The effects of socialization on beginning science teachers' pedagogical decision making and science instruction

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The effects of socialization on beginning science teachers’
pedagogical decision making and science instruction

by

Lori Marie Ihrig

A dissertation submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Education

Program of Study Committee:
Michael Clough, Co-Major Professor
Joanne Olson, Co-Major Professor
Eunjin Bang
James Colbert
Anne Foegen

Iowa State University
Ames, Iowa

2014

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DEDICATION

To my family
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ABSTRACT

Teaching induction and mentoring programs are often promoted as ways to improve teacher effectiveness and reduce attrition by supporting beginning teachers. However, new teachers’ establishment and engagement in support relationships may vary depending on alignment of supports to new teachers’ pedagogical understanding. The purpose of this three-year longitudinal qualitative study was to follow a cohort of Master of Arts in Teaching (MAT) graduates from a research-based secondary science teacher education program (TEP) during their TEP and first two years of teaching to explore how they engaged in relationships intended to support effective research-based science instruction (RBSI) during their TEP and first two years of teaching. Moreover, this study sought to understand the influences which exist, if any, between beginning science teachers’ pedagogical considerations, teaching practices, and socialization experiences during their TEP and first two years of teaching. The findings from this study support the contention that beginning science teachers effectively educated to make research-based science teaching decisions and practices will do so if they are supported through collegial relationships with cohort members and advocacy from superordinates. Equally important, this study supports the contention that teachers leaving their TEP with little understanding of RBSI are unlikely to develop such understanding and implement such practices during their first two years of teaching. Contrary to the common conception that experienced teachers and administrators make for effective more-knowledgeable RBSI mentors, the beginning science teachers in this study encountered superordinates who threatened, sabotaged, and imposed sanctions in response to participants’ attempts to implement practices congruent with RBSI.
CHAPTER 1: INTRODUCTION

Overview and Statement of the Problem

The Paradox of Effective Teaching

Unlike other professions, the general public has closely observed the profession of teaching by spending a significant portion of time, from early childhood through young adulthood, in close proximity to a practicing teacher (Lortie, 1975). Because of the intimate experiences gained then, people construct deeply held and mistaken conceptions of what being a teacher means, and what learning and effective teaching entails. For example, the more effective the teacher, the more effortless teaching appears to observers, thus promoting the myth that effective teaching is easy, or at least not terribly complex (Munby, Russle, & Martin, 2001). This belief is aptly expressed by Berliner (1987): “We in education are haunted by the public’s erroneous belief that someone can walk in off the street and deliver a curriculum to 30 or so children” (p. 6).

Nonetheless, policymakers, business leaders, and the general public maintain that effective teaching is rare and significant problems exist in education (Dreifus, 2013; Smith, Nelson, Trygstad, & Banilower, 2013; U.S. Department of Education [U.S. DOE], 2008). Policy recommendations designed to address the problems of poor teaching frequently rest on the assumption that a deep understanding of content knowledge is largely sufficient for effective teaching (Paige, 2003). This view is especially prevalent in science teaching. For example, take the following suggestion provided by Rita Colwell, former director of the National Science Foundation, in response to the question “If you could make one change to improve science education in the United States what would it be?”:

I’d like to bring graduate students in science, engineering and mathematics into the elementary, middle and senior high schools to teach the science to these K–12 students.
The purpose is to elevate the science taught in the K–12 schools by providing teachers who are knowledgeable of their science, engineering or mathematics and, most importantly, love their chosen professions (Dreifus, 2013).

Two conflicting conceptions of science teaching are comfortably being simultaneously held: first, the act of teaching is so simplistic that anyone with sufficient science content knowledge is equipped to teach well; second, effective science teaching is rare, even among science teachers possessing bachelor’s degrees in science. This paradox is driving public policy away from traditional science teacher education programs (TEPs) in an effort to improve education. Moreover, some states are reducing the amount of science content required for particular science teaching endorsements. This makes it possible for teachers with less content preparation to obtain endorsements and states can therefore maintain that their students are taught by qualified science teachers.

Traditional science TEPs focus on pedagogical coursework, content coursework, and field experiences. However, the routes available to becoming a science teacher are increasingly bypassing or reducing pedagogical coursework and focusing primarily on field experiences (U.S. DOE, 2013; Windschitl, 2005). This shift in policy concerning science teacher preparation— while congruent with the conception that effective teaching is not overly complex and may be learned primarily or solely through apprenticeship—is contradictory to policymakers’, business leaders’, and the general public’s concern that the current science teaching practices being enacted in schools are problematic. As Goodlad (1990) argued, preparing teachers via socialization in existing schools is an ineffective means of changing schools and promoting effective teaching:

Schools and teachers are not very effective, said report after report. Yet according to conventional wisdom, the best way to ensure a competent teaching force is to place neophytes in those same schools with those same teachers. Surely we can come up with better remedies than this. (p. xiii)
The Effects of Teacher Socialization

While the process of teacher socialization begins well before entering a TEP, it continues during teacher preparation and into the first years of teaching. The support of beginning teachers from administrators, mentors, and colleagues is generally considered crucial to successful teacher socialization (Little, 1990). For example, principals can increase teacher retention in disadvantaged schools (Grissom, 2011) and meet the needs and foster the growth of beginning teachers (Kardos, Johnson, Peske, Kauffman, & Liu, 2001; Youngs, 2007), mentors can fulfill the role of “help giving” (Little, 1990), and supervisors can successfully negotiate collaborative relationships with beginning teachers (Waite, 1993). Beneath the veil of educational improvement and beginning teacher support, public policy is sanctioning and/or funding alternative teacher certification routes and district-administered mentoring programs. Such policies are placing schools in the position of administering a substantial portion of teachers’ pedagogical education and bearing full responsibility for the socialization of beginning teachers. These policies are seeing widespread adoption and support despite schools being extensively criticized for archaic practice and insufficient impact on student learning.

The Necessity of Effective Science Teacher Education Programs

Effective science TEPs promote and require a deep and robust understanding of both science content knowledge and pedagogical knowledge for successful science teaching. Effective science TEPs foster and model conceptions of science teaching and learning that are congruent with research-based science instruction (RBSI) as promoted by national science education reform documents (American Association for the Advancement of Science [AAAS], 1990; AAAS, 1993; AAAS, 2001; National Research Council [NRC], 1996; NRC, 2012; NGSS Lead States, 2013). Effective science TEPs strive to transform preservice teachers’ notions of science
teaching and learning from the naïve conceptions derived from many years as students to conceptions that are congruent with research-based science education as promoted by science education reform documents. However, even when science TEPs are successful in their endeavors, beginning teachers emerging from these TEPs are likely to work in schools that predominantly conceptualize teaching and learning in a manner that is incongruent with well-established research (Goodlad, 2004; Roth et al., 2006; Rozelle, 2010; Smith, Banilower, Nelson, & Smith, 2013). As Grossman, Wineburg, and Woolworth (2001) described, “We have little sense of how teachers form the bonds of community… [and] work through the inevitable conflicts of social relationships” (p. 943). Therefore, a need exists to study how beginning science teachers from research-based teacher education programs are socialized—both into science teaching during their TEP and into their schools during their first years of teaching.

Wilson et al. (2001) reviewed 57 studies in teacher preparation and concluded “there is no research that directly assesses what teachers learn in their pedagogical preparation and then evaluates the relationship of that pedagogical knowledge to student learning or teacher behavior” (p. 12). If, as Berliner (1987) argued, “Raising any number of children and having gone to school for a number of years does not make an expert teacher” (p. 6), and assuming that intensive high-quality TEPs are a necessary component (1) in the development of effective science teachers and (2) in improvement of the current state of science teaching, then we must research how effectively science TEPs prepare science teachers to teach science. We must also research how schools support or undermine what science teachers learn in their TEPs. Therefore, this study sought to better understand the socialization of beginning science teachers working to implement practices congruent with RBSI.
Purpose

The purpose of this three-year longitudinal study was to follow how a cohort of Master of Arts in Teaching (MAT) graduates from a research-based secondary science teacher education program (TEP) during their TEP and first two years of teaching to explore how they engaged in relationships intended to support effective RBSI during their TEP and first two years of teaching. Moreover, this study sought to understand the influences which exist, if any, between beginning science teachers considerations of teaching and learning, teaching practices, and socialization experiences during their TEP and first two years of teaching. The overarching goal of the study was to identify the effects of teacher socialization on the implementation of RBSI by beginning science teachers.

Research Questions

Pedagogical Considerations and Practice

1. How congruent are study participants’ considerations of teaching and learning with research-based science instruction at the end of their TEP, first year of teaching, and second year of teaching?

2. To what extent are study participants implementing teaching practices congruent with research-based science instruction at the end of their TEP, first year of teaching, and second year of teaching?

Socialization Experiences

3. What is the nature of study participants’ relationships with members of their cohort during their TEP, first year of teaching, and second year of teaching?

4. What is the nature of study participants’ relationships with the superordinates charged with supporting them during their first and second years of teaching?
Relationships Between Variables

5. What relationships exist, if any, between study participants’ pedagogical considerations, teaching practices, and their socialization experiences during this study?

Significance of the Study

This research matters because the socialization that beginning teachers receive in their schools may be at odds with the complex research-based science teaching practices congruent with science education reforms they are attempting to enact. Beginning teachers’ beliefs about learning and teaching tend to revert back to traditional, time-honored, and often ineffective notions and practices that are ubiquitous in schools—the conceptions of teaching they held prior to entering their TEPs (Fletcher & Luft, 2011; Luft & Roehrig, 2007).

Intense school socialization experiences may account for first year teachers’ reversion back to practices and beliefs held prior to their TEP (Brickhouse & Bodner, 1992; Fletcher & Luft, 2011; Luft & Roehrig, 2007; Luft, Roehrig, & Patterson, 2003; Zeichner & Tabachnick, 1981). For example, Bergman (2007) and Herman, Clough, and Olson (2013) documented the fierce institutional constraints faced by graduates of an intensive research-based science TEP when attempting to implement research-based science teaching practices congruent with science education reform documents. Moreover, lack of support from administration and colleagues is a significant institutional constraint experienced by first and second year science teachers more broadly (Brickhouse & Bodner, 1992; Emmer, 1986; Loughran, 1994). Another likely factor is that effective teaching practices are complex and difficult to implement (Berliner, 1988; Berliner, 2000; Luft, 2001; Shulman, 1987), especially when compared to time-honored practices such as assigning a textbook reading, lecturing, and conducting a cookbook laboratory exercise. Socialization efforts may be steering beginning teachers toward these and other simplistic
practices under the veil of supporting beginning teachers in classroom management, covering content, and preparing students for high stakes assessments. These socialization efforts are likely aligned with “recent efforts that place primacy on … simplistic lists of what ‘works’ in classroom practice [and] have done little more than create a confusing array of prescriptive strategies and recommendations that are not linked to one another in a meaningful fashion” (Clough, Berg, & Olson 2009, p. 826). Likewise, Erickson (as cited in Moss et al., 2009) argues,

It follows that policy evidence for “scaling up”—trying to get everybody to adopt “best practices”—no matter how well produced technically—just doesn’t tell us what we need to know as educators. Best practices, as specific behaviors, don’t travel intact across the hall in one school building, let alone across the country (p. 508).

Davis, Petish, and Smithey (2006) document the need for research on teacher education programs and their graduates to better understand efforts to educate and support science teachers who persist in the profession and are effective at implementing research-based practices in a manner congruent with science education reforms. They note 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).

**Summary of Methodology**

This longitudinal study investigated a cohort of graduates of a TEP using a qualitative methodology grounded in social constructionism epistemology and a theoretical perspective of interpretism (Crotty, 1998; Bogdan & Biklen, 2007). Case study methods and a multiple case study design were employed. Participants were formally interviewed using a semistructured interview protocol near their completion of the TEP, near the end of their first year teaching, and near the end of their second year teaching. Participants were informally interviewed without a protocol throughout the study, and field notes were constructed to capture the researcher’s
impressions of the interviews. Visits to each participant’s classroom ranged from four through
 ten visits to conduct observations during participants’ first and second years of teaching. All
classroom observations were scored using the LSC-COP (Horizon Research, 2005). Additionally,
teachers’ interaction patterns with students were documented using a modified version of the
Schlitt Abraham Test of Interaction Coefficients (SATIC) coding sheet (Abraham & Schlitt,
1973), and field notes were recorded. A variety of artifacts were collected throughout the study:

- Syllabi, assignments, grades, letters of recommendation from participants’ time in
  the TEP,
- Classroom artifacts from participants’ first two years of teaching, and
- Correspondence between the participants via an online group and between
  participants and the science education faculty of the TEP.

To create a triangulated case description for each participant based on the convergence of
support from a variety of sources (Yin, 2009), interviews, observations, field notes, memos, and
artifacts were brought together and analyzed using the constant comparative process of open and
analytical coding to develop triangulated themes (Anfara, Brown, & Mangione, 2002; Merriam,
2009). Cross-case analyses were conducted to explore the relationships, if any, which existed
between how participants engaged in relationships intended to support effective teaching
congruent with science education reforms, their socialization experiences, and their teaching
practices during this study. These analyses helped build a general explanation to fit the cohort
(Yin, 2009). Cross-case analysis was an iterative process employing a constant comparative
method whereby data were again reduced across cases using analytic coding and category
formation to compare data within and between categories and across cases (Anfara, et al., 2002;
Strauss & Corbin, 1998; Merriam, 2009).
Limitations

I am a female Caucasian teacher and researcher born, raised, and educated in the Midwest. This study’s participants were Caucasian and completed the MAT portion of their education in the Midwest. All participants taught in the Midwest during their first year of teaching, and one participant taught in the Southeast during his second year of teaching. The interpretive nature of qualitative research was conducted largely through the lens of this Caucasian and Midwestern context.

An assumption of this study is that the sample is likely to be representative of a range in (a) depth of understanding of research-based practice and—because the sample represents an entire cohort from TEP—(b) ability to effectively implement high-quality research-based practices in a manner congruent with science education reforms. While other TEPs may have differing structures and operate in different contexts, the results of this study can inform all efforts to prepare highly effective teachers.

This study focused on the relationships that exist, if any, between beginning teachers’ considerations and implementation of practices congruent with RBSI and their socialization experiences during their first two years of teaching. Investigating other factors that may be related to teachers’ considerations and implementation of practices congruent with RBSI during the first two years of teaching (e.g., subject taught, grade level, school demographics, medical conditions) was beyond the scope of this study. The limitations of this study are more thoroughly addressed at the end of Chapter 3.
CHAPTER 2: LITERATURE REVIEW

Introduction

In this chapter, I first review the literature relevant to the specific aspects of teacher development that shaped this study’s in-depth exploration of beginning science teachers. Then, I describe teacher development as a theoretical framework and discuss implications of employing this framework to this study.

Current State of Science Education

Fifty years ago, Schwab (1964) noted that science is commonly taught as an “unmitigated rhetoric of conclusions in which the current and temporal constructions of scientific knowledge are conveyed as empirical, literal, and irrevocable truths” (p. 24). Schwab argued for an inquiry approach to science teaching because

the nation faced three important needs, each of which required that science be taught not as a rhetoric of conclusions but as a fluid, ongoing activity. . . . The first was the need for additional scientists who could probe the frontiers of scientific knowledge. . . . The second need was for competent political leaders who could operate effectively in a world dominated by science and technology. . . . The third need was for a public that was aware of and sympathetic to an ongoing program of scientific research and discovery. (DeBoer, 1991, pp. 164–165)

Similarly, Rutherford (1964) argued that “to separate conceptually scientific content from scientific inquiry is to make it highly probable that the student will properly understand neither” (p. 84). Out of these compelling calls for inquiry-based science instruction in the 1960s the reforms-based science teaching movement of the 1990s was born.

For instance, the American Association for the Advancement of Science (AAAS) began Project 2061—named in 1985 when project developers were looking forward to the return of Halley’s comet in 2061—by building (with Rutherford’s involvement) on Schwab’s and Rutherford’s early arguments:
Scientific inquiry is not easily described apart from the context of particular investigations. . . . There are, however, certain features of science that give it a distinctive character as a mode of inquiry. Although those features are especially characteristic of the work of professional scientists, everyone can exercise them in thinking scientifically about many matters of interest in everyday life. (AAAS, 1990, p. 3)

Later, the National Science Education Standards (National Research Council [NRC], 1996) clearly articulated a need for inquiry-based science as an instructional practice. These standards said students “must experience inquiry directly to gain a deep understanding of its characteristics. Yet experience in itself is not sufficient. . . . [Teachers] must also assist students to reflect on the characteristics of the processes in which they are engaged” (NRC, 2000, p. 13).

The National Science Education Standards outlined voluntary national standards for science education in five areas: science system standards (for educational systems), science program standards, science teaching and professional development standards, science assessment standards, and science content standards. And most recently, the Next Generation Science Standards (NGSS Lead States, 2013) describe essential practices, crosscutting concepts, and disciplinary core ideas all students should learn. The current wave of reform efforts reflect the research-based teaching strategies and models of instruction that have been at the heart of reform efforts for decades.

The premise that reform is a slow and deliberate process requiring a long-term commitment was at the heart of Project 2061. To understand the context in which it proposed educational reforms, consider Goodlad’s description of schooling in 1984:

Rarely does one find a teacher who has abandoned lectures, quizzes, textbooks, workbooks, and written exercises in favor of learning organized almost exclusively around observations of things outside of schools, projects requiring small group collaboration, and primary documents—with reading, writing, and dialogue emerging out of such activities. (Goodlad, 2004, p. 265)
Moreover, in his large-scale study of schools, Goodlad found that teacher talk dominated classrooms and that conceptions of teaching and learning were largely incongruent with the calls for increased student inquiry of the 1960s. Goodlad concluded:

*Teachers teach as they were taught.* They employ the techniques and materials modeled during the 16 or more years they were students in schools. Relatively late in this learning through modeling, they experienced a modicum of professional preparation to teach—presented largely in the same telling mode to which they had become accustomed. (1983, p. 468)

Goodlad’s conclusions echo the insights Lortie (1975) derived from his sociological study of schoolteachers.

The current state of science education is, unfortunately, like a case of déjà vu. For example, in a summary of a study of 364 mathematics and science lessons, Weiss, Pasley, Smith, Banilower, and Heck (2003) concluded:

Fewer than 1 in 5 mathematics and science lessons are strong in intellectual rigor; include teacher questioning that is likely to enhance student conceptual understanding; and provide sense-making appropriate for the needs of the students and the purposes of the lesson. Overall, 59 percent of mathematics/science lessons nationally are judged to be low in quality, 27 percent medium in quality, and only 15 percent high in quality. (p. 103)

Additionally, in a summary of teacher-reported survey data collected from 7,752 mathematics and science teachers, Banilower, et al. (2013) reported that:

Perhaps most striking, and in contrast to what is known from learning theory about the importance of reflection, is that students in one-fourth of high school science classes are never asked to write reflections on what they are learning. Having students attend presentations by guest speakers is also rare in grades K–12, with roughly 50 percent of science classes never having that experience. . . . roughly 90 percent of classes in each grade range include the teacher explaining a science idea to the whole class in their most recent lesson. The use of whole class discussion is also prevalent, especially in elementary lessons (91 percent), but is less common in middle and high school lessons (77 and 67 percent, respectively). About half of elementary and middle school classes include students doing hands-on/laboratory activities and reading about science in the most recent lesson, compared to fewer than 4 in 10 high school classes. In contrast, students completing textbook/worksheet problems is more common in middle and high school science lessons (51 percent and 59 percent, respectively) than in elementary lessons (43 percent). (pp. 76–77)
Meanwhile, for those teachers who may have perceived themselves implementing reform-oriented instruction, a concerning trend emerged concerning equity issues:

Classes with mostly high-achieving students are more likely to stress reform-oriented objectives and teaching practices than classes consisting of mostly low-achieving students. Classes of mostly low-achieving students tend to have to take external assessments more frequently than classes of mostly high-achieving students. (p. 89)

Despite years of national calls for teachers to reform science teaching and learning by employing pedagogies starkly different from those they experienced in their own schooling, evidence supports a sobering picture of teachers teaching much the same as they always have.

