davis et al. (2006) sees the study of beginning teachers as being a critical area to research, writing that:

“New teachers are crucial for enacting and spreading reforms—many learn about current reform movements in their teacher education programs and thus seem most likely to be able to adopt and promote reform-oriented instruction.” (p. 608)

While many new teachers learn about inquiry in their teacher education programs, little is known about their experiences enacting inquiry pedagogy in their own classrooms (Davis et al., 2006). The findings presented in this dissertation describe these experiences and elucidate factors that influence a new teacher's ability to enact reform. Although this research in some ways echoes new teachers' survivalist tendencies (Fuller & Bown, 1975; eg), it also uncovers critical findings for those individuals charged with preparing and employing new science teachers.

This dissertation demonstrates the influence that a new teacher's emotions has on her ability to enact instructional practices. Amy and Jennifer describe the anxiety they experience when enacting inquiry pedagogy. This emotional “hot spot” influenced their instructional decision-making and their investment in inquiry pedagogy. Pintrich, Marx and Boyle (1993) linked motivational constructs (goals, values, self-efficacy and control beliefs) and classroom contexts to student learning. Instead of rational and “cold” perspectives on conceptual change, they argue for considering “the ways in which students' motivational beliefs about themselves as learners and the roles of individuals in a classroom learning community can facilitate or hinder

conceptual change” (p. 167). In a way, teacher preparation programs and science education reform initiatives have approached changing teaching practices in the same “cold,” overly rational manner as Pintrich et al. (1993) describe models of conceptual change. While many studies communicate the lack of support for inquiry pedagogy in schools (Anderson, 2002; Tobin et al., 1994; Wells, 1995), research often focuses on teachers’ cognitive challenges to enacting this practice rather than motivational constructs or school contexts that influence teachers and their ability to enact reform-based practice. For example, in a study of constraints that new teachers face when implementing scientific inquiry, Roehrig and Luft (2004) focus mainly on participants’ content knowledge and understanding of the nature of science. While these constructs may be important for enacting inquiry pedagogy, widening the lens to include the affective dimensions as communicated in this dissertation may help the science education community better understand teachers’ lack of support for inquiry pedagogy.

Through their stories, Amy and Jennifer clearly describe how their emotions and views of self influence whether they continue using inquiry pedagogy or alter their lesson to adopt more didactic means of instruction. These emotions arise from their feelings of being comfortable teaching the content (self-efficacy), from the unpredictability of inquiry lessons (control beliefs), from how they perceive their students as viewing them (teacher identity) and from various school constraints (agency). This research also demonstrates how intertwined these aspects are, informing each other in a complex, dialectical fashion. The participants’ self-efficacy and professional identity emerge from their interactions with the community (their students and colleagues) and the perceived agency afforded by their schools’ curricula and administration. By providing descriptions of teachers’ experiences enacting inquiry pedagogy, this dissertation expands our understanding of factors that influence teachers’ instructional practices. This work

also communicates important implications for those stakeholders charged with preparing, employing or studying new science teachers.

Implications for Science Education Community

Amy and Jennifer cite their lack of comfort teaching science through inquiry as a source for the emotional “hot spot” they experience. Through their educational history as science students, Amy and Jennifer encountered science classrooms where lecture-based instruction was the norm. In a sense, this type of instruction has been modeled to them for the majority of their academic lives in science. To help develop new teachers’ confidence with inquiry pedagogy, teacher preparation programs must include more coordinated opportunities for preservice teachers to experience inquiry pedagogy in practice. Preservice teachers should not just learn about inquiry pedagogy in the abstract, but see it modeled in science classrooms and practice using it in field placements. Looking at Amy and Jennifer’s educational history, both teachers experienced inquiry-focused methods courses and field placements. They describe their content courses, however, as being more traditional, lecture-based environments. These conflicting experiences may help to cultivate the anxiety that these new teachers describe. Through their content preparation, Amy and Jennifer have developed idealized identities as teachers that may contrast with those engendered during their methods courses and field experiences. To better prepare new science teachers to enact inquiry pedagogy, content courses need to include more scientific inquiry to model its use with prospective teachers. Additionally, methods courses need to expand to include opportunities where preservice teachers design and practice teaching inquiry lessons. Methods courses should also include videos of exemplary inquiry lessons and case studies that describe inquiry pedagogy (McDonald et al., 2007). Through expanded preparation experiences and coordinated content courses, new teachers may overcome the apprenticeship of

observation they have experienced and become more comfortable teaching the content through inquiry.