Contemporary solutions proposed by policymakers to address the current state of science education often call for reducing the amount of pedagogical coursework that comprises a teacher’s education to entice those with content knowledge into classrooms. The logic for such proposals is generally based on the same misconceptions about teachers and teaching described above (i.e., the current teaching force is comprised of incompetent, inadequately educated teachers who were themselves poor students). Policymakers contend that if teachers were simply more knowledgeable and passionate in their understanding of science content, then they would be qualified, competent, and skillful as teachers. This conviction is articulated by Rita Colwell, the former director of the National Science Foundation:

I’d like to bring graduate students in science, engineering and mathematics into the elementary, middle and senior high schools to teach the science to these K–12 students. The purpose is to elevate the science taught in the K–12 schools by providing teachers who are knowledgeable of their science, engineering or mathematics and, most importantly, love their chosen professions. (Dreifus, 2013)

Such proposals fail to recognize that beginning science teachers already are better prepared in their content knowledge than beginning teachers in other disciplines. They “are more likely to have earned bachelor’s degrees from the most selective colleges and universities” than other new teachers, are more likely than other new teachers “to have earned a master’s degree or a
doctorate,” and are less likely to hold a degree in science education (Ingersoll, Merrill, & May, 2012, pp. 31–32).

Moreover, prospective science teachers already take the majority of their coursework outside of colleges of education. “The typical candidate for elementary teaching takes about 70 percent of his or her course work outside the school or college of education, and candidates for high school teaching take about 80 percent of their work in other colleges” (Berliner & Biddle, 1995, p. 107). Science faculty members outside of colleges of education frequently have other important priorities that supersede thinking “about the ways they teach as a source of student learning, or, for that matter, take responsibility for the education of teachers” (Hawley, 1992, p. 262). These educational contexts may be related to a recent finding that science teachers who have strong content preparation but little or no pedagogical preparation are twice as likely to leave the profession at the end of their first year of teaching compared to first-year teachers who experienced comprehensive pedagogical preparation (Ingersoll et al., 2012). In light of this finding, Abell’s (2007) conclusion following a review of research on science teacher knowledge seems well justified: there is ample evidence to support the argument that science content knowledge is “necessary but not sufficient, for effective teaching” (p. 1102).

Conceptions of Teaching and Learning

The call for effectively drawing from educational research when making decisions about teaching and understanding student learning is not a new educational reform movement. In The Sources of a Science of Education, Dewey argued for research based decision making by teachers (Dewey, 1929). Ninety years later, Clough et al. (2009) expanded upon Dewey’s argument and described how a framework for decision making can assist teachers in the complex tasks of applying research to pedagogical decisions. This framework for teacher decision making
rests on the research base of our knowledge of the learner and learning and aims for the realization of student goals as called for by current education reforms such as the *Next Generation Science Standards* (NGSS Lead States, 2013). These means (educational research) and ends (student goals) come together in complex ways to inform teachers’ everyday decisions and “[enable] the educator, whether administrator or teacher, to see and to think more clearly and deeply about whatever he is doing” (Dewey, 1929, p. 75). Teacher decision making is not an insignificant matter:

Teachers make about 30 nontrivial decisions per hour. . . . These complex, professional, nontrivial decisions take place in environments where teachers can have 1,500 distinct interactions per day with different children on different issues, in different classes where aggregates of students need to be supervised all the time. (Berliner, 1987, p. 24)

Despite a strong and reliable research base testifying to the complexity of effective teaching, public conceptions of the profession are largely mistaken. Pushkin (2001) conducted a review of education-related newspaper articles from 1999–2000 in the *New York Times*, *USA Today*, and other papers. Overall, an unfavorable image of teachers emerged where the public might conclude that:

- Teachers were poor students in school and college.
- Teachers are poorly educated.
- Teachers are poorly paid.
- Teachers are incompetent.
- Teachers are illiterate.
- Teachers do not know anything.
- Teachers perpetuate ignorance.
- Teachers are warm bodies in classrooms.
- Teachers cannot teach, but somebody can. (p. 10)

Pushkin’s review adds further evidence to Berliner and Biddle’s earlier (1995) claim that the public views teachers as hopeless underachievers. Moreover, the act of teaching is not perceived as an incredibly complex act (Berliner, 1987). These general conceptions of teaching contribute
to students entering TEPs with misconceptions concerning their role as a teacher and the complexity of effective teaching and learning.

**The Necessity of Effective Teacher Education**

**Characteristics of Effective Teacher Education**

People who choose to enter teacher education have the same misconceptions of teaching as the general public. Nonetheless, they believe that through their commitment, intelligence, enthusiasm, and passion they will teach differently than those who came before them. But when it comes to enacting science instruction that is congruent with current science education research and reforms, enthusiasm is not enough (Luft & Roehrig, 2005). Russell and Martin (2007) elaborate:

> Just as children in elementary, middle, and secondary schools tend to be unaware of their initial beliefs about phenomena and unaware of how personal experiences shape and constrain those beliefs, so those who are learning to teach science tend to be unaware of their initial beliefs about what and how they will learn in a program of science teacher education. (p. 1151)

Literature reviews and recent studies related to teacher beliefs demonstrate that teachers’ beliefs about teaching and learning are deeply held, resistant to transformation, and profoundly shape their practice (Fang, 1996; Jones & Carter, 2007; Kagan, 1992; Pajares, 1992; Richardson; 1996; Windschitl & Thompson, 2006; Windschitl, Thompson, & Braaten, 2008). These findings have significant implications for TEPs.

To help prospective teachers move past their misconceptions about teaching and begin to support research-based science instruction, TEPs must guide them to change conceptually. The process of conceptual change requires purposeful and intentional instruction (Appleton, 1993; Posner, Strike, Hewson, & Gertzog, 1982). To transform prospective teachers’ conceptions of teaching and learning, Posner et al.’s model of conceptual change requires that TEPs
• make prospective teachers aware of, and uncomfortable with, their preexisting ideas about teaching and learning that they formed during experiences as learners observing teachers;
• teach them new conceptions of teaching and learning in ways that are congruent with the research base, intelligible, and plausible;
• model effective implementation of research-based practices, promote reform-oriented goals, and provide opportunities for prospective teachers to implement their new understanding and skills, so they come to see their new understandings of teaching and learning as fruitful.

How does research into what makes TEPs effective support the need to assist beginning teachers in conceptual change?

Literature reviews on effective TEPs from the last 20 years are consistent about effective teacher education. Howey (1996) summarizes them well:

the cornerstone of a coherent program [is] a conceptual framework. . . . Coherent programs should also assist in determining activities that socialize preservice students in purposeful and positive ways. . . . Ultimately preservice programs manifest their coherence in the type of pedagogy modeled for and engaged in by preservice students. (p. 143)

Feiman-Nemser (2001) outlined a corresponding description of the “central tasks” of learning to teach: “analyzing beliefs and forming new visions; developing subject matter knowledge for teaching; developing understandings of learners and learning; developing a beginning repertoire; developing the tools to study teaching” (p. 1016). Feiman-Nemser further argued that research makes clear that effective programs (1) are built around a conceptual framework, (2) have field experiences that are purposeful and integrated with coursework, and (3) conceptualize preservice
teachers as learners. More recent research on effective TEPs has continued to build upon and reiterate these same themes.

Darling-Hammond (2006a), in discussing research supported by the National Academy of Education’s Committee on Teacher Education, argued that TEPs must “[require] that new teachers come to understand teaching in ways quite different from their own experiences as students,” educate teachers “not only to understand but also to do a wide variety of things, many of them simultaneously,” and create teachers who are able to “understand and respond to the dense and multifaceted nature of the classroom” (p. 305). Darling-Hammond (2006b) studied seven exemplary TEPs that prepare teachers with transformative ideas about teaching and learning and demonstrate effective teaching practices as beginning teachers. Each program was unique, but the programs all shared the following characteristics that corresponded to and expanded upon previous findings:

- A common, clear vision of good teaching permeates all coursework and clinical experiences.
- Well-defined standards of practice and performance are used to guide and evaluate coursework and clinical work.
- Curriculum is grounded in knowledge of child and adolescent development, learning, social contexts, and subject matter pedagogy, taught in the context of practice.
- Extended clinical experiences are carefully developed to support the ideas and practices presented in simultaneous, closely interwoven course work.
- Explicit strategies to help students (1) confront their own deep-seated beliefs and assumptions about learning and students and (2) learn about the experiences of people different from themselves.
- Strong relationships, common knowledge, and shared beliefs among school- and university-based faculty.
- Case study methods, teacher research, performance assessments, and portfolio evaluation apply learning to real problems of practice (Darling-Hammond, 2006b, p. 41)
The findings of decades of research, spanning a variety of teacher education programs, have created multiple lines of evidence that make clear that high-quality teacher education programs are deliberate and extensive.

**Characteristics of Effective Science Teacher Education**

In a mixed-methods longitudinal study examining the links between science teacher education, science teaching, and student learning across multiple universities ($n=150$ science teachers), Tillotson and Young (2013) found that effective science teacher education is congruent with the attributes of effective teacher education programs, in general. Specifically, they found:

- The overall coherence, duration, and type of learning interventions within preservice preparation programs can have a profound influence on the extent to which science teacher education graduates develop reform-based teaching beliefs and practices. . . . Programs that contain purposeful interventions such as: 1) a developmental sequence of *multiple science methods courses* [emphasis added] integrated with multiple-grade level field placements; 2) *extensive field experiences* [emphasis added] across diverse settings in classrooms where cooperating host teachers promote the instructional practices modeled within the preservice program; and 3) numerous interventions designed to foster reflective thinking such as *writing theory-based rationales for teaching with an associated oral defense* [emphasis added] appear to be most promising. Teacher preparation programs structured with these experiences may provide the coherence and opportunity for reflection necessary to enable teachers to develop beliefs and understandings of teaching aligned with reform-based science education.

- Preservice teacher education programs must take an active role in establishing learning *cohorts* [emphasis added] that provide preservice teachers with a purposeful and supportive group of peers with whom to collaborate throughout the duration of the program.

- A meaningful preservice program is more than just a collection of a series of disjointed courses. The teacher education graduates who demonstrated the most-reform-based teacher beliefs and practices were those who described their preservice program as a series of *coherent and inter-connected learning experiences* [emphasis added] that built sequentially upon one another. . . . one area of weakness that must be addressed is the poor modeling of reform-based science teaching offered by the science content faculty . . .
• The evidence is clear that science teachers who exhibit more reform-based teaching practices can have a powerful effect on improving students’ attitudes toward science, their likelihood of considering a career in science, and how they envision science influencing their everyday life. This is in stark contract to science classroom where teachers rely on a dissemination model of teaching with an emphasis placed on memorizing factual information. (p. 158–159)

Tillotson and Young’s findings are also consistent with a growing body of evidence that has important implications for the design and implementation of effective science TEPs. For example, a review of the literature on the development of science teacher Pedagogical Content Knowledge (PCK) during TEPs supports the notion that science teacher education must first begin with preservice teachers having meaningful experiences with students in classrooms and include purposeful reflection (Schneider & Plasman, 2011). Barrett and Green (2009) describe such a program grounded in the development of PCK to prepare teachers who have necessary skills to continue to reflect and grow in their pedagogical thinking and practice following their TEP.

Also congruent with the conclusions of Tillotson and Young is Loughran’s (2007) review of the research focused on the science teacher as a learner. Loughran makes a strong argument that preservice teachers need to experience science content courses that effectively model practices congruent with science education reforms. This is a position further supported by Akcay and Yager (2010) in their investigation of the advantages of engaging preservice teachers in application courses that fully immerse the teachers in learning in a manner advocated by the National Science Education Standards (NRC, 1996).

In other words, the characteristics of effective TEPs are well documented. Science teacher educators must “change how students—and prospective teachers think about education” (Russell & Martin, 2007, p. 1175). This requires expertise, vision, and dedication to creating transformative science TEPs. As Howey (1996) put it:
[The question is] how to fundamentally transform the character of much of what now passes for teaching and learning in all school contexts at all levels. Teaching in far too many instances, and certainly far too often in the halls of academe, remains largely a lecture-recitation activity. “Learning,” in turn, remains basically a passive and largely individual activity. This form of “learning” is massively reinforced as youngsters watch tens of thousands of hours of television out of school. A vicious cycle of mediocrity continues in teaching wherein teachers continue to teach as they are taught. From this perspective the challenge in designing more potent programs of teacher preparation is not so much coming to agreement on the “knowledge bases” for and the content of preservice preparation, although surely there are knotty issues here, but rather how that curriculum is represented to and engaged in by prospective teachers in pedagogically powerful ways, that is, in contexts that are, in fact, conducive to learning to teach. (p. 145)

As intensive and effective as a science TEP may be, the process of teacher development does not end at graduation. Beginning teachers continue to learn during their induction years, and they need to be supported to effectively enact the teaching they envisioned and began practicing during their TEPs (Hammerness, et al., 2005; Feiman-Nemser, 2001; Howey, 1996).

**Socialization Experiences in Schools**

When beginning science teachers enter schools, powerful socialization experiences collide. Teacher socialization begins early in one’s life—prior to enrollment in a TEP or receiving colleague or administrative support during the induction years—because from early childhood to young adulthood a considerable amount of time is spent in close proximity to a practicing teacher (Lortie, 1975). The process of teacher socialization in schools is described by Edgar and Warren (1969) as one that involves pressures to change, to influence neophytes in socially “desirable” directions, to drop previous patterns of behavior and accept new norms held by the socializing agent or “significant other.” The “significant other” could be one person acting as a role model, or a group of people such as colleagues, parents, or students whose various expectations impinge on the role of the teacher. (p. 387)

For instance, the support of beginning teachers from administrators, mentors, and colleagues is generally considered crucial to successful teacher socialization (Little, 1990). Principals can increase teacher retention in disadvantaged schools (Grissom, 2011), and they can meet the
needs and foster the growth of beginning teachers (Kardos et al., 2001; Youngs, 2007). Mentors can fulfill the role of “help giving” (Little, 1990), and supervisors can successfully negotiate collaborative relationships with beginning teachers (Waite, 1993). Additionally, teacher collaboration and administrative support are related to teacher retention (Bang, Kern, Luft, & Roehrig, 2007; Borman & Dowling, 2008; Hancock & Scherff, 2010; Ingersoll 2001, Ingersoll & May, 2011; Patterson, Roehrig, & Luft, 2003).

While socialization has often been characterized as an important part of teacher induction (Little, 1990), school socialization experiences may account for first year teachers’ practices and beliefs reverting to those held prior to their TEP (Fletcher & Luft, 2011; Luft et al., 2003). Significant others—as defined above by Edgar and Warren (1969)—often have different perspectives on the purposes of school and the methods necessary to achieve those purposes than those promoted by research (Herman et al., 2013; Spector, Greely, & Kingsley, 2004). Indeed, mentoring can emphasize traditional conceptions of teaching and time-honored teaching practices such as reading from textbooks, completing worksheets, and conducting verification labs (Feiman-Nemser & Parker, 1993). Superordinates often explicitly and tacitly subvert reform-based conceptions of teaching and influence beginning teachers’ decision making in significant ways (Brickhouse & Bodner, 1992; Crawford, 2007; Tobin & McRobbie, 1996).

Therefore, even when beginning teachers leave their TEP understanding, valuing, and attempting to implement research-based practices, if these practices are met with resistance from significant others, they can be eroded during novices’ first years of teaching (Brickhouse & Bodner, 1992; Zeichner & Tabachnick, 1981). Indeed, teachers lacking extensive and effective teacher preparation in their TEP will often conform to traditional practices within the first three years of
teaching (Zeichner & Tabachnick, 1981). As Goodlad (1990) argued, socialization into traditional schools is an ineffective means of promoting reforms-based instructional practices:

Had there been recognition and understanding, surely reformers would not have prescribed once again that old bromide: Have today’s teachers mentor tomorrow’s. Schools and teachers are not very effective, said report after report. Yet according to conventional wisdom, the best way to ensure a competent teaching force is to place neophytes in those same schools with those same teachers. Surely we can come up with better remedies than this. (p. xiii)

Teachers can be socialized into the norms of reforms-based science teaching promoted by their TEP (Herman et al., 2013), i.e., viewing teaching and learning in a manner consistent with Project 2021 (AAAS, 1993), the National Science Education Standards (NRC, 1996), NGSS (NGSS Lead States, 2013) and contemporary education research (Clough et al., 2009). Beginning science teachers from a reform-oriented TEP who deeply understand research-based science teaching may actively seek support from like-minded individuals beyond the school building when experiencing socialization into the profession. But these teachers cannot simply close their doors and opt out of interacting with others when their new schools are not reform-oriented. They must work with their superordinates (i.e., they are assigned mentors, work on teams, and/or are evaluated by administrators). Their schools that may also have a culture of collaboration or a culture of contrived collegiality—in which they are directed by the administration to meet together to implement mandated curriculum and instructional strategies (Hargreaves & Dawe, 1990)—or some combination of the two. In either culture, beginning science teachers’ superordinates within these schools likely view their efforts as helping novices feel supported.

The longitudinal effects of the socialization of beginning science teachers’ pedagogical thinking and their implementation of teaching practices congruent with RBSI have yet to be studied. This study aimed to understand how beginning science teachers engage in relationships
intended for RBSI support during their induction years. Therefore, the overarching goal of the study was to add to our understanding of science teacher development.

**Research Based Science Instruction**

The history of calling for research based instruction extends back to Dewey’s 1929 argument for teachers applying research to (a) conceptualizing teaching and learning, (b) planning lessons, (c) informing teaching strategies, (d) understanding students’ learning, and (e) reflecting on and assessing teaching. Research coalesces with the educational goals we have for students in complex ways to inform teachers’ everyday decisions and “[enable] the educator, whether administrator or teacher, to see and to think more clearly and deeply about whatever he is doing” (Dewey, 1929, p. 75).

To assist teachers in the highly complex task of implementing RBSI to promote desirable student goals such as those described in the *Next Generation Science Standards* (NGSS Lead States, 2013) a variety of models have been developed and implemented in TEPs across the country. While there is no singular model for effective teacher education, research on TEPs makes very clear that effective programs have common attributes. Effective programs have a unified coherent vision of good teaching that permeates coursework and clinical experiences, have clearly defined standards for practice, and the curriculum is grounded in the research base on child development, learning, and pedagogy (Darling-Hammond, 2006b, p. 41; Howey 1996; Tillotson & Young, 2013). Coherent models provide a framework from which the research base in education “becomes a rich set of opportunities from which a teacher constructs an educational program, rather than a chaos of alternatives” (Bransford, Brown, & Cocking, 2000, p. 23). Importantly, however, neither the research base of education nor any coherent model of
education can prescribe what teachers should do in every given situation, “there is no universal best teaching practice” (p. 22).

One example of a coherent model employed by a science TEP is Ambitious Science Teaching. This framework promotes the goals of:

- supporting student learning across ethnic, racial, class, and gender categories; fostering deep understanding of ideas and engagement in solving complex problems rather than the typical emphases on activities and procedural talk . . . attention to students’ emerging ideas and regular adjustments to practice based on assessment of students’ understanding. (Thompson, Windschitl, & Braaten, 2013, p. 580)

This model emphasizes four practices that that can be generalized to different science teaching contexts and subject matter—selecting big ideas/models, working on students’ ideas, working with science ideas, and pressing for explanation (pp. 580–581).

The creators of this model devised a set of tools to prepare teachers for ambitious instructional practices. These tools draw from the research base on student learning and pedagogy to promote student goals congruent with educational reforms. They were purposefully designed to influence the practices of the beginning teachers in their program toward alignment with the research base in science education. “Just as teachers can influence students’ opportunities to learn by providing needed resources, we believed that teacher interns themselves could have their own practice shaped by tools to prepare them for the work of ambitious instruction” (Windschitl, Thompson, Braaten, & Strope, 2012, pp. 886–887). For example, in using one such tool preservice teachers are instructed to move about the room while students work in small groups and ask questions such as, “What are you seeing here? How do you think this is related to ___? So what can we infer from this?” (p. 887). The Ambitious Science Teaching framework and supporting tools are coherently modeled and implemented in the TEP’s methods coursework, clinical experiences, and a university-based induction program. Yet, while
the framework coheres the TEP and influences teachers’ pedagogical decision making, the four practices that ground the model do not prescribe a universal best practice.

The Framework for Teacher Decision-Making (Clough et al., 2009) was used to create a consistent vision of effective instruction in the TEP of the participants in this study. The authors of the model explain:

Preservice and inservice teacher education is the very place where the research-practice gap is supposed to be bridged. Ideally, in these settings, teacher educators work with prospective and experienced teachers to help them understand how the research base can be used to inform practice. These efforts should be devoted to developing and supporting habits of planning, classroom observation, analysis, decision-making, and reflection informed by relevant research. Helping teachers make sense of the education research base and bring some rationality to decision-making is essential for diminishing the research-practice gap. . . . Rather than prescriptive strategies, a framework that makes teacher decision-making a central feature, while explicitly addressing those decisions and how they interact would do much to help educators understand synergistic relationships and aid in making sense of the dizzying array of research findings. It would make clear that teachers are decision-makers in complex dynamic environments, and would value education research as a coherent whole. Such a framework would articulate factors of classroom life that must be considered simultaneously when making informed decisions. (pp. 825–826)

Similarly to Clough et al.’s concerns that teachers are frequently employing prescriptive strategies, the creators of the Ambitious Science Teaching model observe “intellectually rich activities have a history of being proceduralized in classrooms, often to the point of being treated as unrelated science tasks, and unrelated important science ideas” (Thompson et al., 2012, p. 884). Moreover, the Clough et al. (2009) lament:

The very real need to have something for students to do often interferes with teachers’ thinking about the goals they have for students and how people learn. . . . Decisions regarding what science content to teach and task and materials that will help students make desired meaning are interrelated and should be thoughtfully made in light of desired goals for students and how people learn. (p. 826)

The Teacher Decision-Making Framework provides an organizational structure useful for engaging in the complex task of thoughtfully selecting and implementing teaching practices to promote desired student goals by synergistically applying the education research base.
As one example of how a synergistic decision-making draws from educational research to promote educational goals, consider the scenario of a teacher leading a discussion. Creating meaningful and engaging discussions requires teachers who ask thought-provoking open-ended questions of their students. However, if the teacher does not also engage in positive nonverbal behaviors, such as appropriate wait time and friendly nonverbals, students are likely to feel uncomfortable responding to such probing questions. Additionally, to continue to engage students in a discussion after one student responds, the teacher must listen closely to what students are saying. Then, instead of immediately evaluating students’ responses the teacher engages in specific behaviors to encourage more students to share their thinking. For example, the teacher may again employ wait time along with welcoming nonverbals. Perhaps to draw out reluctant students, the teacher also lists students’ ideas on the board, has students engage in a think-pair-share, or has students write their ideas in their notebooks. Then, the teacher is in a position to use a wide variety of students’ ideas to move the discussion in a direction that meaningfully addresses students’ misconceptions and develops ideas accepted by the scientific community. To do so the teacher may use questions such as those suggested by Windschitl et al. (2012) in the previously described discourse tool (i.e., What are you seeing here? How do you think this is related to ___? So what can we infer from this) to shift the discussion away from “a concern for right answers to reasoning and justification for ideas” (Clough et al., 2009). Moreover a teacher who is thinking about their teaching through the synergy of the Teacher Decision-Making Framework should also consider the developmental appropriateness of the content selected for the discussion and the extent that the content is appropriate for promoting the desired student goal of understanding of fundamental science concepts—knowing that the
discussion is unlikely to be successful if the content is too simplistic, too abstract, or a disconnected collection of science facts.

Like the Ambitious Teaching model, the Framework for Teacher Decision-making is supported by tools that assist beginning teachers in shaping their practice in ways that accounts for the research on how people learn and promotes desirable student goals such as critical thinking, problem solving, effective communication, a deep understanding of fundamental science concepts, etc. One such tool is a modified version of the Schlitt Abraham Test of Interaction Coefficients (SATIC) coding sheet (Abraham & Schlitt, 1973). The SATIC coding sheet (Appendix C) was used by participants of this study in their TEP as a tool to assess, reflect upon, and improve their interaction pattern with students. Similar to the discourse analysis tool of Windschitl et al. (2012) the SATIC coding sheet also supports teachers in asking questions that mentally engage students with science concepts and reveal student thinking. To improve practice, teachers create action plans to limit their use of long periods of lecture, short answer questions, and responding to students in a manner that immediately and directly evaluates student responses. Moreover, teachers develop action plans to shift their interaction pattern towards one that relies more heavily on asking thought-provoking extended-response questions and responding to students in a manner that requires students to elaborate upon their thinking or uses students’ ideas to develop scientific ideas as accepted by the scientific community.

Similar to the Ambitious Science Teaching, the Framework for Teacher Decision-making and supporting tools were coherently modeled and implemented in the participants’ methods coursework and clinical experiences. While the Teacher Decision-making framework influences teachers’ pedagogical decision making to synergistically account for the implications of how
people learn and promote desirable student goals, neither the model nor the supporting tools prescribe a universal best practice.

RBSI forms the basis for both the Ambitious Science Teaching model and the Framework for Teacher Decision-making, along with other frameworks for science instruction such as the 5E Instructional Model. The creators of the 5E Instructional Model argue, “Recent reports . . . have confirmed what educators have asserted for many years: The sustained use of an effective, research-based instructional model can help students learn fundamental concepts in science and other domains” (Bybee et al., 2006). Therefore the findings that effective TEPs are grounded in a coherent model, and likewise that effective science instruction is grounded in a coherent model are not surprising.

For the purposes of this study, RBSI was defined as science instruction that takes into account research regarding how people learn and research regarding pedagogical decision-making and practice that promotes student goals aligned with science education reform documents. As such, because RBSI is complex it does not prescribe a singular approach to science instruction. Arguing for a research-based framework for science teaching, but well aware of the importance of context and the complexity of education research and pedagogical decision-making, Clough et al., (2009) write:

Rather than prescriptive strategies, a framework that makes teacher decision-making a central feature, while explicitly addressing those decisions and how they interact would do much to help educators understand synergistic relationships and aid in making sense of the dizzying array of research findings. It would make clear that teachers are decision-makers in complex dynamic environments, and would value education research as a coherent whole. Such a framework would articulate factors of classroom life that must be considered simultaneously when making informed decisions. (p. 826)
Theoretical Framework

Teacher Development

The framework of teacher development provides the organizational structure for this study. In proposing a framework of teacher development, Feiman-Nemser (2001) explored what teacher education might look like if the concept of learning to teach were envisioned as a continuum. This continuum begins in teacher preparation and continues on into the teaching years. Feiman-Nemser used three questions to ground her argument:

(a) What are the central tasks of teacher learning in the early stages of learning to teach?
(b) How well do conventional arrangements for teacher preparation, new teacher induction, and early professional development address these central tasks and what are some major obstacles that might get in the way?
(c) What are some promising programs and practices that promote reform-minded teaching and enable teachers to become active participants in school reform? (p. 1014)

The framework Feiman-Nemser developed suggests that learning to effectively implement reform-based instruction is too great a task to accomplish in its entirety during the preservice years. Learning to teach effectively happens over time and continues during teachers’ first years of teaching. Because aspects of teaching and learning will be purposefully and meaningfully attended to in each phase along the continuum (preservice, induction, later years), teachers are given space in each phase to develop deep understandings of teaching and learning. When learning to teach is a continuum, teacher education programs (TEPs) do not have to address all that is associated with teaching, and mentors do not need to view novices as blank slates.

This study is an in-depth look at the context and consequences of intended support and socialization experiences of an MAT cohort during their TEP and first two years of teaching. Because this study is not an investigation into the effects of a specific mentoring or induction policy, an evaluation study of specific mentoring or induction programs, or a direct study of the effectiveness of the participants’ TEP, this review did not delve into the history of research on
TEPs or into the research on mentoring and induction programs. Nonetheless, findings may have implications for teacher education, mentoring, and induction policy and programs.
CHAPTER 3. METHODOLOGY

Introduction

Teacher socialization begins prior to enrollment in a teacher education program (TEP) with an “apprenticeship of observation” (Lortie, 1975, p. 61). This roughly 13,000-hour apprenticeship spans a student’s education and is characterized by the student being in close proximity to, interacting with, and scrutinizing a wide variety of teachers, thereby developing a deep conceptualization of what it means to be a teacher. The process of teacher socialization then continues during teacher preparation and into the induction years where support of new teachers is generally considered crucial to successful teacher socialization (Grissom, 2011; Little, 1990; Waite, 1993; Youngs, 2007).

The understandings about research-based science instruction (RBSI) developed by beginning science teachers in their TEP may dramatically alter the initial conceptions of teaching and learning they developed during their many years of observing teachers. However, following a research-based science education program, beginning teachers conceptions of teaching and learning may not align with the conceptions of those charged with mentoring and socializing them during their first years of teaching. Therefore, this study sought to better understand the socialization of beginning science teachers working to implement research-based science teaching congruent with RBSI. As Grossman et al. (2001) described, “We have little sense of how teachers form the bonds of community… [and] work through the inevitable conflicts of social relationships” (p. 943). Studying how graduates of a research-based science teacher education program engage in relationships intended to support them as they are socialized into the profession of teaching, may lead to a better understanding of the effects of teacher socialization on the implementation of research-based practices congruent with RBSI.
The purpose of this three-year longitudinal study was to follow how a cohort of Master of Arts in Teaching (MAT) graduates from a research-based secondary science teacher education program (TEP) during their TEP and first two years of teaching to explore how they engaged in relationships intended to support effective RBSI during their TEP and first two years of teaching. Moreover, this study sought to understand the relationships which exist, if any, between beginning science teachers’ considerations of teaching and learning, teaching practices, and socialization experiences during their TEP and first two years of teaching. The overarching goal of the study was to identify the effects of teacher socialization on the implementation of RBSI by beginning science teachers.

**Research Questions**

**Pedagogical Considerations and Practice**

1. How congruent are study participants’ considerations of teaching and learning with research-based science instruction at the end of their TEP, first year of teaching, and second year of teaching?

2. To what extent are study participants implementing teaching practices congruent with research-based science instruction at the end of their TEP, first year of teaching, and second year of teaching?

**Socialization Experiences**

3. What is the nature of study participants’ relationships with members of their cohort during their TEP, first year of teaching, and second year of teaching?

4. What is the nature of study participants’ relationships with the superordinates charged with supporting them during their first and second years of teaching?
Relationships Between Variables

5. What relationships exist, if any, between study participants’ pedagogical considerations, teaching practices, and their socialization experiences during this study?

Design of the Study

Methodological Framework

To deeply understand the experiences and teaching practices of an entire TEP cohort during their first two years of teaching, this study used qualitative methodology grounded in social constructivism epistemology and a theoretical perspective of interpretism (Crotty, 1998; Bogdan & Biklen, 2007). This study employs case study methods and a multiple–case study design because, as Yin (2009) contends, case study methods are advantageous when attempting to study “contextual conditions—believing that they might be highly pertinent to your phenomenon of study” (p. 13).

In one sense, the cohort in this study could be considered a case, with each participant defined as a unit of that case. This would define the study as a single-case embedded design. However, since this study followed graduates into their first two years of teaching, the cohort was no longer a useful organizing context for the participants’ interactions. Each participant had moved on to a different school context. Since there is more than one unit of analysis—each participant represented a case that could be analyzed in isolation and also compared to the other cases to build an understanding of the cohort as a whole—the study was designed as a multiple-case study (Creswell, 2007).

Context

The science teacher education program the participants completed is an intensive 15-month cohort program designed to prepare “highly qualified secondary science teachers who
understand how people learn . . . and employ reforms-based practices . . . based on the best available educational research implemented in a holistic manner . . . to create powerful learning environments” (Herman et al., 2013, pp. 275–276). The science education component of the program aims to educate, as opposed to train, preservice teachers, to deeply understand the synergistic nature of making and implementing research-based instructional decisions and teacher behaviors that reflect research on how people learn and promote student actions congruent with desired science education student goals. The structure, sequence, credits, and contact hours of the science education portion of the program are described in Table 1 (modified from Herman et al., 2013).

Table 1. Science Teacher Education Program Structure, Sequence, Credits, and Contact Hours

| Graduate Science Teacher Education Program (Master of Arts in Teaching) |
|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|
| **Summer—Semester 1** | **Fall—Semester 2** | **Spring—Semester 3** | **Summer—Semester 4** |
| • Introduction to the Complexities of Learning and Teaching Science (2 credits, 20 contact hours) | • Science Methods I (2 credits, 50 contact hours) | • Science Methods II (2 credits, 50 contact hours) | • Advanced Pedagogy in Science Education (3 credits, 45 contact hours) |
| • 20+ observation hours | • Nature of Science in Science Education (3 credits, 45 contact hours) | • School Internship (2 credits, 60+ hours) | |
| | • School Internship (2 credits, 60+ hours) | • Student Teaching (12 credits, 14 weeks) | |

Notes. The courses described above are the science education–specific coursework preservice teachers must complete. Other education courses (e.g., educational psychology, multicultural education) must also be completed. Nine study participants completed an elective “Restructuring Science Activities” course during their fourth semester.

This is an intensive TEP program grounded in what is known about effective science teacher education (i.e., longitudinal, based in classroom experiences, spiraling curriculum, requires qualitative and quantitative self-evaluation, stresses understanding the nature of science and its implications for science instruction, grounded in a cohesive framework). It is a program designed to promote a coherent view of learning and teaching among its students through a deep
understanding of the research on teaching and learning that overwhelmingly supports RBSI. Moreover, it is a program that addresses how to navigate working in schools that promote practices incongruent with RBSI.

All participants earned their MAT degree by successfully completing the TEP described above. As members of the same cohort, the participants progressed through the TEP together. The cohort model was leveraged throughout the science education portion of the program to foster collaborative working relationships through assignments that required the members of the cohort to work together to successfully complete significant assessments, provide each other targeted analytical feedback, and share sources of information. Additionally, cohort members were encouraged to develop relationships where they could rely upon each other for emotional and intellectual support as they wrestled with course concepts and assignments that were sometimes difficult to understand and/or implement. In addition to the intentional promotion of cohort relationships, the program overtly drew students’ attention to the possibility of facing fierce institutional constraints during their first years of teaching. In doing so the science education faculty raises practical strategies for surviving and thriving in the face of constraints.

**Participant Selection**

The participants in this study were drawn from an MAT cohort of the TEP with 12 students. One member of the cohort exited the program during the second semester. Another member of the cohort was interested in participating in the study but was excluded because in lieu of acquiring a science teaching position after completing the TEP, he pursued an additional teaching license in secondary mathematics and subsequently obtained an at-risk student support position in mathematics. Another graduate of the cohort was interested in participating in the study, but did not secure a teaching position during the study’s second year. He did obtain a
science teaching position during the third year and subsequently participated. Therefore, this study was conducted with 10 of 11 graduating members of a single TEP cohort.

This study was deliberate in the selection of an entire cohort. Many studies use a convenience sample (e.g., Herman, et al.) and the group is generally assumed to be representative based on other factors, such as performance in a program. By selecting an entire cohort for participation, with all but one cohort member taking part in the study, I can state with confidence that I have the range of abilities and experiences for that year’s graduates. Participant recruitment began after Institutional Review Board Approval was secured for this study. Via e-mail or during an informal mentoring visit, participants were provided with the purpose and protocol for the study and a document seeking each participant’s voluntary informed consent.
Participants’ School Contexts

Table 2 summarizes the participants’ school settings during their first two years of teaching.

Table 2. Participants’ Teaching Contexts

<table>
<thead>
<tr>
<th>Teacher*</th>
<th>Year</th>
<th>Community^</th>
<th>School^</th>
<th>Grades^</th>
<th>Enrollment^</th>
<th>F/R Lunch^</th>
<th>Preps#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrea</td>
<td>First</td>
<td>Urban</td>
<td>Public</td>
<td>6–8</td>
<td>581</td>
<td>84%</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>Rural</td>
<td>Public</td>
<td>5–8</td>
<td>431</td>
<td>35%</td>
<td>1</td>
</tr>
<tr>
<td>Chris</td>
<td>First</td>
<td>Urban</td>
<td>Public</td>
<td>6–8</td>
<td>581</td>
<td>84%</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>Rural</td>
<td>Public</td>
<td>6–8</td>
<td>542</td>
<td>67%</td>
<td>1</td>
</tr>
<tr>
<td>Emma</td>
<td>First/Second</td>
<td>Rural</td>
<td>Public</td>
<td>9–12</td>
<td>274</td>
<td>31%</td>
<td>3</td>
</tr>
<tr>
<td>Ethan</td>
<td>First</td>
<td>Urban</td>
<td>Public</td>
<td>6–8</td>
<td>581</td>
<td>84%</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>Urban</td>
<td>Public</td>
<td>9–12</td>
<td>2,268</td>
<td>72%</td>
<td>1</td>
</tr>
<tr>
<td>Hannah</td>
<td>First</td>
<td>Urban</td>
<td>Public</td>
<td>9–12</td>
<td>1,535</td>
<td>38%</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>Rural</td>
<td>Public</td>
<td>6–8</td>
<td>343</td>
<td>25%</td>
<td>1</td>
</tr>
<tr>
<td>Jack</td>
<td>First/Second</td>
<td>Rural</td>
<td>Public</td>
<td>9–12</td>
<td>791</td>
<td>24%</td>
<td>2</td>
</tr>
<tr>
<td>Liam</td>
<td>First/Second</td>
<td>Suburban</td>
<td>Public</td>
<td>6–8</td>
<td>924</td>
<td>27%</td>
<td>1</td>
</tr>
<tr>
<td>Mason</td>
<td>First</td>
<td>Rural</td>
<td>Public</td>
<td>7–12</td>
<td>325</td>
<td>30%</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>Urban</td>
<td>Public</td>
<td>6–8</td>
<td>708</td>
<td>51%</td>
<td>2</td>
</tr>
<tr>
<td>Noah</td>
<td>First/Second</td>
<td>Suburban</td>
<td>Public</td>
<td>9</td>
<td>699</td>
<td>21%</td>
<td>1</td>
</tr>
<tr>
<td>Martin</td>
<td>First/Second</td>
<td>Suburban</td>
<td>Public</td>
<td>9–12</td>
<td>2,103</td>
<td>17%</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes. *Pseudonyms were used to ensure participants’ anonymity. ^Data from the National Center for Education Statistics. +Free/Reduced. #The number of different types classes the teacher was responsible for (e.g., Biology, Physics, and Chemistry).

Data Collection

Baxter and Jack (2008) contend that a primary feature of case study research is employing multiple data sources. Baxter and Jack (2008), Snyder (2012), and Yin (1981) assert that data from multiple sources need to be integrated in data analysis and not analyzed in isolation. Each data source is one piece of a puzzle, and each piece contributes to the researcher’s
understanding of the whole phenomenon. For each case, interviews and classroom observations were conducted, and electronic and nonelectronic artifacts were collected.

Data were collected over the two years following the participants’ completion of the TEP and archived artifacts were acquired from participants’ time in their TEP. A longitudinal investigation afforded the opportunity to study the socialization of beginning teachers both in the participants’ initial year of transition from their TEP and in their second year with lessened novelty effects.

**Interviews.** Semi-structured and informal interviews were conducted to investigate participants’ considerations regarding how people learn (i.e., learning theories), goals for students, and their teaching decision-making and practice. (See Appendix A for interview questions.) Significant portions of the interviews were directed toward collecting data regarding to what extent and how participants were establishing and engaging in support relationships. Each participant was interviewed on three separate occasions using a semi-structured interview protocol. These interviews occurred (1) prior to their first year of teaching, (2) toward the end of that first year, and (3) toward the end of their second year of teaching. The first round of interviews was conducted in an office on the TEP university campus. The second and third rounds of interviews were conducted in a variety of locations (e.g., participants’ classrooms, in a coffee shop) or across several types of media (e.g., phone, Skype). Locations and communications media were negotiated between the participant and researcher. Audio of each interview was recorded and transcribed.

In addition to these formal semi-structured interviews, on numerous occasions unplanned informal discussions took place that were not audio-recorded. Informal discussions with participants most frequently occurred before or after a classroom observation; some occurred
over lunch and between class periods, and some occurred during phone calls to schedule classroom visits. Informal interviews generally began with the question, “How are you doing?” and proceeded conversationally. Extensive notes were written during and immediately after these informal discussions to accurately capture and retain what the subjects shared. Informal interviews helped build rapport with participants, learn about their perceptions of their first years of teaching, and seek elaboration on observed lessons.