Preservice teachers would also benefit from multiple field experiences where they can observe inquiry modeled in various classroom settings and have the opportunity to practice using inquiry with students. Returning to Amy and Jennifer's educational history, both individuals experienced an inquiry-focused field placement with the same chemistry teacher (Brad). Each participant, however, encountered a field placement earlier in her program that did not explicitly model inquiry pedagogy. Without a coordinated effort across different preparation experiences (content courses, methods courses and field placements), preservice teachers may not develop confidence and comfort teaching science through inquiry and may see inquiry as instructionally foreign from their own experiences as science students.

This dissertation provides additional implications for teacher preparation programs, however. Reading Amy and Jennifer's descriptions of their experiences, one can see that a teacher's professional identity does not stop developing as she enters a school and begins teaching. Through their narratives, Amy and Jennifer appear to be conflicted between multiple views of self. They are navigating between their identities as teachers developed through their years as science students and through their preparation as inquiry-oriented teachers. Closely related to their views of self are their perceptions of their ability to successfully teach using inquiry. Despite their extensive science backgrounds, they describe being uncomfortable teaching the content and express their anxiety with using inquiry. As they navigate these emotions, they must make decisions that impact the instructional environment of their classrooms. Should they control the class through predictable lectures as their teachers had done or should they "let go" of their classroom to allow more inquiry as their teacher educators had

proposed? If they choose to use inquiry, how do they navigate their emotions of anxiety, fear and unpreparedness? While the school communities to which Amy and Jennifer participate bring upon these decisions and emotions, they are left to reflect and make meaning of these experiences on their own. Teacher educators often spend very little time discussing these factors with preservice teachers. Teacher candidates are taught to develop lesson plans, but are not taught to reflect on their actions in a manner that aids in their identity development. Preservice teachers are taught about curriculum design but are not taught about the culture of schools to adequately prepare them to enter schools and enact reform.

Teacher preparation programs should include more opportunities that support the development of preservice teachers' identity and self-efficacy. One possibility is expanding teacher preparation programs to include more opportunities to engage preservice teachers in the recognition and reification of their roles within the classroom and school community (Gee, 2005; Luehmann, 2007; Wenger, 1998). These opportunities could include preservice teachers reflecting on experiences through the use of personal journals, web logs, portfolios, and discussions with peers and inservice teachers (Nasir & Saxe, 2003; Sfard & Prusak, 2005). As Luehmann (2007) writes,

“Although participation is essential for learning, learning as identity work occurs in the interpretation, narration, and thus recognition of that participation (by self and others). The interpretation of one's participation through reflective work is a process through which identities are fashioned” (p. 828).

Additionally, grouping preservice teachers into collaborative groups to promote reflection during field experiences has been linked to having a positive influence on teachers' self-efficacy (Cannon & Scharrmann, 1996). Expanding teacher preparation programs to include these

processes will help to develop the skills and strategies needed to negotiate the culture of schools and enact reform-based practices in their classrooms. These processes can also prepare new teachers to better navigate the emotions that Amy and Jennifer describe in this dissertation.

Although incorporating identity development experiences in teacher preparation programs can help new teachers navigate the cultures of schools and implement reform, additional conclusions can be drawn from this research. One real challenge for schools and teacher preparation programs is to see teacher development as a lifelong process. After an individual graduates from a teacher preparation program, local school districts are now charged with the process of inducting new teachers into the schools. In this dissertation, Amy and Jennifer discuss their experiences being mentored during their first year of teaching. Jennifer describes feeling isolated from her mentor when she proposes using inquiry. While Amy describes her mentor as being helpful, she also describes being influenced by his lecture-based teaching style. To the participants, this mentoring experience did little to help them navigate the emotions they experienced or help them develop as inquiry-oriented teachers.