**Classroom observations.** When conducting classroom observations, I was positioned in the back of the room at a location agreeable to the participant. I neither circulated through the room during instruction nor initiated interactions with students. However, if a student asked me a personal question (e.g., Are you a student teacher?), I answered, or I redirected students to their teacher when I was asked classroom-based questions (e.g., May I go to the restroom?).

I used a Livescribe recording pen to write field notes while simultaneously recording audio of the observed lessons. Field notes were descriptive. They documented classroom layout, classroom events, teacher behaviors, and student actions promoted in participants’ classroom activities. Additionally, analytical and interpretive memos were recorded in field notebooks to capture personal responses and to make sense of research, observations, and interactions with participants (Maxwell, 2013).

The extent to which participants’ lessons were congruent with the *National Science Education Standards* ([**NSES**] NRC, 1996) reforms-based teaching standards was documented using the Local Systematic Change Classroom Observation Protocol (LSC-COP; see Appendix B). *NSES* was used as the primary reform document for this study because this document was the accepted standard for practice during the time these teachers completed their TEP. The LSC-COP was developed to evaluate the implementation of National Science
Foundation (NSF) science education Local Systemic Change grants (Horizon Research, 2005). The LSC-COP is widely used in science education research to assess the alignment between a lesson and effective research-based teaching congruent with science education reforms as defined by the NSES. The LSC-COP helps an observer score the effectiveness of a science lesson in four categories: (1) lesson design, (2) implementation, (3) content, and (4) classroom climate. Additionally, each lesson was given a capsule rating to “encapsulate your overall assessment of the quality and likely impact of the lesson” (Horizon Research, 2005). The capsule ratings range from ineffective instruction, elements of effective instruction, beginning stages of effective instruction, accomplished effective instruction, to exemplary instruction. To ensure LSC-COP data were valid and reliable, I was trained by a faculty member who had received training for the National Science Foundation under the guidance of Horizon Research until intercoder agreement > 90% for each domain was reached.

Participants’ verbal interaction patterns during instruction were documented using a modified version of the Schlitt Abraham Test of Interaction Coefficients (SATIC) coding sheet (Abraham & Schlitt, 1973). The SATIC coding sheet (Appendix C) is used by TEP students as a tool to analyze their interaction patterns with students. While in the TEP, on at least four occasions participants SATIC coded their interaction patterns, identified their interaction pattern, compared their pattern to research-based behaviors aligned with how students learn and desired student goals, and developed strategies to move their interaction pattern toward the desired state. Therefore, use of the SATIC to code and analyze participants’ question-and-response patterns was congruent with the expectations and experiences of their TEP. I was first taught to analyze interaction patterns as an undergraduate in my own TEP. Prior to coding participants’ interactions patterns, I observed an TEP faculty member teach students how to analyze their
interaction patterns. The faculty member’s assessment and feedback on three students’ SATIC analysis assignments were reviewed. Next, I independently assessed and provided feedback on students’ assignments; this assessment and feedback was submitted to the faculty member for review and discussion of incongruences and subtleties of coding. Through this process I developed a deep understanding of SATIC analysis, and research-based teacher behaviors aligned with how people learn and science education goals for students.

Artifacts. Because participants could not be observed daily, interviews and field notes were triangulated with classroom artifacts (e.g., syllabi, lesson plans, activities, worksheets, assessments), and used to determine if the student actions promoted by participants were congruent or incongruent with the participants’ stated and observed student goals and research-based science instruction (RBSI). To triangulate interview data concerning support relationships, e-mail exchanges were collected between participants and science education faculty and participants and doctoral students; e-mail exchanges between participants shared via the cohort’s online group were also collected. To assess participants’ teaching and understanding of RBSI and practices as they exited the TEP, artifacts from their TEP were collected (e.g., Research-based Framework for Teaching Science, SATIC self-evaluation of Teaching Behaviors, Draw a Science Teacher assessments, Lesson Plans developed for Science Methods II, grades in the science education portion of the TEP, and letters of recommendation from faculty of the science education portion of the TEP).

Data Analysis

Data analysis was conducted to explore: (1) participants’ considerations of teaching and learning, (2) participants’ implementation of RBSI, (3) how participants engage in relationships with their cohort members, (4) how participants engaged in relationships intended to support
effective RBSI, and (5) the relationships which exist, if any, between beginning science teachers’ considerations of teaching and learning, teaching practices, and socialization experiences during their TEP and first two years of teaching. To create a triangulated case description for each participant based on the convergence of support from a variety of sources (Yin, 2009), interviews, observations, field notes, memos, and artifacts were brought together and analyzed using the constant comparative process of open and analytical coding to develop triangulated themes (Anfara, et al., 2002; Merriam, 2009).

**Descriptive case reports.** A descriptive case of each participant was crafted to create a narrative grounded in the study’s questions and these individual cases are presented in Chapter 4. Moreover, since the study is longitudinal and a primary strength of case studies is “the ability to trace changes over time” (Yin, 2009, p. 145), each case is presented chronologically to facilitate a time-series analysis of participants’ experiences as they exited the TEP and traversed their first two years of teaching. Each case begins with a synopsis of the participants’ pedagogical considerations, teaching practices, and socialization experiences prior to their first year of teaching as they exited the TEP. This description was derived from analyses of artifacts from participants’ time in the TEP (Research-based Framework for Teaching Science, Self-evaluation of Teaching Behaviors, Draw a Science Teacher assessments, Lesson Plans developed for Science Methods II, grades in the science education portion of the TEP, letters of recommendation from faculty of the science education portion of the TEP, and TEP exit interviews). Next, the participant’s school setting, pedagogical considerations, teaching practices, and socialization experiences during their first and then second years of teaching is described for each case. These descriptions were derived from analyses of interviews, field notes, memos, LSC-COP codes, classroom artifacts, SATIC codes, and e-mail communications. Detailed
descriptions of the analysis process for each data source used to build the descriptive cases are presented below.

**Cross-case analyses.** To explore the overarching relationships, if any, that existed between participants’ pedagogical considerations, their socialization experiences, and their teaching practices during this study cross-case analyses were conducted. This analysis helped build a general explanation to fit each case (Yin, 2009). Cross-case analysis is an iterative process employing a constant comparative method whereby data are again reduced across cases using analytic coding and category formation to compare data within and between categories and across cases (Anfara et al., 2002; Merriam, 2009). The cross-case analysis procedures and findings are presented in Chapter 4.

**Analysis of teacher education program artifacts.**

*SATIC Self-evaluation of Teaching Behaviors Assignment.* All MAT students complete multiple SATIC Self-evaluation of Teaching Behaviors assignments during their third semester in the TEP. The assignment was described as follows in the course syllabus:

All students must participate in an associated secondary school teaching experience. For at least two, and likely three, teaching sessions you must turn in a thorough quantitative and qualitative assessments of your teaching that provides audio or video recorded evidence you are: (a) implementing research-based teaching behaviors and strategies that reflect how students learn and facilitate student goals consistent with the reform documents in science education; and (b) accurately self-assessing. You will compare the actual state to the desired state represented in your developing research-based framework and make appropriate recommendations that will move your teaching progressively towards the desired state. Your self-evaluations are due Monday, February 7th, March 7th, and March 28th. They will be assessed by the quality of your interaction pattern (its congruency with a $3c/4$, 6, 11/12 pattern; voice intonation and volume; etc.), the accuracy of your self-assessment, and how well you link your self-evaluation to the research/literature base. Begin audiotaping immediately! At least one, and likely two, of these tapes and self-assessments will be given to a classmate to assess, and that detailed assessment will be turned in along with the original student’s tape and self-assessment.

Quantitative and qualitative analyses of the Self-evaluation of Teaching Behaviors assignments were conducted. The mean frequency of each participant’s question and response types, as
documented in their assignments, were analyzed. If the participant’s quantitative analysis differed from that of the professor or cohort member who assessed the accuracy of the participant’s analysis, the coding of the professor or cohort member was used. The feedback of the professor or cohort member was also qualitatively analyzed to gain a sense of the participant’s abilities concerning: 1) accurate and effective self-assessment, 2) the construction of a concrete action plan to improve teaching behaviors, and 3) citation of relevant literature necessary to construct a self-evaluation based on a firm research-based foundation. The assignments for each participant were also analyzed for evidence of growth across each of these three areas.

Course Grades for Science Methods II. The letter grade each participant defended (based on clearly described criteria in the course syllabus) for Science Methods II was included as a source of evidence to determine the degree to which each participant held teaching beliefs and enacted effective teaching congruent with science education reforms. How participants’ letter grades were assigned is described by operational definitions for each grade. The operational grade definitions, as they appeared in the course syllabus, are outlined in Table 3.
Table 3. *Operational Definitions of Letter Grades for Science Methods II*

<table>
<thead>
<tr>
<th>Grade</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>This individual is an excellent preservice secondary science teacher. This person 1) always refers to student goals aligned with science education reform documents, 2) skillfully articulates (both orally and in writing) a thorough, yet concise, research-based framework for teaching science that conveys a robust understanding of learning, teaching, and synergistic relationships, 3) extensively and accurately self evaluates classroom practice thus showing an understanding of the desired state, discrepancies, and recommendations to move progressively towards the desired state, and (4) clear evidence of 3c/4, 6, 11/12 interaction patterns with students. All assignments are thorough, show great effort and convey a deep understanding of learning and teaching. This person demonstrates excellent and thorough lesson planning, a strong command of subject matter, and discusses issues and research in science education. All of these MUST have been well demonstrated through active participation in class sessions. This person uses research findings to support statements and exhibits a passion for teaching. This individual is a formal operational teacher. Compelling evidence must be provided to justify an “A”.</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>This individual is a very good preservice secondary science teacher. This person 1) often refers to student goals aligned with science education reform documents, 2) clearly articulates (both orally and in writing) a thorough research-based framework for teaching science that indicates an understanding of learning, teaching, and several important synergistic relationships, 3) accurately self evaluates classroom practice thus showing an understanding of the desired state, discrepancies, and recommendations to move progressively towards the desired state, and (4) emerging evidence of 3c/4, 6, 11/12 interaction patterns with students. All assignments are thorough and convey a very good understanding of learning and teaching. This person has a good grasp of subject matter, demonstrates very good lesson planning, and sometimes discusses issues and research in science education. All of these MUST have been demonstrated at times in class discussions. This person uses research findings to support most statements, but misses other appropriate opportunities. A strong commitment to teaching is always exhibited. This individual is in transition between concrete and formal. The “B” student, with effort, shows every sign of one day becoming an “A” teacher.</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>This individual is a satisfactory preservice secondary science teacher. This person shows the basic competencies necessary for secondary science teaching, may be quite successful in some areas, but struggles in others. This person 1) conveys declarative knowledge of student goals, learning and teaching, 2) has a research-based framework, but struggles to convey synergistic relationships, 3) self-evaluates classroom practice, but misses important issues that show an understanding of the desired state, discrepancies, and recommendations to move progressively towards the desired state, and (4) lacks evidence of 3c/4, 6, 11/12 interaction patterns with students. Special attention during student teaching/first year teaching will likely be required to ensure effective teaching that matches the desired state. All assignments are turned in, but they sometimes are skeletal or late. This person has a sufficient grasp of subject matter, demonstrates satisfactory lesson planning, but is sometimes cynical towards education research. This individual demonstrates a satisfactory commitment to teaching, but is concrete-operational as a teacher.</td>
</tr>
</tbody>
</table>

Notes. *Despite the course title, this is the third science methods class for TEP students. The class occurs during the third semester in the program. *Students must consistently demonstrate effective communication (i.e. correct grammar, spelling, punctuation, and verbal communication) required of a secondary teacher. This requirement supercedes all other grade criteria.

*Letters of Recommendation.* The faculty member who taught several of the science education courses wrote a letter of recommendation for each participant. While much of each letter was dedicated to describing the work each participant completed in as a part of the TEP,
each participant was described (and thus categorized in descending order) as an exceptional, excellent, very good, fine, or a student in our program. How each participant was categorized in his or her letter of recommendation was included as a source of evidence to determine the degree to which each participant held teaching beliefs and implemented effective research-based teaching congruent with science education reforms. The faculty member’s description of each of these key terms is described in Table 4.

Table 4. Categorizations of Students for Differentiating Letters of Recommendation

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exceptional</td>
<td>Reserved for those who deeply understand learning and teaching and exhibit a worth-ethic. As a total package, I am as confident as I can be that they will be highly effective science teachers. These are people who I expect will either overcome institutional constrains or leave the school. I don’t think I have been wrong about many of these.</td>
</tr>
<tr>
<td>Excellent</td>
<td>For those who understand a great deal about learning and teaching and who have what it takes to be a highly effective science teacher. Whether or not they become that teacher depends on their commitment to teaching and the environment they face.</td>
</tr>
<tr>
<td>Very Good</td>
<td>For those who get some of the big ideas, but don’t understand learning and teaching well enough to be highly effective teachers (unless they put in much more time and effort). If these people were place in a very supportive environment, they would do very good things associated with highly effective teaching. But they will fold and/or be unable to implement highly effective teaching in an unsupportive environment or one that has institutional constraints.</td>
</tr>
<tr>
<td>Fine</td>
<td>For those students who ask for a letter, were nice and did what was necessary to move through our program, but have shown insufficient deep understanding of learning and teaching, and have not shown the motivation and effort that would be necessary to effectively teach science. In these letters I talk more about our program than the characteristics of the student. These people can go out and teach science the way it is commonly taught (directive teaching and student recall), but they will not be the effective teachers our program sets out to prepare.</td>
</tr>
<tr>
<td>A Student in Our Program</td>
<td>This is a kind way of saying that the principal should look elsewhere.</td>
</tr>
</tbody>
</table>

Analysis of interviews. Interviews were analyzed using the constant comparative process of open and analytical coding to develop themes (Anfara et al. 2002; Glaser & Strauss, 1967; Merriam, 2009). Initially, open coding was used to develop themes to represent each participant’s experiences with respect to each year of the study (their time in the TEP, first year of teaching, and second). Then, codes were further refined as within case analysis was conducted.
to identify prominent themes that extend longitudinally throughout each case. Interview data supporting the findings presented in the descriptive cases are included as embedded quotations or footnotes. Each quotation and footnote was cited within parenthesis (e.g., [Maxwell, 1:1]). Citations were constructed by first listing the participant’s pseudonym, followed by the document number (i.e., 1=TEP exit interviews, 2=end of first year of teaching, 3=end of second year of teaching), followed by the line number of the start of the quote in the Dedoose analysis program.

**Analysis of teaching observations.**

*LSC-COP.* The extent that which participants’ lessons were congruent with the *National Science Education Standards* ([NSES] NRC, 1996) reforms-based teaching standards was documented using the Local Systematic Change Classroom Observation Protocol (LSC-COP; see Appendix B). The effectiveness of each science lesson observed was scored in four categories: (1) lesson design, (2) implementation, (3) content, and (4) classroom climate. Additionally, each lesson was given a capsule rating ranging from ineffective instruction to exemplary instruction. These data were reduced by calculating the mean score for each category and the mean capsule rating for each of the following time spans: TEP, first year, and second year of teaching. A graphic representation of these means is included in the descriptive case of each participant.

*Interaction pattern.* Participants’ verbal interaction patterns during instruction were documented using a Modified SATIC Coding Sheet (Appendix C). To analyze these data individual codes were aggregated as follows:

- Codes 1 and 2—Combining these codes represents the frequency with which a teacher initiates student interactions through statements that do not require student
responses (i.e., lecturing/giving directions or making statements/asking rhetorical questions).

- Codes 3a and 3b—Combining these codes represents the frequency with which a teacher asks questions that do not promote student mental engagement (i.e., asking yes/no or short-answer questions).

- Codes 3c and 4—Combining these codes represents the frequency with which a teacher asks questions that demand meaningful student mental engagement and assesses student thinking (i.e., asking thought-provoking short-answer questions or extended-answer questions).

- Codes 5 and 7–10—Combining these codes represents the frequency with which a teacher responds to a student in a manner that decreases student mental engagement (i.e., rejecting, confirming, repeating, clarifying or interpreting student comments or answering students’ questions).

- Codes 11 and 12—Combining these codes represents the frequency with which a teacher responds to a student in a manner that increases student mental engagement and assesses student thinking (i.e., asking for clarification or elaboration, or using a student question or idea).

The percent occurrence of codes in each aggregate category is described for each participant during three timespans: their TEP, first year of teaching, and second year of teaching. Additionally, the percent occurrence of code 6 was described. These percentages were used to generate an overall interaction pattern that could be assessed for congruency with RBSI as promoted by the TEP (i.e., an interaction pattern that consists of primarily asking questions coded as 3c/4, and responding to students with codes 6/11/12).
Trustworthiness

Establishing trustworthiness in qualitative research is not as straightforward as establishing reliability and validity in quantitative research. As Merriam (2009) observed, “To a large extent, the validity and reliability of a study depend upon the ethics of the investigator” (p. 228). However, some consensus exists concerning strategies that promote trustworthiness in qualitative research: prolonged engagement in the field, clarifying researcher positionality and bias, triangulation, peer review, member checking, creating thick, rich descriptions, maximum variation in sample selection, and an audit trail (Creswell, 2013; Merriam, 2009). The following sections detail how this study was designed and conducted to construct trustworthy conclusions.

Positionality. During my first year of graduate school I registered for and completed two classes (“Nature of Science in Science Education” and “Restructuring Science Activities”) alongside the cohort of students that became the participants of this study. In two other classes the cohort completed (“Science Methods I” and “Science Methods II”), I worked as a teaching assistant and taught portions of a few class periods. When I began this research project, I shifted from student and sometime teacher to observer in the back of the room—a data collector.

Prior to my first classroom observation, I imagined myself pleasantly walking into a participant’s classroom and saying, “Hello” to the teacher with a smile and then I would ask, “Where would you like me to sit so that I will not be in the way?” I planned to make myself an unobtrusive observer and then I would ask clarifying questions of my participant before I left. However, during my first classroom visit, I sat in a chair at the back of the classroom and observed two class periods, just as I had planned. Following my observations, I had a few questions I wanted to ask the teacher during her preparation period. As I approached the teacher to ask if she could spare some time to answer a few questions, she blurted out, “How did I do?
How was my questioning?” At that moment, I realized I had failed to account for how the research participants may view me. I did not account for the year I spent developing relationships with the participants before I ever set foot in their classrooms. These relationships were varied and complex. Yet I thought I could ignore them because now I was a researcher.

In the moment that followed that first participant asking about her performance, I decided to answer her questions and any other participant’s, too. If they asked about questioning, I talked with them about their interaction patterns. If they asked about classroom management, I talked with them about what I observed going on in their classrooms. However, if they did not ask about something I observed, I did not discuss it. I realized that even though I viewed myself as a researcher, my participants viewed me as a researcher/mentor—someone whose background they knew and trusted. They knew I would be observing their first years of teaching in order to conduct my doctoral research, and in a sense they wanted compensation in the form of feedback.

My next classroom observation began in much the same way as the first. I conducted my observations and then approached the teacher to ask him questions. This time when I approached the teacher, I was prepared for him to ask for feedback, but he did not. I felt insulted. I had just observed him teach for hours; was he not the least bit curious what I thought? Maybe he was interested. Maybe he believed it was inappropriate to ask because I was fulfilling the role of researcher and was no longer a fellow student and sometime teacher. Maybe he was uncomfortable being observed and too insecure as a first year teacher to ask, “How did I do?”

At the completion of my second year of observing ten participants, some never asked for feedback, others sought feedback with every visit, and still others asked, but only after a time, “Is it okay to ask you how I am doing?” In this study I was not an insider. I was not a member of their MAT cohort; nor was I a beginning teacher. I did not have the shared experiences of oral
defenses, lesson planning, and the stresses of student teaching that brought the cohort together. However, I was not fully an outsider, either—with some participants I became a relied upon and critical mentor. I was a member of their Google group to document their conversations, but they did not include me in their discussions. My relationships varied with each participant in this study. My relationships with some of participants likely affected the very behaviors I observed and documented.

As a participant researcher in a case study with cross-case comparisons, positionality is not as simple as being an insider or being an outsider. My positionality, my placement relative to the research project and the participants in it, was wrapped up in my relationship and interactions with each participant. Glesne (2011) argues “positionality is not fixed and, perhaps, should be plural, since relationships vary between and among people and change over time” (p. 157). I have a distinct positionality with each of the ten participants in this study. This positionality was documented through analytical memos and reported in case-by-case findings in Chapter 4.

**Prolonged engagement in the field.** Each case was developed over the course of two years. During this time I visited each participant on several occasions and a total of 133 hours of teaching was observed. I did not visit participants during the fall semester of their first year of teaching which provided with them space to settle into their new schools and become familiar with colleagues, students, curriculum, school norms, etc. During the spring semester of the second year of the study (i.e., most participants first year of teaching), I visited each participant’s school between 2–4 times and observed 2–8 class periods (2.8–7.5 hours of instruction). During the third year of the study (i.e., most participants second year of teaching), I visited each participant’s school between 2–7 times and observed between 2–15 class periods (1.8–19.5 hours of instruction). Table 5 summarizes the number of times I visited each participant, the number of
class periods I observed, and the number of hours I spent observing participants’ lessons. The wide range of visits and observation hours exist because some participants had contexts (described in their case reports) that made their participation in observations difficult to navigate as beginning teachers. In addition to classroom observations, I formally and informally interviewed participants, sometimes I ate lunch with them and with their colleagues, I chatted with participants during their preparation periods and before and after school, and I accompanied participants when they conducted supervisory duties before school, during lunch, and after school.
Table 5. *Classroom Observations*

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Year</th>
<th>Visits</th>
<th>Periods Observed</th>
<th>Hours Teaching Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrea</td>
<td>First</td>
<td>3</td>
<td>3</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>5</td>
<td>10</td>
<td>7.5</td>
</tr>
<tr>
<td>Chris</td>
<td>First</td>
<td>3</td>
<td>3</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>2</td>
<td>3</td>
<td>1.8</td>
</tr>
<tr>
<td>Emma</td>
<td>First</td>
<td>3</td>
<td>4</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>6</td>
<td>15</td>
<td>12.5</td>
</tr>
<tr>
<td>Ethan</td>
<td>First</td>
<td>2</td>
<td>2</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>2</td>
<td>2</td>
<td>2.8</td>
</tr>
<tr>
<td>Hannah</td>
<td>First</td>
<td>4</td>
<td>7</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>6</td>
<td>12</td>
<td>9.2</td>
</tr>
<tr>
<td>Jack</td>
<td>First</td>
<td>2</td>
<td>5</td>
<td>7.5</td>
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<tr>
<td></td>
<td>Second</td>
<td>7</td>
<td>13</td>
<td>19.5</td>
</tr>
<tr>
<td>Liam</td>
<td>First</td>
<td>4</td>
<td>8</td>
<td>6.7</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>6</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Mason</td>
<td>First</td>
<td>2</td>
<td>6</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>5</td>
<td>8</td>
<td>6</td>
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<tr>
<td>Noah</td>
<td>First</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Second</td>
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<td>9</td>
<td>6.8</td>
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<td>Martin</td>
<td>First</td>
<td>5</td>
<td>12</td>
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</tr>
<tr>
<td></td>
<td>Second</td>
<td>—</td>
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<td>—</td>
</tr>
</tbody>
</table>

Total Hours of Teaching Observed = 133.1
**Triangulation.** A variety of data sources were collected and comparatively analyzed with the intent of generating converging themes (Anfara et al., 2002; Merriam, 2009; Yin, 2009). To assess participants’ teaching beliefs and practices as they exited the TEP, multiple artifacts representing a variety of assessments from the TEP were collected (Research-based Framework for Teaching Science, Self-evaluation of Teaching Behaviors, Draw a Science Teacher assessments, Lesson Plans developed for Science Methods II, grades in the science education portion of the TEP, and letters of recommendation from faculty of the science education portion of the TEP). Emerging findings from interviews and field notes were compared with findings from classroom artifacts (syllabi, lesson plans, activities, worksheets, assessments, etc.) and analyzed to determine if the student actions promoted by participants were congruent or incongruent with the participants’ stated and observed student goals and effective research-based teaching congruent with science education reforms. Interview data concerning support relationships were confirmed by analyzing e-mail exchanges between participants and science education faculty, other participants, and doctoral students, as well as exchanges shared between participants via the cohort’s Google group.

**Peer review.** Weekly meetings were held with my science education co-major professors while planning, conducting, and writing up the study. The primary focus of these meetings was to discuss the study, including “the process of study, the congruency of emerging findings with raw data and tentative interpretations” (Merriam, 2009, p. 229).

**Creating thick, rich descriptions.** As detailed above, a descriptive case of each participant was crafted to create a narrative of each participant grounded in the study’s research questions. Each case begins with a synopsis of the participants’ teaching beliefs, teaching practices, and support relationships as they exited the TEP and prior to their first year of teaching.
Next, each case describes the participant’s school setting, teaching beliefs, teaching practices, and support relationships during their first year and then their second teaching. Finally, a cross-case analysis was conducted to construct a general explanation that fit each case.

**Maximum variation in sample selection.** One concern with multiple case study research is that inadequate thought is sometimes given to the choice of research sites and how sites relate to the theoretical underpinnings of the research study. Walford (2001) asserts, “it is frequently evident (either from internal evidence or from personal communications) that a study was undertaken in particular locations simply because they provided convenient sites for the researchers” (p. 151). Each case for this multiple-case study was undertaken because the participant was a member of a bounded cohort of a specific TEP. This selection process aligns with the theoretical underpinnings of this study in two significant ways: (1) it answers the need to study specific TEPs, and (2) it studies an entire cohort of graduates as opposed to a sample of convenience. A strength of having a sample of participants that represents a complete cohort lies in likelihood that the study participants were socialized to varying degrees into a community of like-minded beginning teachers; therefore, the sample represents the cohort’s full range of socialization. Furthermore, the sample is more likely to be representative of a range in (a) depth of understanding of research-based practice and (b) ability to effectively implement high-quality research-based science instruction.

**Creating an audit trail.** Appendices are included to ensure further transparency in my “methods, procedures, and decision points in carrying out the study” (Merriam, 2009, p. 229). Appendix D displays a matrix detailing the relationships between the research questions and semi-structured interview questions (Anfara et al., 2002; Merriam, 2009).
Limitations. I am a Caucasian researcher born, raised, and educated in the Midwest. This study’s participants were Caucasian and completed the MAT portion of their education in the Midwest. All participants taught in the Midwest during their first year of teaching, and one participant taught in the Southeast during his second year of teaching. The interpretive nature of qualitative research was conducted largely through the lens of this Caucasian and Midwestern context.

An assumption of this study is that the sample is likely to be representative of a range in (a) depth of understanding of research-based practice and—because the sample represents an entire cohort from TEP—(b) ability to effectively implement high-quality research-based instruction in a manner congruent with science education reforms. However, on more than one occasion, the two TEP faculty members who instruct the science education portion of the program commented that this cohort’s performance in the program surpassed typical cohort groups. Moreover, because the science education component of the TEP program consists of multiple science methods courses and is taught by science education faculty recognized for highly effective science teaching and science teacher education, the teacher education experiences of subjects in this study are unlikely representative of TEPs across the nation. While other TEPs may have differing structures and operate in different contexts, the results of this study can inform all efforts to prepare highly effective teachers.

Even though I viewed myself as a researcher, my participants viewed me as a researcher/mentor—someone whose background they knew and trusted. With some participants I became a relied upon and critical mentor. Other cohorts from TEP do not have access to a similar kind of person from the program during their first years of teaching.
This study focused on the relationships that exist, if any, between beginning teachers’ pedagogical considerations and implementation of science teaching practices congruent with RBSI and their socialization experiences during their first two years of teaching. Investigating other factors that may be related to teachers’ pedagogical considerations and implementation of science teaching practices congruent with RBSI during the first two years of teaching (e.g., subject taught, grade level, school demographics, medical conditions) was beyond the scope of this study.
CHAPTER 4. FINDINGS

Overview

The purpose of this chapter is to present the findings of a three-year longitudinal multiple-case study designed to identify the relationships between teacher socialization, beginning science teachers’ pedagogical considerations of science teaching and learning, and their implementation of practices congruent with research-based science instruction (RBSI). The chapter begins with case reports that present the analyses and findings for each participant. Then, the cross-case analyses and findings (beginning on page 149) are discussed for each of the research questions guiding this study.

Research Questions

Pedagogical Considerations and Practice

1. How congruent are study participants’ considerations of teaching and learning with research-based science instruction at the end of their TEP, first year of teaching, and second year of teaching?

2. To what extent are study participants implementing teaching practices congruent with research-based science instruction at the end of their TEP, first year of teaching, and second year of teaching?

Socialization Experiences

3. What is the nature of study participants’ relationships with members of their cohort during their TEP, first year of teaching, and second year of teaching?

4. What is the nature of study participants’ relationships with the superordinates charged with supporting them during their first and second years of teaching?

Relationships Between Variables

5. What relationships exist, if any, between study participants’ pedagogical considerations,
teaching practices, and their socialization experiences during this study?

Case Reports

What follows is a descriptive case of each participant. These cases were crafted to create a narrative for each participant grounded in the study’s research questions. Each case is presented chronologically to facilitate a time-series analysis of participants’ experiences as they exited the TEP and traversed their first two years of teaching. Each case begins with a synopsis of the participant’s pedagogical considerations, teaching practices, and socialization experiences prior to his or her first year of teaching as after exiting the TEP. This description was derived from analyses of artifacts from each participant’s time in the TEP (Research-based Framework for Teaching Science, SATIC Self-evaluation of Teaching Behaviors, Draw a Science Teacher assessments, Lesson Plans developed for Science Methods II, grades in the science education portion of the TEP, letters of recommendation from faculty of the science education portion of the TEP, and TEP exit interviews). Next, each case describes the participant’s school setting, pedagogical considerations, teaching practices, and socialization experiences during his or her first and second years of teaching. These descriptions were derived from analyses of interviews, field notes, memos, LSC-COP codes, classroom artifacts, SATIC codes, and e-mail communications. Finally, each case is summarized to detail how the participant’s pedagogical considerations, teaching practices, and socialization experiences changed over the first two years of teaching.

Case 1—Andrea

Preservice.

Context. Prior to enrolling in the TEP, Andrea worked at a science museum. To participate in the TEP she made a round-trip commute of roughly 1.5 hours. Andrea said she
began the program “passionate about making a difference in the world” and confident that she could make a difference through education.

*Socialization experiences.* At times during her participation in the TEP, Andrea doubted her science education professors. In wrestling with her doubt, Andrea credits her relationships with members of her cohort, cooperating teachers, and professors in helping her not only to understand the significance of RBSI, but also to develop a deep understanding of effective teaching.

During her practicum, Andrea worked with a cooperating teacher who neither rejected nor fully implemented practices congruent with RBSI. Despite this misalignment between his practices and the practices promoted and modeled by the TEP, Andrea had a positive relationship with her cooperating teacher. She was able to identify her cooperating teacher’s strengths and find value in her relationship with him.

Andrea’s interactions with her cooperating teacher likely influenced how she believed she would interact with colleagues during her first years of teaching. In looking forward, Andrea was not concerned with how she might navigate sometimes well-intentioned yet misguided support from colleagues who neither valued nor implemented practices congruent with RBSI. She was instead concerned about classroom management and selection of developmentally appropriate concepts.

*Pedagogical considerations.* As Andrea exited the TEP, she reflected upon her teaching experiences in ways that are congruent with the TEP and RBSI. For example, she kept her students’ goals in mind, and her focus was on working with her students’ thinking.

Andrea perceived that her beliefs about her role as a teacher shifted dramatically during her time in the TEP. In discussing the Draw a Science Teacher task she had completed at the
start of the TEP, she recognized how she had held views of teaching that did not account for the learner or reflect RBSI. Andrea’s proposed modifications reflected her view of a teacher as one who makes intentional decisions to work with students’ ideas and helps develop their understanding.7

Teaching practice. During Andrea’s third semester in the TEP, she audiorecorded and analyzed two lessons to qualitatively and quantitatively assess her teaching and complete the SATIC Self-evaluation of Teaching Behaviors assignment. Andrea conducted one analysis in February and one in March; the percent of each SATIC code occurrence is depicted in Figure 1. Early in that third semester, Andrea primarily exhibited a SATIC pattern that was incongruent with RBSI. She heavily employed teacher talking (codes 1 & 2) and responses that limit student engagement and assessment of students’ thinking (codes 5 & 7–10). However, Andrea also demonstrated potential to transition toward practices congruent with RBSI by asking some open-ended questions (codes 3c & 4) and sometimes responding in a student-centered manner (codes 11 & 12) to promote student mental engagement.

Andrea defended an A- in Science Methods II (see Table 3 for grade criteria) at the end of her third semester in the TEP. She was categorized as an excellent student in the program in her letter of recommendation (see Table 4 for categorization criteria). These assessments of Andrea’s understanding suggest she understood a great deal about learning and teaching and had the potential to be a science teacher who could effectively implement practices congruent with RBSI.

The first year.

Context. During Andrea’s first year of teaching, she worked in a public middle school in an urban community. Her middle school served 581 students enrolled in grades 6–8, 84% of
whom qualified for free or reduced lunch. Andrea taught one course, Sixth Grade Science, in a block schedule. Two other teachers in the middle school taught Sixth Grade Science; one teacher was a member of Andrea’s TEP cohort and the other teacher was a graduate of the TEP with more than 5 years teaching experience. Andrea cotaught one class period with a special education teacher. Andrea reported that the only team that “made growth” in the school’s assessment program was the sixth-grade science team—comprised of three TEP graduates. Nonetheless, at the conclusion of Andrea’s first year of teaching no members of the team were still employed by the school. One member did not have his contract renewed and the other two members found new positions for the next school year.

Socialization experiences. During the first few months of her teaching career, Andrea openly promoted practices congruent with RBSI and advocated effective science teaching practices with her superordinates. Unfortunately, the school-based leaders she looked to for support, assistance, and guidance repeatedly admonished her efforts. For example, during the first week of school, Andrea began what would become a series of efforts to mitigate safety problems in her classroom.

I had contacted my principal about my concerns. . . . She told me that I was so obsessed with the classroom that she was worried I was missing the point of the professional development, and that perhaps I need to focus on other things. . . . So that was my first experience where I was like “Okay. This is going to be a problem.” (Andrea, 2a:470)

Other problems arose with Andrea’s official mentor teacher. Andrea leaned on her mentor for emotional support and to better understand administrative level decisions. In response, Andrea’s mentor, who held no evaluative power, was highly critical of her, and Andrea believed she violated their mentor-mentee relationship and shared information with the principal, who did hold evaluative authority.8 Andrea felt her mentor was using the guise of support and a close relationship with the principal to intimidate her.9 Finally, Andrea drew sharp criticism from one
of the School Improvement Leaders (SILs) after she expressed concern that a new school-wide mandate was incongruent with RBSI: “I was . . . told that he had heard that I was being a problem and he would really encourage me to have a better attitude.”

In response to her school-based critics, Andrea reached back to the TEP for assistance in navigating the relationships intended for support provided by her school. Andrea shifted her strategy to be covert in her relationships with her superordinates to survive her first year of teaching.

My best move, moving forward, would be to get on the good side of the vice principal, because he had liked me for my classroom management and, also, just start smiling and not saying anything, because I wasn’t being listened to anyway. . . . The message that they were really trying to sell me is, “We don’t want you to think. We want you to act like you’re doing what we’re telling you to do.” (Andrea, 2a:563)

She relied upon TEP faculty and members of her cohort for help navigating the institutional constraints she faced, for emotional support, for lesson planning, for advice on whether to remain in teaching, and for interview preparation as she applied for new teaching positions elsewhere.

If I hadn’t kept in contact with all those people, if they weren’t there, I don’t think I’d be teaching anymore. . . . I think I would’ve just been done and looked for a different profession. . . . I was having panic attacks last year. I put on 50 pounds. . . . I was physically affected by what I went through last year. I was emotionally affected. And that was all while feeling supported. (Andrea, 3:818)

_Pedagogical considerations._ When discussing her first year of teaching, Andrea reflected upon how people learn, her goals for students, and her selection of content, materials, and strategies in a manner that was largely congruent with RBSI, but she rarely included specific examples that illustrated depth of understanding or demonstrated how she realized RBSI in her classroom.

_Teaching practice._ During the spring semester of Andrea’s first year of teaching, she was observed teaching three lessons (one each in March, April, and May). A portion of each lesson
was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 1. Andrea primarily exhibited a SATIC pattern that heavily employed teacher talking (codes 1 & 2), dichotomous and short-answer questions (codes 3a & 3b), and responses that acknowledge students’ answers (code 6) or used students’ ideas (codes 11 & 12) and promoted mental engagement, which was a shift from her pattern during the TEP. Andrea’s interaction pattern during her first year of teaching shifted toward a pattern more reflective of RBSI—asking a greater percentage of thought-provoking and extended-response questions and decreasing her use of behaviors that limit student engagement and assessment of students’ thinking.

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 2, Andrea scored low to medium-low across all categories, and her mean capsule rating of 4 is reflective of practice that was in the low end of “Beginning Stages of Effective Instruction” (Appendix B). Such practice can be described as “instruction that is purposeful and characterized by quite a few elements of effective practice. . . . Overall, the lesson is somewhat limited in its likelihood to enhance students’ understanding of the discipline or to develop their capacity to successfully ‘do’ science” (Horizon, 2005, p. 11).

The second year.

Context. During Andrea’s second year of teaching, she worked in a public middle school in a rural community. Her middle school served 431 students enrolled in grades 5–8, 35% of whom qualified for free or reduced lunch. Andrea was the only teacher of Seventh Grade Earth Science, which she taught in a nine-period day. Andrea had previously student-taught in the high school of this district.

Socialization experiences. Andrea felt well supported by her principal and assigned mentor\textsuperscript{17} during her second year of teaching. However, due to her negative experiences during
her first year of teaching, she approached each of these relationships with caution and sometimes fear—even at the end of the school year. Meanwhile, Andrea continued to seek support from relationships established at TEP by remaining in contact with members of her cohort who had experiences and expertise in earth science. Andrea also remained connected to the TEP by informally working with a preservice teacher from the TEP. She viewed these interactions as an opportunity to “pursue highly effective teaching.”

**Pedagogical considerations.** When discussing her second year of teaching, Andrea continued to reflect in ways that were congruent with RBSI. However, her reflections were of increased depth and sophistication as she provided examples from her classroom to support her beliefs. Andrea’s reflections moved beyond a perfunctory reiteration of themes promoted in the TEP and began to reflect on teaching and learning in a more synergistic manner.

**Teaching practice.** During Andrea’s second year of teaching, she was observed teaching 10 lessons on five separate occasions (in October, April, and May). A portion of each lesson was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 1. Andrea’s interaction pattern demonstrated her further shift toward practices congruent with RBSI—asking a greater percentage of thought-provoking and extended-response questions (codes 3c & 4), employing responses that used students’ ideas (codes 11 & 12), and decreasing her use of behaviors that limit student engagement and assessment of students’ thinking (codes 5 & 7–10).

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 2, Andrea scored medium to medium-high across all categories, and her mean capsule rating of 6 remained reflective of practice that was in the high end of “Beginning Stages of Effective Instruction.” (Horizon Research, 2005, p.11).
Summary.

Socialization experiences. Andrea’s relationships with her superordinates changed dramatically throughout the three years of this study. She began the program skeptical of the science education faculty at the TEP but by the end of the program she trusted them. She viewed her relationship with her cooperating teacher as one where she could learn from what she observed his strengths to be and respectfully disagree about other aspects of his practice. In the TEP, Andrea developed relationships with her superordinates where respectful questioning was interpreted as mental engagement and a necessary component to wrestling with complex concepts and practices and deep understanding of effective science teaching practices. However, at Andrea’s first school, asking questions was interpreted as disrespectful behavior indicative of a bad attitude. Andrea only received support from her superordinates to implement practices incongruent with RBSI. In this environment, Andrea relied heavily on support from members of her cohort, other like-minded graduates of the TEP, and the TEP science education faculty. When she moved to a new school during her second year of teaching, Andrea was guarded. Even though her superordinates were supportive of practices congruent with RBSI and she was given multiple leadership responsibilities, she was scarred by her prior experience:

Every place I’ve gone I’ve worried that I was going to be shot down or I was going to be looked at like I was crazy, and I’ve only been met with support. . . . At the end of the school year, I still have it. . . . I have this innate feeling when . . . [my superordinates or supportive colleagues] have something to talk to me about I worry that it’s going to be negative. (Andrea, 3:901)

Andrea maintained relationships with cohort members, but they shifted from primarily working with cohort members and like-minded graduates of the TEP who were in her building to working with cohort members who had expertise in the subject area she was teaching. As time passed, she relied less on the expertise of the TEP science education faculty, but she maintained
ties with the program by informally working with an intern and being a guest speaker in a secondary science methods class.