Currently, many states require an induction process for new teachers that often includes mentoring from more experienced teachers. Feiman-Nemser and Parker (1993) write that many mentoring experiences simply reinforce traditional norms and practices rather than improving teaching. This occurs for a variety of reasons. Mentors volunteer to assist new teachers without fully understanding their role or the expectations of the mentoring experience. In many schools, mentors receive no formal training in how to assist new teachers in their development. Mentors and beginning teachers are also not given adequate time during the school day to help cultivate a mentoring relationship. These factors lead to mentoring experiences like those described by Amy and Jennifer.

To better support new teachers in their development, teacher educators need to reach out to local school districts and aid in the design of new induction and mentoring programs. These induction programs would not just enculturate new teachers into schools but would focus on helping beginning teachers through the emotional first years of teaching. For example, focusing the mentoring experience on reflection and recognition work, as suggested earlier with teacher preparation programs, could better support beginning teachers in reconciling their developing identities. Also, induction programs that allowed more time for reflection and mentoring could better support teachers' development. Selecting and training mentors to also be mindful of the affective needs of new teachers is a critical component of a redesigned induction program.

This research also highlights the need to discuss with beginning teachers other reform initiatives currently occurring in schools and the effect these initiatives can have on one's professional identity and teaching. While the reforms proposed in the National Science Education Standards have become a component of many teacher preparation programs, other reform movements are taking place in school districts. In her stories, Amy describes an initiative called Learning Focused Schools that promotes the use of graphic organizers, word walls, and other highly structured instructional techniques intended to promote student engagement. Jennifer describes her district's concern for the state assessments as being a prevalent issue for teachers when they plan lessons. Each participant describes how these reforms have a strong impact on the participants' agency over their instructional decisions and constrains their ability to enact inquiry pedagogy in their classrooms. As Amy states,

“I'm generally not pleased with how I'm teaching right now. But it's what I can manage. It's what I can do with where I am at right now. So that inner voice is saying 'you know you should've just let them figure that out' or 'this is the better

way to teach it, you should've taught it this way' but again, there's a lot of other factors.”

Beginning teachers need to identify their core beliefs about teaching and learning and learn how to enact a professional identity congruent to these beliefs within the culture of schools. While it may be impossible to discuss every reform initiative that takes place in schools, highlighting different reform programs may help new teachers understand the nature of school reform and critically analyze their benefits and shortcomings. This process may also help new teachers identify ways in which their beliefs can be incorporated within a local reform initiative. Amy and Jennifer see inquiry pedagogy as being divergent from the local reforms they face. They feel they must choose between inquiry pedagogy and their district-mandated curricula. In reality, there may be some overlap of which they are unaware. Discussing reform initiatives may help new teachers identify these commonalities and better prepare them to negotiate the reforms they are likely to face in their careers.

Implications for Policy Makers

Besides describing the experiences of two beginning teachers enacting inquiry pedagogy, this dissertation shows the influence of accountability initiatives on teachers' sense of agency, their identity and their self-efficacy. Through these reforms, federal and state governments offer a single view of teacher quality, one related solely to student performance on knowledge-based assessments. Policy makers adopt these reform initiatives by outlining the effects on teaching and learning, Day (2002) writes, but:

“there are no signs that they recognize the crucial effects on teachers' emotional as well as intellectual identities. It is through our subjective emotional world that we develop our personal constructs and meanings of our outer realities and make

sense of our relationships and eventually our place in the wider world. In addition, these are also clearly related to our motivation and state of attention.” (p. 685)

While many of these stakeholders purport to be driven by improving student learning, they fail to realize the effects that these mandates and initiatives have on teachers. As can be seen from Amy and Jennifer’s descriptions of their experiences, their perceived lack of agency emanates from district mandates and initiatives. Although these mandates are couched within the guise of improving student learning, the resulting emotions communicated in this dissertation can have powerful effects on teachers’ job satisfaction, contributing to increased teacher attrition and difficulties recruiting new teachers.