**Pedagogical considerations.** While in the TEP Andrea demonstrated that she understood RBSI. She continued to reflect on her teaching in ways congruent with these practices during her first year of teaching. However, she was often vague and perfunctory in her reflection. Although she seemed to be attempting to maintain her understanding, given the fierce institutional constraints she was facing, she was struggling to implement practices congruent with RBSI and therefore meaningfully deepen her understanding of effective science teaching. During Andrea’s second year of teaching, when she received better support, she was able to reflect more deeply and synergistically about RBSI.

**Teaching practice.** Andrea’s interaction pattern moved dramatically toward a desired interaction pattern during the three years of this study. Even while under intense scrutiny during her first year of teaching, Andrea reduced her use of ineffective teacher-centered responses. During Andrea’s second year, she was able to make decisions in a manner congruent with RBSI, as evidenced by her improved LSC-COP scores (see Figure 2). Her interaction pattern also improved dramatically, and she spent more time asking students thought-provoking questions (see codes 3c & 4 in Figure 1) and responding in a manner that mentally engages students (see codes Figure 1).
Figure 1. Percent occurrence of Andrea’s question and response types during her teacher education program (TEP), first year of teaching, and second year of teaching.

*Maximum Capsule rating is 8; Maximum rating for other categories is 5.

Figure 2. Mean rating of each LSC-COP category for observations conducted during Andrea’s first and second years of teaching.

*Maximum Capsule rating is 8; Maximum rating for other categories is 5.
Case 2—Chris

Preservice.

Context. Chris considered himself a nontraditional student in the TEP, having been out of higher education and in the workforce for nine years prior to beginning work on his master’s degree. To participate in the TEP, Chris moved to a new state and paid out-of-state tuition. Chris was “intrinsically motivated to be successful” (Chris, 1:12).

Socialization experiences. Chris considered the degree to which he worked with other members of his cohort to be dependent upon overlapping areas of science content expertise. Given his primary endorsement area was earth science he worked closely with Liam. In fact, while they worked together on assignments where they were required to collaborate with classmates, they also provided each other feedback on additional assignments and developed a friendship outside of class.22

Chris had a positive experience with his cooperating teacher and he described him as someone he “almost” (Chris, 1:77) considers a friend. Not only was he the same age as his cooperating teacher, but they also shared similar interests, and Chris described him as a like-minded graduate of the TEP. His cooperating teacher modeled practices congruent with RBSI as promoted by the TEP in two geology courses, and then Chris taught an environmental science class. While teaching environmental science, Chris felt he had the freedom to teach in a manner he wanted, understood he could ask questions of his cooperating teacher to gain his insight, perceived his teacher’s suggestions to improve his practice as supportive, and felt he could call his teacher at home on Sunday evenings for assistance with lesson planning.23
Chris’s positive experiences in the TEP—along with his supportive interactions with his cohort members and cooperating teacher—likely influenced his confidence when looking forward to his first year of teaching.

I don’t foresee me hitting too many road blocks my first year, because the school is fairly progressive, and it seems that they are very research-oriented. I would like to think that it’s a model school for the rest of the school district. (Chris, 1:913)

Chris was not concerned with how to navigate sometimes well-intentioned yet misguided support from colleagues who neither value nor implement RBSI. He was aware, however, that beginning teachers sometimes do encounter obstacles when attempting to implement practices congruent with RBSI.

Pedagogical considerations. Chris expressed no cognitive or emotional struggle in going through the conceptual change process of understanding RBSI as promoted by the TEP. Chris entered the TEP believing that “a good science teacher was somebody who was good at explaining. I thought that the experiences that I had, myself, would be sufficient to help students come to understand science ideas” (Chris, 1:619). He developed an understanding of how deeply content must be understood to effectively scaffold student thinking, the significance of a teacher’s interaction pattern, the crucial role of nature-of-science instruction in effective science teaching, and the synergistic nature of teacher decision-making. In addition to understanding the complexities of RBSI, he substantially changed his conceptions of learning from naïvely viewing the processes of learning through learning styles to one of understanding how multiple learning theories come together to account for how all people learn.

Teaching practice. During Chris’s third semester in the TEP, he audiorecorded and analyzed two lessons to qualitatively and quantitatively assess his teaching and complete the SATIC Self-evaluation of Teaching Behaviors assignment. He conducted one analysis in January and the other in March; the percent of each SATIC code occurrence is depicted in Figure 3. Early
in that third semester, Chris primarily exhibited a SATIC pattern that, while generally incongruent with RBSI, included a noteworthy use of RBSI-congruent behaviors. Chris’s pattern heavily employed teacher talking (codes 1 & 2) and responses that limit student engagement and assessment of students’ thinking (codes 5 & 7–10). Though it was not his primary pattern, Chris nevertheless demonstrated a strong potential to transition toward a pattern more congruent with RBSI by asking open-ended questions (codes 3c & 4) and responding in a student-centered manner (codes 11 & 12) to promote student mental engagement.

Chris defended an A in Science Methods II (see Table 3 for grade criteria) at the end of his third semester in the program. He was categorized as an exceptional student in the TEP in his letter of recommendation (see Table 4 for categorization criteria). These assessments of Chris’s understanding suggest he deeply understood learning and teaching and was extremely likely to be a teacher who effectively implements practices congruent with RBSI.

**The first year.**

*Context.* During Chris’s first year of teaching, he worked in the same urban public middle school as Andrea—a school that served 581 students enrolled in grades 6–8, 84% whom qualified for free or reduced lunch. Chris taught two courses, Earth Science and Eighth Grade Science, in a block schedule. Chris knew he would be leaving this school and moving across the country to marry and live with his fiancée at the end of the school year. He was highly motivated to secure a good letter of recommendation upon his departure. In response the question “What was your biggest influence on your decision-making as a teacher during your first year?” he responded:
I can honestly say it’s a tough question. I’m going to be very, very honest. . . . student goals were the number one thing. . . . But I knew I was going to leave there. I just want to tell you, that letter of recommendation was the number one thing on my mind, and I knew if I had my students pass these tests, that I would get the glowing letter of recommendation. If I [were perceived] to be a yes man, I would get a glowing letter of recommendation . . . I knew I needed to get another job and if I didn’t have that letter of recommendation . . . it would be tough to get [my career] started. So that was it. I did very, very much fulfill my student goals, very much for Earth Science. I let my students down in my 8th grade. It was bad. It was borderline traditional teaching. I still structured the class a little bit different, but I wasn’t hitting all my goals. But as far as my decision-making, my decision-making was based on making sure that I could get that good letter of recommendation. (Chris, 2: 421)

Socialization experiences. Chris was very intentional in how he engaged in relationships with his superordinates. Chris did not seek support to implement practices congruent with RBSI from his mentor teacher because the mentor’s suggestions “weren’t congruent with how I taught, and how I think people learn, and what research suggests” (Chris, 2:318). Chris was deliberate in his engagement with his mentor, choosing to seek advice on how to manage his teaching and personal life.  

Early in the school year he invited administrators into his classroom to view activities, and he made sure that when they were in his room, he implemented strategies promoted by the administration (e.g. gradual release of responsibility). He also intentionally sought advice from School Improvement Leaders and was purposeful in sharing artifacts that demonstrated that he used their advice. Chris further perceived that questioning his superordinates was unwelcome.

Don’t ever challenge them. I mean at least not [as] a first or second year teacher. . . . We ought to ask questions and we want our students to be able to ask questions, but we’re in a situation. They don’t want to be challenged. (Chris, 2:270)

Chris paid attention to the perspectives of his administrators and was covert in his relationships with his superordinates.
[You had to] track every time that you worked pacing, or phrasing, or smoothness . . . I ended up just putting tallies in it and never really doing it . . . I was extremely dishonest, but I became desensitized . . . I was basically getting one over on them. I was kind of conning my [way] through the school year . . . They put so much pressure on, or so much emphasis on, the testing . . . To make it look like I valued the tests, I joined the committee to work on revising the tests . . . you’ve got to play the game, even if it means not being exactly truthful with yourself and to your students, to a certain extent. But the administration, you just got to do what you’ve got to do, so you can get in, get out, and get on with your career. Knowing when and what types of questions to ask your administration, I know I’ve already said that before, but that’s a big thing. What’s going to set them off? What’s going to throw up a red flag for them? (Chris, 2:557)

Prior to his first year of teaching, Chris had had experiences that prepared him for the difficulties he encountered in the form of misguided support from superordinates who neither valued nor implemented RBSI.

There’s so many times you wake up in Northeast Philadelphia to gunshots, you know, right outside your door, or a helicopter that’s like 25 feet over your building with a spotlight shining down your alley . . . So I had other experiences. So I can work with you, I know how to get you off my case, and I could just navigate. (Chris, 2:790)

Chris garnered support for implementing practices congruent with RBSI from the two other teachers in the building who were members of his cohort and another teacher who is a graduate of the TEP. Primarily, Chris and Andrea developed a reciprocal relationship where Chris would help Andrea with earth science content and Andrea would help Chris phrase questions effectively. 32 Chris felt highly supported by the TEP even though he had graduated and was no longer enrolled.

The MAT Program, that kind of support was not expected. Traditionally, you leave a program and that’s it. Here I feel there’s a genuine interest in graduates—in making sure the graduates of the program are successful. [We were] sending emails with very, very clear questions for advice, and within a matter of days, we were a getting very, very thoughtful response that truly, truly helped out and their visits . . . But the mentoring just from the program itself, I wasn’t expecting that kind of help. The school, they’ve got our money. They got a little bit of what they wanted out of us . . . But the people that were in charge of the program truly care, that’s the high support. (Chris, 2:350)

Pedagogical considerations. When discussing his first year of teaching, Chris reflected upon how people learn, his goals for students, and his selection of content, materials, and
strategies in a manner that was largely congruent with RBSI. While he sometimes included specific examples that illustrated the depth and interconnectedness of his understanding, when discussing how he realized RBSI in his classroom during his first year of teaching, he often provided perfunctory responses.

**Teaching practice.** During the spring semester of Chris’s first year of teaching, he was observed teaching three lessons (one each in March, April, and May). A portion of each lesson was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 3. Chris primarily exhibited a SATIC pattern that heavily employed teacher talking (codes 1 & 2), asking open-ended questions (codes 3c & 4) and responding in a manner that used students’ ideas (codes 11 & 12) and promoted mental engagement, which was a shift from his pattern during the TEP. Chris’s interaction pattern during his first year of teaching shifted toward a pattern more reflective of RBSI—asking a greater percentage of thought-provoking and extended-response questions, and sharply decreasing his use of responding behaviors that limit student engagement and assessment of students’ thinking.

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 4, Chris scored medium to medium-high across all categories, and his mean capsule rating of 5 is reflective of practice that was in the middle of “Beginning Stages of Effective Instruction” (Appendix B). Such practice can be described as instruction that is “purposeful and characterized by quite a few elements of effective practice. . . . Overall it remains somewhat limited in its likelihood to enhance students’ understanding of the discipline or to develop their capacity to successfully ‘do’ science” (Horizon Research, 2005, p.11).

One of the three observed lessons (an Eighth Grade Science lesson) was incongruent with RBSI, while the other two lessons (both Earth Science Lessons) were highly reflective of RBSI.
In Eighth Grade Science, Chris experienced intense resistance from his students because he was not doing the same activities as the other Eighth Grade Science teacher. (He did not experience student resistance of this sort in Earth Science because he was the only Earth Science teacher in the building.) Eventually, Chris became tired, sick, and frustrated, and he gave in. He began teaching the same lessons as the other Eighth Grade Science teacher, focusing his time and energy on implementing practices congruent with RBSI in his Earth Science classes.

The second year.

Context. During Chris’s second year of teaching he worked in a public middle school in a rural community. His middle school served 542 students enrolled in grades 6–8, 67% of whom qualified for free or reduced lunch. Chris was one of two teachers of Sixth Grade Science in his building.

Socialization experiences. Chris was guarded in how he interacted with colleagues and his administration when he began his second year of teaching. He did not feel anyone explicitly assisted him in implementing practices congruent with RBSI at his new school, nor did he perceive that they were interested in thwarting his efforts. His school did not have an official state or district mentoring program, and his informal mentor was, like Chris, in only her second year of science teaching—she had taught math for five years prior. Chris explained, “I was sharing some of my research with her, but as far as her offering support [for] highly effective science teaching, it wasn’t necessarily there” (Chris 3:241).

The principal gave Chris the impression that he wanted what was best for students and wanted to be in the loop, but he did not want to micromanage. Chris believed that a lack of feedback following administrative observations was indicative of his administration not
understanding effective science teaching practices. He did not view these evaluations as confirmation of his mastery of RBSI.  

Chris felt his principal and other administrators were impressed by his teaching and supportive of practices congruent with RBSI. Chris also effectively navigated systems and practices that did not support RBSI. As a result his administrators were tolerant when he did not implement school-wide initiatives.  

Chris continued to access support from relationships he established during his time in the TEP by remaining in contact with Liam, who had experiences and expertise in earth science, and Andrea, who had worked closely with him on his questioning during his first year. Although he significantly decreased his contact with Liam and Andrea, he felt he had built a solid foundation by relying upon them heavily for lesson planning support during his first year.  

**Pedagogical considerations.** When discussing his second year of teaching, Chris continued to reflect in ways that were largely congruent with RBSI. However, his reflections were of increased depth and sophistication as he provided examples from his classroom to support his reflections. Chris’s considerations of his practice moved beyond a perfunctory reiteration of themes promoted in the TEP and began to account for the synergistic relationships between implications that follow from how people learn; the selection of content, materials, strategies, and teacher behaviors; and the promotion of student goals.  

**Teaching practice.** During Chris’s second year of teaching he was observed teaching three lessons on two separate occasions in February. A portion of each lesson was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 3. Chris’s interaction pattern during his second year of teaching continued to shift toward a pattern more reflective of RBSI—asking an even greater percentage of thought-provoking and extended-response questions (codes
3c & 4), employing more responses that used students’ ideas (codes 11 & 12), and decreasing even further his use of behaviors that limit student engagement and assessment of students’ thinking (codes 1 & 2, and 5 & 7–10).

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 4, Chris scored medium-high to high across all categories, and his mean capsule rating of 8 is reflective of “Exemplary Instruction” (Appendix B). Such practice can be described as “instruction that is purposeful, where all students are highly engaged most or all of the time in meaningful work . . . highly likely to enhance most students’ understanding of the discipline and to develop their capacity to successfully ‘do’ science” (Horizon, 2005, p. 11).

Summary.

Socialization experiences. Chris’s relationships with his superordinates changed dramatically throughout the three years of this study. He found the TEP to be a transformative experience. However, at Chris’s first school he understood that RBSI was not valued and in order to survive he had to navigate his relationships with his superordinates; he did so in very sophisticated ways (see notes 30, 31, and 32). At a new school during his second year of teaching, Chris was guarded. Even though his superordinates supported practices congruent with RBSI and gave him leadership responsibilities, he was deeply scarred by his prior experience. Even at the end of that highly supported second year, Chris avoided speaking out.

I still very rarely will put out an idea in a meeting with more than four or five teachers. I’ll put out ideas, but it’s me and one other person. I won’t put them out for other people. For some reason I just don’t do that yet. I think a lot of people just have their own ideas. I would much rather do it one-on-one (Chris, 3:967).

Chris maintained relationships with cohort members Liam and Andrea, but his interactions decreased in frequency.
Pedagogical considerations. While in the TEP Chris demonstrated that he deeply understood RBSI. Moreover, he continued to reflect on his teaching in ways congruent with RBSI during his first year of teaching. However, he was often vague and perfunctory in his answers. He seemed to be attempting to maintain his understanding, but given the fierce institutional constraints he was facing, he was struggling to openly implement practices congruent with RBSI and meaningfully deepen his understanding of effective science teaching. During Chris’s second year of teaching, when he was supported in implementing practices congruent with RBSI, he reflected more deeply and synergistically about RBSI.

Teaching practice. Chris’s interaction pattern dramatically moved toward a pattern congruent with RBSI during the three years of this study. Even when encountering intense scrutiny during his first year of teaching, Chris reduced his use of ineffective teacher-centered responses. During Chris’s second year of teaching, he was able to make more decisions in a manner that is congruent with RBSI, as evidenced by his improved LSC-COP scores (see Figure 4). Correspondingly, his interaction pattern improved dramatically, and he spent more time asking students thought-provoking questions (see codes 3c & 4 in Figure 3) and responding in a manner that mentally engages students (see codes 11 & 12 in Figure 3).
Figure 3. Percent occurrence of Chris’s question and response types during his teacher education program (TEP), first year of teaching, and second year of teaching.

Figure 4. The mean rating of each LSC-COP category for observations conducted during Chris’s first and second years of teaching.

*Maximum Capsule rating is 8; Maximum rating for other categories is 5.
Case 3—Ethan

Preservice.

Context. Ethan considered himself a nontraditional student in the TEP; because he was older than many of the members of his cohort and because he was in the military and workforce prior to beginning work on his master’s degree.

Socialization experiences. Ethan struggled to develop collaborative relationships with members of his cohort. He did not go to college right after high school, and he felt uncomfortable letting his guard down with his classmates, likely because he was self-conscious about how his classmates would perceive him. During the second semester of the TEP he struggled with TEP’s expectations for reading and writing, and he was compelled to seek out assistance from his classmates to successfully complete the program. Ethan ended up working closely with Hannah and Andrea when he first reached out to members of his cohort. He also developed strong “professional relationships” (Ethan, 1:86) with Jack and Martin because they completed their practicum and student teaching together at a school that required a 50-minute one way commute.

Ethan had the “high respect” (Ethan, 1:131) for the TEP science education faculty, and he described his cooperating teacher as being a “hard-core” (Ethan, 1:114) graduate of the science education program who modeled and promoted effective RBSI as promoted by the TEP. Ethan portrayed his relationship with his cooperating teacher as tough, but acknowledged that his cooperating teacher had high expectations for him and a great impact on his understanding of effective science instruction.
In looking forward to his first year of teaching, Ethan was most concerned about a lack of parent involvement.\(^{50}\) Leaving the TEP he felt prepared for his first year of teaching and was looking forward to the experience.

[I feel] really prepared. I’m going to be my own worst enemy because . . . the time I take and I put in is almost detrimental because I’m trying to make sure I do all the things I’m supposed to do, and it’s almost too time-consuming to do your first year out. And that’s what I’m worried about the most. But I know I’ve got all the tools in the tool bag, I’ve got some experience using those tools and the tool bag. So now, just have to go out and establish the routines for myself and my class. I feel awesome. (Ethan, 1:644)

The tight alignment in the promotion of practices congruent with RBSI between the TEP science education faculty, his cooperating teacher, and the cooperating teachers of members of his cohort who student taught at Ethan’s school likely influenced his perceptions of what the teaching culture of his first school would be like. Ethan was not concerned with how to navigate sometimes well-intentioned, yet misguided support from colleagues who neither value nor implement RBSI.

**Pedagogical considerations.** Ethan experienced cognitive and emotional struggle in going through the conceptual change processes of understanding RBSI as promoted by the TEP. He described himself as “standoffish” (Ethan, 1:239) until he realized that the TEP faculty and graduate students had created a safe environment for participation. He grappled with making sense of the assigned readings (see note 50), he experienced difficulty with receiving feedback from his cooperating teacher (see note 51) and when describing his experiences with the program he acknowledged, “It was tough. I almost quit a million times” (Ethan, 1:674). Ethan wrestled with understanding RBSI, but at the end of the program he articulated a strong rationale for developing a compelling set of student goals,\(^{51}\) an understanding of the relationships that exist between teacher behaviors and student actions,\(^{52}\) and a superficial understanding of the
relationships that exist between building conceptual understanding, learning theories, and models of instruction.53

Teaching practice. During Ethan’s third semester in the TEP he audiorecorded and analyzed two lessons to qualitatively and quantitatively assess his teaching and complete the SATIC Self-evaluation of Teaching Behaviors assignment. He conducted one analysis in February and the other in March; the percent of each SATIC code occurrence is depicted in Figure 5. Early in that third semester, Ethan primarily exhibited a SATIC pattern that, while incongruent with RBSI, included the use of behaviors congruent with RBSI. Ethan’s pattern heavily employed dichotomous or short-answer questions that limit student thinking (codes 3a & 3b) and responses that limit student engagement and assessment of students’ thinking (codes 5 & 7–10). Ethan demonstrated the potential to transition toward a pattern more congruent with RBSI by asking open-ended questions (codes 3c & 4) and responding in a student-centered manner (codes 11 & 12) to promote student mental engagement, though this was not his primary pattern.

Ethan defended a B+ in Science Methods II (see Table 3 for grade criteria) at the end of his third semester in the program. He was categorized as a very good student in the TEP in his letter of recommendation (see Table 4 for categorization criteria). These assessments of Ethan’s understanding suggest he had a very good understanding of learning and teaching. In a supportive environment and with much time and effort, he had the potential to implement practices associated with highly effective teaching. However, he was seen as unlikely be unable to implement highly effective teaching in an unsupportive environment or one that has institutional constraints.
The first year.

Context. During Ethan’s first year of teaching he worked in the same urban public middle school as Andrea and Chris—a school that served 581 students enrolled in grades 6–8, 84% whom qualified for free or reduced lunch. Ethan taught Sixth Grade Science in a block schedule. Two other teachers in the middle school taught Sixth Grade Science: Andrea and another graduate of the TEP with more than 5 years teaching experience. Ethan was a member of the team Andrea reported was the only team that “made growth” in the school’s assessment. Nonetheless, the conclusion of Ethan’s first year of teaching was devastating. His contract was not renewed and he was ineligible to transfer to another position within the district.

Socialization experiences. Ethan became skeptical of his relationships with his superordinates early in the school year when Andrea was criticized for asking questions (see note 11), when another other Sixth Grade Science teacher was told his posture during professional development meetings was inappropriate, and when Ethan’s mentor began holding separate meetings with him and Andrea instead of group mentoring meetings. Additionally, when Ethan confided in his mentor, “she made me feel like, ‘What’s the problem with this? Just do what you’re supposed to do. . . . Why are you thinking about that?’” So, then it goes back to me confiding in her, because I can’t confide in the administration. In the end, the administration finds out about it anyways” (Ethan, 2:478). Like Andrea, Ethan believed his mentor violated their mentor-mentee relationship and shared information with the principal.

Ethan tried to balance implementing school-wide mandates to please his superordinates with implementing practices congruent with RBSI. However, he eventually felt he was expected to fully teach in a manner incongruent with RBSI. Ethan became increasingly discouraged and frustrated.
I could handle not having a stellar lesson plan . . . because those are the struggles that I expected, but I did not expect to have absolutely zero support from the administrators. I’m usually excited and stuff when I teach. They don’t care about all that stuff. They just want see you implementing their order, their dictator-type sh*t. (Ethan, 2:523)

In March, Ethan was asked to a Guided Group Interaction meeting with the sixth grade team, Ethan’s mentor, the vice principal, and a school improvement leader because the “vice principal sensed that there was some tension between the sixth-grade teachers and it was an opportunity to, supposedly, air out things. . . . [We] should’ve known better, but we fell for it” (Ethan, 2:486).

When asked what happened as a result of this meeting Ethan responded, “I didn’t get recommended for my renewal of my contract. Which I had a feeling, if I wouldn’t have said anything during that [meeting], it wouldn’t have been an issue, and I would have maybe transferred somewhere else. No problem” (Ethan, 2:533).

Ethan was deeply and negatively affected by his experiences with his superordinates during his first year of teaching.

I should plot a path of my emotions, like how [my first year of teaching] affected me and twisted me. It’s almost like Anakin Skywalker turning into Darth Vader. It’s weird, because I see a lot of similarities to that story line. . . . He’s got a lot of talent and these guys see it in him, and then he goes out and he keeps getting burned and no one’s listening to him and the no one’s taking him serious, and he speaks out. He gets put in his place . . . [and then turns to the] dark side. . . . That’s my analogy for me, because . . . I see similarities in how his demise came about. He had a lot of potential and, then, he turned into Darth Vader. . . . I’m on the verge of turning to the dark side, which means quitting teaching and walking away. . . . There’s still hope right now, but it’s running out. All because of the first year. (Ethan, 2:1286)

Ethan reached out for support to enact practices congruent with RBSI from the two other teachers in the building who were members of his cohort (Andrea and Chris) and another teacher who is a graduate of the TEP. Additionally, Ethan sought support from a math teacher who had seven years teaching experience at his school and was a member of the sixth grade team (she transferred out of the school at the end of the year). Ethan was frank about how difficult he found seeking support to be, and he acknowledged that he likely would not have reached out to Andrea and Chris if they had not been working together in the same building.
Pedagogical considerations. When discussing his strengths and how he knew learning was occurring during his first year teaching, Ethan shared specific examples that illustrated he understood the interconnectedness of learning theory, teacher behaviors, strategies, and student goals and was passionate about enacting practices congruent with RBSI.60,61,62

Teaching practice. During the spring semester of Ethan’s first year of teaching, he was observed teaching two lessons (one each in February and March). A portion of each lesson was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 5. Ethan primarily exhibited a SATIC pattern that heavily employed teacher talking (codes 1 & 2), asking dichotomous or short-answer questions that limit student thinking (codes 3a & 3b) and responses that limit student engagement and assessment of students’ thinking (codes 5 & 7–10). Ethan’s interaction pattern during his first year of teaching shifted toward a pattern more reflective of RBSI—responding more frequently in a student-centered manner (codes 11 & 12) to promote student mental engagement and decreasing his use of responding behaviors that limit student engagement and assessment of students’ thinking, though this was not his primary responding pattern.

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 6, Ethan scored medium-low across all categories, and his mean capsule rating of 3 is reflective of practice that had of “Elements of Effective Instruction” (Appendix B). Such practice can be described as “instruction that has some elements of effective practice. . . . Overall, the lesson is very limited in its likelihood to enhance students’ understanding of the discipline or to develop their capacity to successfully ‘do’ science” (Horizon Research, 2005, p.11). Ethan struggled with classroom management, which greatly
impacted his implementation and his ability to address difficulties students were having understanding concepts.

**The second year.**

*Context.* Ethan worked as a teaching specialist at a nonprofit organization focused on dropout prevention and work-based learning experiences that lead to quality employment after high school. The nonprofit employing Ethan was associated with an urban public high school that served 2,268 students enrolled in grades 9–12, 72% of whom qualified for free or reduced lunch. Ethan taught in the nonprofit’s school-to-career program, and he taught students with the goals of preparing students for success both in school and in the workplace. Ethan was the only teaching specialist from the nonprofit that worked for this high school and he taught in the school’s annex with a subset of teachers from the high school.

*Support.* Ethan had a difficult time finding a position for his second year of teaching. He obtained strong letters of recommendation from TEP faculty, his student teaching advisor, and me. Nonetheless, with his previous administration also providing a reference, he was unable to obtain an interview. Throughout his year at the nonprofit, Ethan continued to apply for science teaching positions and again he was unsuccessful. Finally, when TEP faculty proactively contacted a school following Ethan’s application, Ethan obtained an interview, and he was subsequently offered a science teaching position for his third year.

Ethan was reluctant to participate in research while working at the nonprofit because he did not want to draw any unnecessary attention to himself. However, he expressed feeling conflicted because he was interested in having me visit his classroom to document his teaching practices. I determined that tying informal mentoring and support to research consent could be perceived as coercive, so I decided to visit his classroom and SATIC-code his interaction pattern
without including any of the data in my research. However, on his own volition—once he felt more secure in his position at the nonprofit—Ethan consented to both an interview and to the recording of the data my observations generated.

Similar to his first year of teaching, Ethan was reluctant to reach out to members of his cohort for support. Because he was not an employee of a public school, he did not have a mentor through the state’s mentoring program. Ethan was intentional about maintaining a low profile and not drawing attention to himself, and the first time he received a classroom visit from an administrator was in May. Ethan expressed four strategies that he used to navigate his relationships with colleagues during his second year of teaching: (1) seek out advice, (2) work with colleagues with different backgrounds, (3) refrain from promoting RBSI, and (4) refrain from questioning practices promoted by others.

Pedagogical considerations. While Ethan was not teaching science during his second year, his reflections on his decision-making were still influenced by his understanding of the learner and RBSI. While Ethan’s considerations of his practice moved beyond a perfunctory reiteration of themes promoted in the TEP, his reflections lacked a depth in accounting for the synergistic relationship between all of the components of his framework. He focuses heavily on the relationship between his interaction pattern, student engagement, and initiating learning with concrete representations.

Teaching practice. During Ethan’s second year of teaching, he was observed teaching two lessons on two separate occasions. One lesson was SATIC-coded in October, and the percent of each SATIC code occurrence is depicted in Figure 5. Ethan’s interaction pattern during his second year of teaching dramatically shifted toward a pattern reflective of RBSI—primarily asking thought-provoking and extended-response questions (codes 3c & 4), employing responses
that used students’ ideas (codes 11 & 12), and drastically decreasing his use of behaviors that limit student engagement and assessment of students’ thinking (codes 1 & 2, and 5 & 7–10). Since Ethan was not teaching science, his lessons were not scored using the LSC-COP. Nonetheless, Ethan became highly effective at classroom management, and he was therefore better able to effectively implement his lessons and address difficulties students were having.

**Summary.**

*Socialization experiences.* Ethan’s relationships with his superordinates varied throughout the three years of this study. He found the TEP to be a hard-earned transformative experience. Although he struggled in coming to trust his cohort members, he felt the TEP faculty and graduate students created a safe learning environment. However, at Ethan’s first school he continued to operate under the assumption that wrestling with ideas and questioning rationales were safe and desirable activities. As a result, he felt unsupported and betrayed in his relationships with his superordinates. In Ethan’s second year of teaching, he appeared as though he had carefully calculated how to become an invisible and forgettable participant in relationships intended for support. Despite having ultimately obtained a new position in his third year at the school where he student taught—a school Ethan knows is supportive of practices congruent with RBSI (see note 51)—he was deeply troubled by his experiences over the previous two years.

Teaching is different than what I thought it was going to be. Not everyone is on the same page. I didn’t realize administration has so much control over what you teach, how you teach. It’s weird. That’s what’s affected me borderline for career decisions. I thought this was going to be totally it for my career. . . . Maybe I wasn’t cut out to do this. . . . [the last two years have] taken some confidence and smushed it because I trusted people and they burned the sh*t out of me. So, I’m very confused. (Ethan, 3:696)

Where once Ethan painted a picture of optimism and excitement for new beginnings, now he is somber, filled with doubt, and anxious.  

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Pedagogical considerations. While in the TEP Ethan demonstrated that he understood RBSI. Moreover, he continued to reflect on his teaching in ways congruent with RBSI during his first year of teaching. However, he was often perfunctory in his answers. He seemed to be attempting to maintain his understanding, but given the fierce institutional constraints he was facing, he was struggling to implement practices congruent with RBSI and therefore meaningfully deepen his understanding of effective science teaching. During Ethan’s second year of teaching, Ethan was not teaching science, and when he reflected on his teaching practices he was able to reflect more deeply within certain constructs, but less synergistically about RBSI.

Teaching practice. Ethan’s interaction pattern dramatically moved to a desired interaction pattern during the three years of this study. Even when encountering intense scrutiny during his first year of teaching, and no support for implementing practices congruent with RBSI during his second year, Ethan reduced his use of ineffective teacher-centered responses (see codes 5 & 7–10 in Figure 5), spent more time asking students thought-provoking questions (see codes 3c & 4 in Figure 5), and responding in a manner that mentally engages students (see codes 11 & 12 in Figure 5).
Figure 5. Percent occurrence of Ethan’s question and response types during his teacher education program (TEP), first year of teaching, and second year of teaching.

*Maximum Capsule rating is 8; Maximum rating for other categories is 5.

Figure 6. The mean rating of each LSC-COP category for observations conducted during Ethan’s first and second years of teaching.
Case 4—Emma

Preservice.

Context. Prior to enrolling in the TEP, Emma was an undergraduate student. She was proud of graduating in four years with a double major in entomology and animal ecology and a minor in microbiology. She entered the TEP knowing she was a successful student.

Socialization experiences. At times during her participation in the TEP, Emma doubted her science education professors. In wrestling with her doubt, Emma credits first having a practicum teacher who implemented practices congruent with RBSI as promoted by the TEP and second having a cooperating teacher while student teaching who implemented practices incongruent with those promoted by her TEP. Additionally, Emma recognized the extensive support she received from faculty to help her navigate her difficult student teaching experience.

Emma was slow to feel connected to the members of her cohort, but by the end of the program, she considered them family. Despite the challenges Emma encountered in her relationships during her time at the TEP, she also experienced a sense of growth and belonging. In looking forward to her first year of teaching Emma was not concerned with how to navigate sometimes well-intentioned yet misguided support from colleagues who neither value nor implement RBSI. She felt the TEP had prepared her for how to interact with people who did not understand the research base she was drawing from.

Pedagogical considerations. As Emma exited the TEP, she reflected upon teaching in ways that were sometimes superficial and vague. In discussing the Draw a Science Teacher task she completed at the start and the conclusion of the TEP, she recognized how when she began the TEP she valued outdoor education—much as she still did at the end—but she was much more aware of the careful planning and management tasks involved with teaching.
reflections were very narrowly focused, and she did not discuss how outdoor education is supported by the implications of how people learn or the ways in which outdoor education promotes her student goals.

*Teaching practice.* During Emma’s third semester in the TEP, she audiorecorded and analyzed two lessons to qualitatively and quantitatively assess her teaching and complete the SATIC Self-evaluation of Teaching Behaviors assignment. Emma conducted one analysis in January and the other in March; the percent of each SATIC code occurrence is depicted in Figure 7. Early in that third semester, Emma primarily exhibited a SATIC pattern that was incongruent with RBSI. She heavily employed teacher talking (codes 1 & 2), and while she asked open-ended questions (codes 3c & 4), her responses limited student engagement and assessment of students’ thinking (codes 5 & 7–10).

Emma defended a B+ in Science Methods II (see Table 3 for a grade criteria) at the end of her third semester in the program. She was categorized as an excellent student in the TEP in her letter of recommendation (see Table 4 for categorization criteria). These assessments of Emma’s understanding suggest she understood learning and teaching and had the potential to be a science teacher who effectively implements RBSI.

*The first year.*

*Context.* Emma worked in a public high school in a rural community. Her high school served 274 students enrolled in grades 9–12, 31% of whom qualified for free or reduced lunch. Emma taught three courses: ninth grade Integrated Science, Environmental Science, and Chemistry. She was the only teacher who taught these classes.

*Socialization experiences.* Emma felt very supported by her colleagues and administration during her first year of teaching, exclaiming, “I love the administration and the
people that I work with at my school” (Emma, 2a:28). She was comfortable analyzing lessons with her colleagues as a part of her school’s professional development efforts to engage students in critical thinking. She also participated in a workshop prior to her first year of teaching on using the Science Writing Heuristic (Keys, Hand, Prain, & Collins, 1999) to help students move away from memorizing details and focus understand on big ideas in science. Emma viewed this workshop as supporting what the TEP promoted as effective questioning and scaffolding of student thinking. Emma believed her mentor teacher (the only other science teacher at the school) to be a great resource for developing an understanding of her students’ personalities and what concepts they had been exposed to previously. Emma stayed in contact with members of her cohort by sending and reading group e-mails, emailing Liam individually to ask Earth Science questions, and planning lessons with Mason because he lived nearby.

Pedagogical considerations. When discussing her first year of teaching, Emma’s reflections largely focused on adequately covering content. When making teaching decisions she did not consider her students’ goals, and she drew upon how people learn in a manner that was superficially congruent with RBSI.

Teaching practice. During the spring semester of Emma’s first year of teaching, she was observed teaching four lessons on three separate occasions. A portion of each lesson was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 7. Emma primarily exhibited a SATIC pattern that heavily employed asking open-ended questions (codes 3c & 4) and responding in a manner that used students’ ideas (codes 11 & 12) and promoted mental engagement. To a lesser extent she used responses that limit student engagement and assessment of students’ thinking (codes 5 & 7–10). Emma’s interaction pattern during her first year of teaching shifted toward a pattern more reflective of RBSI—asking a greater percentage
of thought-provoking and extended-response questions, spending more time working with students’ ideas, and decreasing her use of behaviors that limit student engagement and assessment of students’ thinking.

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 8, Emma scored medium-low to medium across all categories, and her mean capsule rating of 4 is reflective of practice that was in the low end of “Beginning Stages of Effective Instruction” (Appendix B). Such practice can be described as “instruction that was purposeful and characterized by quite a few elements of effective practice. . . . Overall, the lesson is somewhat limited in its likelihood to enhance students’ understanding of the discipline or develop their capacity to successfully ‘do’ science” (Horizon, 2005, p.11).

**The second year.**

*Context.* Emma remained at the same school during her second year of teaching, taught the same classes, and worked with the same administration and mentor. Emma’s classes were much larger during her second year of teaching. She had over 30 students in Environmental Science (her largest class during her first year had 18 students). Instead of limiting enrollment, Emma’s administration decided she would co-teach the class with her mentor in the cafeteria. Eventually the class size was reduced to 26 students, and she moved the class back into her classroom. Emma disclosed in an informal conversation that she believed her enrollment increased because Environmental Science developed a reputation as an easy class.

*Socialization experiences.* Emma’s relationship with her principal changed dramatically during her second year of teaching. “I feel like I lost a lot of support from the administration. [My principal] told me that I need to dumb down my curriculum, essentially, and that I need to use the textbook more” (Emma, 3:9). Moreover, Emma was informed at her end-of-year
evaluation in mid-May that her principal would not be recommending her for her full teaching license and that she would be on probationary status for one more year. Emma knew she had been having difficulties with a colleague throughout the year, but she was “incredibly shocked” (Emma, 3:69), distressed, and baffled by her probationary status.

I cannot control how the administration reacts to what I am doing . . . especially since what I know as best practices cost them no money at all. . . . That’s what upsets me. And because of everything that they preach, like all of the PDs that we have, they say, “You need to have high expectations, you need to not be using textbooks, you need to [be] questioning [students with] open-ended questions, and have projects instead of tests.” Which is what I feel like I’m doing, and then I get my end-of-year review, and it’s the complete opposite of what they’re asking me to do. (Emma, 3:135)

Emma tried to respectfully provide evidence that countered the principal’s claims and demonstrated that she was taking her principal seriously, but felt as though her efforts were not “well-received.”

Emma continued to feel supported and assisted by her mentor, considering her mentor a friend. Moreover, in addition to providing feedback to Emma, she felt that her mentor sought out and valued her feedback too. However, Emma’s mentor was encouraging Emma to make decisions that were not aligned with RBSI, and this did not seem to bother Emma.

Emma’s contact with members of her cohort decreased during her second year of teaching. She was in communication with one cohort member with whom she presented at an annual state practitioner conference. They were working on writing up their presentation as an article for a practitioner journal. When asked the extent to which she collaborated with other like-minded teachers who were not from her TEP, she responded by referring to her mentor (Emma, 3:359).

**Pedagogical considerations.** When discussing her second year of teaching, Emma’s reflections were very consistent with her reflections following the TEP and her first year of teaching. She did not consider her students’ goals, and when making teaching decisions she drew
upon how people learn in a manner that was superficially congruent with RBSI and mainly considered the learning cycle model of instruction.\textsuperscript{89} When discussing how she plans to address her classroom management issues, she does not draw from her students’ goals or implications that follow from learning theory.\textsuperscript{90}

\textit{Teaching practice.} During Emma’s second year of teaching, she was observed teaching 15 lessons on six separate occasions. A portion of each lesson was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 7. Emma primarily exhibited a SATIC pattern that heavily employed asking dichotomous and short-answer questions (codes 3a & 3d) along with open-ended questions (codes 3c & 4), then responding in a manner that acknowledged students’ responses (code 6), used students’ ideas (codes 11 & 12), and promoted mental engagement. To a lesser extent she used responses that limited student engagement and assessment of students’ thinking (codes 5 & 7–10). Emma’s interaction pattern during her second year teaching was less reflective of RBSI than her pattern during her first year.