This dissertation communicates several implications for policy makers. First, wider views of student learning and teacher quality need to be adopted at all levels of government. For example, in the Learning Focused Schools initiative adopted in Amy’s district, administrators are trained to monitor teachers’ use of graphic organizers and whether guiding questions are posted for each day’s lesson. While these techniques may promote student learning in some instructional settings, the whole-scale adoption of these techniques offers a single view of quality instruction that teachers must implement. Additionally, districts provide teachers with mandated curricula that define specific topics and instructional time, further restricting teachers’ ability to enact certain forms of instruction such as inquiry. These restrictions present the view that the amount of content to which students are exposed matters more than the depth and manner in which they learn it. Adopting more research-based views of student learning would help policy makers see the benefits of inquiry pedagogy and would reduce the instructional constraints that Amy and Jennifer describe.

In schools currently, science teachers need to resolve a host of competing reforms when planning lessons. For instance, Amy discusses the challenges she faces negotiating the curriculum borne out of the state assessment, the Learning Focused Schools methodology adopted by her district, and inquiry pedagogy presented by the National Science Education Standards. While similarities may exist across these competing initiatives, a new teacher may see these mandates and reforms as conflicting with one another. The anxiety that Amy and Jennifer experience emerges not only from their comfort teaching science through inquiry, but also through their attempts to resolve the conflicting messages they receive from local, state and national stakeholders. To counter this, policy makers at all levels need to involve teachers, schools of education and content-specific organizations in the creation and adoption of reform initiatives. This approach would allow reforms to complement each other, without sacrificing teacher agency for the benefit of a naïve view of student learning.

Implications for Research Community

While this dissertation focuses on the experiences of new teachers using inquiry pedagogy, it also identifies additional research opportunities that can be undertaken. For example, one important aspect of Amy and Jennifer's ability to enact inquiry pedagogy is their perceived agency over their classroom decisions and instruction. They view their decisions as being constrained by the local curriculum and by district and state initiatives. Little is known about how these reforms influence teachers of different levels of experience. For example, how would more experienced teachers describe their reactions to accountability initiatives such as Learning Focused Schools (LFS)? A phenomenological study could be developed which researched how teachers' describe their experiences during the process of their schools adopting

LFS. This research could help schools better understand the effects these reforms have on teachers and their practice.

Another research possibility emerging from this dissertation could be a longitudinal study focusing on how science teachers' views of self develop over the course of their career. Looking at Amy and Jennifer's descriptions, one wonders how they will reconcile their past educational histories with their identities as inquiry-oriented teachers. A mixed-method study designed to follow a group of science teachers from their earliest field experiences through the beginning years of teaching would help further our understanding of how the dimensions of identity, agency, and self-efficacy interact and develop over a teacher's career.

This dissertation also identifies the need to further study teachers' experiences using inquiry pedagogy. For example, how do more experienced teachers describe their experiences with inquiry lessons? Do they identify additional constraints or emotional challenges to inquiry pedagogy than Amy and Jennifer do? Although teachers' lack of support for inquiry pedagogy is widely identified, most of the attention has focused on teachers' content knowledge or their understanding of the nature of science. Studying teachers and their practice within the culture of schools may help us to better understand the affective challenges to incorporating inquiry pedagogy.

Conclusion

This dissertation examines the experiences of two beginning science teachers as they enact inquiry pedagogy within their schools. Following a hermeneutic phenomenological approach, several themes emerged that describe the lived events of the participants and help to communicate the emotional and personal aspects of teaching with inquiry. Through narratives collected through interviews, conversations and weblogs, the two participants describe how their

emotions and views of self influence whether they continue using inquiry pedagogy or alter their lesson to adopt more didactic means of instruction. These emotions arise from their comfort teaching science through inquiry (self-efficacy), from their perceptions of students' views their roles as teachers (professional identity) and from various school constraints (agency). While these affective are often ignored in research endeavors, this dissertation demonstrates the critical influence they can have over a teacher's practice. For reform in science education to become more widespread, these affective factors need to be further researched and better supported.

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