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 8, Emma scored lower across all categories than she did during her first year, and her mean capsule rating of 3 is reflective of practice that had of “Elements of Effective Instruction” (Appendix B). Such practice can be described as “instruction that contains some elements of effective practice. . . Overall, the lesson is very limited in its likelihood to enhance students’ understanding of the discipline or to develop their capacity to successfully ‘do’ science” (Horizon Research, 2005, p.11). Emma struggled with classroom management, which greatly impacted her implementation and ability to address difficulties students were having.
Summary.

Socialization experiences. Emma’s relationships with her superordinates varied throughout the three years of this study. She was slow to engage in relationships with her cohort and the science education faculty during her time in the TEP; however, she finished the TEP reluctant to leave and feeling as though she considered the cohort and faculty family. She felt highly supported during her first year of teaching by her administration, mentor, and colleagues. Even though Emma’s mentor did not encourage the implementation of practices congruent with RBSI, she viewed her mentor as a like-minded, highly supportive colleague. Nonetheless, she felt discouraged by the end of the second year of teaching when she encountered a difficult collegial relationship and was placed on probationary status for her state teaching license by her principal.

[My principal] wants me to dumb down my expectations, which I really don’t think I will. So I don’t know. To be honest, it makes me want to leave teaching. . . . It’s been a really rough year with all of the classroom management and stuff. . . . Everything I have set my mind to do, I have done, and to have this knowledge that I wasn’t good enough to get my full license as determined by somebody who is in my room three times a year—for one class period—and doesn’t really have science knowledge, really upsets me. (Emma, 3:124)

Emma experienced student teaching with a teacher she viewed as highly ineffective, but he was secure in his job. And while at the end of two years of teaching she was admittedly struggling with classroom management, she was also not being encouraged by her superordinates to improve her classroom management by implementing a research-based framework for teacher decision-making (such as ensuring her content was developmentally appropriate, that her lessons were addressing students misconceptions, that her teacher behaviors were supporting student communication, etc.). Instead, Emma was being threatened by her principal—who was leveraging Emma’s permanent teaching license against her—to move further away from the RBSI as promoted by the TEP than she already had.
Pedagogical considerations. Emma was consistent in her limited considerations of RBSI that solely emphasized the learning cycle as a model of instruction without reference to her students’ goals or implications that follow from an understanding of how people learn.

Teaching practice. During her first year of teaching, Emma’s interaction pattern moved toward a desired interaction pattern, as promoted by the TEP. Although she moved away from this interaction pattern during her second year of teaching, she did not regress to the pattern she initially exhibited during the TEP. Her pattern during her second year of teaching demonstrated an overall increased ability than she possessed during the TEP to question and respond to students in a mentally engaging manner (see Figure 7). Correspondingly, as Emma’s interaction pattern shifted away from a desirable pattern, her ability to conduct instruction in a manner congruent with RBSI also decreased, as evidenced by her lower LSC-COP scores (see Figure 8).

![Bar chart showing the percent occurrence of Emma’s question and response types during her teacher education program (TEP), first year of teaching, and second year of teaching](chart.png)
*Maximum Capsule rating is 8; Maximum rating for other categories is 5.

Figure 8. The mean rating of each LSC-COP category for observations conducted during Emma’s first and second years of teaching.

Case 5—Hannah

Preservice.

Context. Prior to enrolling in the TEP, Hannah was a successful undergraduate student who earned a B.S. in Earth Science and a B.S. in Journalism and Mass Communication. Additionally, Hannah’s mother was a science teacher. Hannah entered the TEP with deeply held conceptions of what it means to teach and learn science.

Socialization experiences. Hannah began her TEP skeptical of RBSI as promoted by the TEP, lacking trust in the science education faculty, her cohort members, and her cooperating teacher.\(^92\) Hannah was annoyed by her cooperating teachers’ promotion and implementation of RBSI,\(^93\) and she was trying to “fake” (Hanna, 1:85) her way through the fall semester in order to exit the program with her previous conceptions intact. Early in the spring semester, however, while student teaching, Hannah came to understand that she:
had a lot of walls up until that point, and I realize[d] that I had a lot to learn and that these people cared enough about me that they wanted to help me learn as much as possible. . . . I realized, “I can’t fake my way through these 16 weeks.” To some extent I had faked my way through the fall. (Hannah, 1:29)

By the end of the program, Hannah deeply valued her relationships with her cohort members, the science education faculty, and her cooperating teacher. While Hannah credited all of these relationships with helping her understand RBSI as promoted by the TEP, she also emphasized the significance of the support she received from her cooperating teacher.

Pedagogical considerations. As Hannah exited the TEP, she reflected upon teaching in ways that accounted for aspects of RBSI as promoted by the TEP—taking into account the learner, teacher behaviors, strategies, and content. However, her reflections demonstrated that while she could conceptualize components of her framework for teacher decision-making, she was struggling to conceptualize the synergistic relationships that exist between these components when reflecting on teaching.

Teaching practice. During Hannah’s third semester in the TEP she audiorecorded and analyzed two lessons to qualitatively and quantitatively assess her teaching and complete the SATIC Self-evaluation of Teaching Behaviors assignment. Hannah conducted one analysis in January and the other in March; the percent of each SATIC code occurrence is depicted in Figure 9. Early in that third semester, Hannah primarily exhibited a SATIC pattern that was somewhat congruent with RBSI. While she heavily employed teacher talking (codes 1 & 2), she more frequently asked open-ended questions (codes 3c & 4) than dichotomous or short-answer questions that limit student thinking (codes 3a & 3b). To respond, she simply acknowledged students’ answers; however, she sometimes responded in a student-centered manner (codes 11 & 12) to promote student mental engagement.
Hannah defended a B+ in Science Methods II (see Table 3 for a grade criteria) at the end of her third semester in the program. She was categorized as an excellent student in the TEP in her letter of recommendation (see Table 4 for categorization criteria). These assessments of Emma’s understanding suggest she understood learning and teaching and had the potential to be a science teacher who effectively implements RBSI.

**The first year.**

*Context.* Hannah worked in a public high school in an urban community. Her high school served 1,535 students enrolled in grades 9–12, 38% who qualified for free or reduced lunch. Hannah taught three courses in a trimester system: Oceanography and Meteorology, Astronomy, and Geology. Each trimester she co-taught two sections with a special education teacher. With the exception of one class during her first trimester of teaching, Hannah and her co-teacher were the only teachers of these classes.

*Socialization experiences.* Much as she was during her TEP, Hannah was guarded in her relationships with superordinates throughout her first year of teaching. When colleagues pointed out to Hannah that she was teaching her courses in a manner that differed from the previous teacher, she navigated those interactions by verbally and emotionally deflecting their comments instead of defending her practice and providing her colleagues with rationales. 99 Hannah’s mentor was the special education teacher she co-taught with—he was also working on his administrative license—and Hannah was purposeful in the types of assistance she sought from him as a co-teacher and a mentor; for example, seeking out his assistance when she was having attendance issues with particular students.100

Late into her first year of teaching Hannah realized that she was isolated and lonely at her school. She acknowledged she was reserved partly because she was planning to marry her fiancé
and move to a new city at the end of the school year.\textsuperscript{101} Although Hannah was lonely, she seemed to be bracing herself to leave by not establishing relationships with colleagues and protecting against the possibility of an emotionally difficult transition to a new school. Instead of developing new relationships during her first year of teaching, Hannah relied upon her established relationships with select members of her cohort and her cooperating teacher.\textsuperscript{102,103,104}

\textit{Pedagogical considerations.} When discussing her first year of teaching, Hannah reflected upon her teaching behaviors,\textsuperscript{105} assessments,\textsuperscript{106} strategies,\textsuperscript{107} and selection of content\textsuperscript{108} in a manner that was congruent with RBSI. She included specific examples from her classroom that illustrated the depth and interconnectedness of her thinking well beyond her reflections at the end of the TEP.

\textit{Teaching practice.} During the spring semester of Hannah’s first year of teaching she was observed teaching seven lessons on four separate occasions. A portion of each lesson was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 9. Hannah primarily exhibited a SATIC pattern that heavily employed asking open-ended questions (codes 3c & 4) and responding in a manner that acknowledged students’ answers (code 6) and used students’ ideas (codes 11 & 12) to promote mental engagement, which was a shift from her pattern during the TEP. Hannah’s interaction pattern during her first year of teaching shifted toward a pattern more reflective of RBSI—asking a greater percentage of thought-provoking and extended-response questions and sharply decreasing her use of teacher lectures that limit students’ mental engagement.

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 10, Hannah scored medium to medium-high across all categories, and her mean capsule rating of 6 is reflective of practice that was in the high end of “Beginning
Stages of Effective Instruction” (Appendix B). Such practice can be described as “instruction that was purposeful and characterized by quite a few elements of effective practice. . . . Overall, the lesson was somewhat limited in its likelihood to enhance students’ understanding of the discipline or to develop their capacity to successfully ‘do’ science” (Horizon Research, 2005, p.11).

**The second year.**

*Context.* During Hannah’s second year of teaching she worked in a public middle school in a rural community. Her middle school served 343 students enrolled in grades 6–8, 25% of whom qualified for free or reduced lunch. Hannah was the only teacher of Eighth Grade Life Science, which she taught in an eight period day.

*Socialization experiences.* At her new school Hannah felt remarkably supported by her principal and superintendent; that they found value in mutual student goals motivated Hannah to work very hard for her administration.109 Hannah was reserved when she began her second year of teaching, but because she planned on staying at this school for a while she purposefully sought out like-minded colleagues to collaborate with.

There are things that are just struggles and tear down any incentive to do highly effective teaching, but I think I have found niches where there are people who think the same way, there are people who want the same things for students, they have the same goals for students, they want the same outcomes, and they want to work as hard as you want to work; and that has been my survival mode, get in with those people, talk with those people, spend time with those people. [I found them by] listening, just listening a lot, and watching how they were listening as well. (Hannah, 3:170)

Despite high levels of administrative support and identification of like-mind colleagues, Hannah received little assistance for RBSI from her mentor, similar to her first year of teaching.110

Moreover, Hannah encountered intense resistance to practices congruent with RBSI from all but one member of her eighth-grade teaching team, even though she had administrative support. She grappled with how to maintain positive working relationships with these
unsupportive colleagues. These relationships were especially difficult to navigate because Hannah was openly collaborating on large public projects with the writing teacher on her team, but not with her other team members. Hannah and the writing teacher initially extended an invitation to all of the members of their team to collaborate on their first team-teaching project. While the other members of their team declined, they were nevertheless resentful of Hannah and the writing teacher’s success. Their resentment created a difficult working environment during their daily team planning time, and Hannah described navigating these relationships as the hardest part of her job (Hannah, 3:635).111

**Pedagogical considerations.** When discussing her second year of teaching, Hannah continued to reflect upon teaching in a manner that was congruent with RBSI. She continued to include specific examples from her classroom that illustrated the depth and interconnectedness of her thinking.112,113

**Teaching practice.** During Hannah’s second year of teaching, she was observed teaching 12 lessons on six separate occasions (in September, October, November, twice in February, and May). A portion of each lesson was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 9. Hannah’s interaction pattern during her second year of teaching continued to shift toward a pattern more reflective of RBSI—asking thought-provoking and extended-response questions (codes 3c & 4) and employing responses that used students’ ideas (codes 11 & 12). On the surface it appears as though her pattern shifted away from a desirable pattern as the amount of time she spent asking thought-provoking and extended response questions decreased; however this is the case because instead of responding to students’ answers by asking new, but related questions, she shifted her interaction pattern and responded by using students’ answers, thus increasing the frequency of codes 11 and 12.
The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As Figure 10 shows, Hannah scored high across all categories, and her mean capsule rating of 7 is reflective of practice that was in the high end of “Accomplished Effective Instruction” (Appendix B). Such practice can be described as “instruction that is purposeful and engaging for most students. Students actively participating in meaningful work. . . . Instruction was quite likely to enhance most students’ understanding of the discipline and develop their capacity to successfully ‘do’ science” (Horizon, 2005, p. 11).

Summary.

Socialization experiences. Hannah’s relationships with her superordinates changed dramatically throughout the three years of this study. During her TEP she admittedly “had a lot of walls up” (Hannah, 1:30) and was slow to “allow people to care about me” (Hannah, 1:156). In Hannah’s first year of teaching, she knew she was transient and seemed to wear a suit of armor when interacting with her new colleagues. Instead of forging new relationships, she relied heavily upon the hard-won relationships she had established during her TEP and the foundation she came to trust. However, in her second year of teaching, she purposefully established meaningful connections with like-minded individuals with the intent of launching long-term relationships, while still remaining connected with select members of her cohort and her cooperating teacher.

Pedagogical considerations. While in the TEP, Hannah demonstrated that she understood RBSI. Moreover, she continued to reflect on her teaching in a manner congruent with RBSI. She included specific examples from her classroom that illustrated the depth and interconnectedness of her thinking well beyond her reflections at the end of the TEP. During Hannah’s second year of teaching, she continued to reflect more synergistically about RBSI.
Teaching practice. Hannah’s interaction pattern dramatically moved toward a pattern congruent with RBSI as promoted by the TEP during the three years of this study. During Hannah’s second year of teaching, she was able to make even more decisions in a manner that is congruent with RBSI as evidenced by her improved LSC-COP scores (see Figure 10). Correspondingly, her interaction pattern improved and she spent more time responding to students in a manner that mentally engaged them (see codes 11 & 12 in Figure 9).

Figure 9. Percent occurrence of Hannah’s question and response types during her teacher education program (TEP), first year of teaching, and second year of teaching.
Figure 10. The mean rating of each LSC-COP category for observations conducted during Hannah’s first and second years of teaching.

Case 6—Jack

Preservice.

Context. Jack was fascinated by physics in high school and planned to earn a doctorate in physics when he entered college. While pursuing his physics degree he became “somewhat disenchanted” (Jack, 4:8) with his courses and laboratory work. However, he realized that he enjoyed physics most when working as a teaching assistant. Upon entering the TEP, Jack was looking for a rigorous MAT program and he found that the “core classes . . . were very much what I was looking for in a graduate program” (Jack, 1:887).

Socialization experiences. Jack found having the same practicum and student teaching placements to be “ideal” (Jack, 1:113). Jack’s cooperating teacher fostered and modeled RBSI as promoted by the TEP. Furthermore, he provided Jack with the freedom “to play around . . . see what works and see what didn’t” (Jack, 1:126). Jack developed strong relationships with the
cohort members he commuted with for his practicum and student teaching experiences (Ethan and Martin). He also felt that the amount of time he spent with his cohort members both in class discussions, and working together outside of class, created a group of people that he believed he would be comfortable relying upon for insight and support during his first year of teaching.\textsuperscript{115}

Jack’s positive experiences in the TEP—along with his supportive interactions with his cohort members and cooperating teacher—likely influenced his level of confidence when looking forward to his first year of teaching.

I feel very prepared [to] lead a class discussion on something. . . . I feel like I can put together a sequence of activities and assignments fairly easily. (Jack, 1:844)

Nonetheless, Jack was concerned with how he might navigate implementing practices congruent with RBSI in a school district unsupportive of those practices.\textsuperscript{116}

\textit{Pedagogical considerations.} As Jack exited the TEP, he reflected upon teaching in ways that are congruent with the TEP and RBSI. In his oral defense of his Research-based Framework for Teaching, he demonstrated a sophisticated understanding of teaching and learning. He perceived that his beliefs about his role as a teacher shifted dramatically during his time in the TEP. In discussing the Draw a Science Teacher task he had completed at the start of the program, he was not surprised by what he initially drew because he believed he had “a pretty clear idea of how far I’ve come since starting this program. I didn’t need to see my original work to know that” (Jack, 1:630).

\textit{Teaching practice.} During Jack’s third semester in the TEP he audiorecorded and analyzed two lessons to qualitatively and quantitatively assess his teaching and completed the SATIC Self-evaluation of Teaching Behaviors assignment. Jack conducted one analysis in February and the other in March; the percent of each SATIC code occurrence is depicted in Figure 11. Early in that third semester, Jack primarily exhibited a SATIC pattern that was largely
congruent with RBSI. While he heavily employed teacher talking (codes 1 & 2), he asked open-ended questions (codes 3c & 4) and responded in a student-centered manner (codes 11 & 12) to promote student mental engagement.

Jack defended an A in Science Methods II (see Table 3 for a grade criteria) at the end of his third semester in the TEP. He was categorized as an exceptional student in the program in his letter of recommendation (see Table 4 for categorization criteria). These assessments of Jack’s understanding suggested he deeply understood learning and teaching and would most likely be a highly effective science teacher who could either overcome institutional constraints at his school, if any were present, or he would leave the school.

The first year.

Context. During Jack’s first year of teaching he worked in a public high school in a rural community. His high school served 791 students enrolled in grades 9–12, 24% of whom qualified for free or reduced lunch. Jack taught two courses, freshman Integrated Science and Physics, in a block schedule. One other teacher taught Integrated Science, and another also taught Physics.

Socialization experiences. Jack relied upon his administration for support in working with students who were acting out in class, and he relied on his colleagues for assistance in accessing resources. Jack’s administration was not supportive of his implementation of practices congruent with RBSI:

There did not appear to be much support for the sorts of inquiry lab activities that I was trying to implement in classes. My administrators have a certain idea of what a science lab should look like, and it does not very well match what we know to be effective science teaching... On one occasion... my administrator... was displeased with how [a lab activity] looked, and then communicated to me, “This is not a good lab activity and you should not be doing this.”... [From that encounter I understood] that I should adhere to the traditional model of labs. (Jack, 2:152)
Despite this confrontation, Jack professed having “a fair amount of freedom” (Jack, 2:257) to teach the way he wanted to. However, as he elaborated, his freedom in fact appeared to be limited.\textsuperscript{119} During interviews, Jack seemed unwilling to fully acknowledge the extent to which the administrative policies and practices of his colleagues presented institutional constraints to implementing RBSI-congruent practices. However, very early on in the school year he reached out to his cohort members for support through their Google Group:

> The institutional constraints at my school are beginning to bear down on me. The most serious of these is the physics curriculum that I must follow. . . . The pacing of the course is frantic. . . . The situation is discouraging, because I know that I am not teaching in an effective manner. I am acutely aware of this because I have such a clear sense of what an effective physics classroom is like. . . . In comparison to what I was able to do [while student teaching], what I am doing now is of rather low quality. (Jack, 9/21/11)

In this communication, Jack clearly demonstrates that he understood he was experiencing institutional constraints and he knew was struggling to implement effective teaching practices.

\textit{Pedagogical considerations.} When discussing his first year of teaching, Jack’s reflections were steeped in his constraints:

> [The greatest influence on my decision making is] obviously that I need to cover topics that I am told I need to cover. . . . [I also try to decide] what sort of interesting, engaging activities can I weave in . . . [because] when I have to barrel through tons of content in sort of [a] lecture format, better get these in somehow, sooner or later, so they can actually learn something. (Jack, 2:356)

His reflections consistently failed to draw upon the sophisticated understanding of RBSI he demonstrated at the end of the TEP; they focused instead on how he navigated institutional constraints to the implementation of RBSI.\textsuperscript{120}

\textit{Teaching practice.} During the spring semester of Jack’s first year of teaching he was observed teaching five lessons on two separate occasions (in April and May). A portion of each lesson was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 11. Jack decreased the amount of time he spent asking open-ended questions (codes 3c & 4) and
responding in a student-centered manner to promote student mental engagement (codes 11 & 12). These behaviors were replaced by asking a greater number of dichotomous and short-answer questions (codes 3a & 3d) and responding to students in a manner that limits student engagement and assessment of students’ thinking (codes 5 & 7–10). Jack’s interaction pattern shifted away from the congruent-with-RBSI pattern he developed in the TEP.

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 12, Jack scored low to medium-low across all categories, and his mean capsule rating of 3 is reflective of practice that had “Elements of Effective Instruction” (Appendix B). Such practice can be described as “instruction that contains some elements of effective practice, but there are serious problems in design, implementation, content, and/or appropriateness. . . . Overall, the lesson is very limited in its likelihood to enhance students’ understanding of the discipline or to develop their capacity to successfully ‘do’ science (Horizon Research, 2005, p.11).

The second year.

Context. Jack remained at the same school, taught the same classes, worked with the same administration, and had a new colleague who also taught Integrated Science. He knew at the start of the year that personnel cuts in his district were inevitable, and the science department would lose one teaching position at the end of the year. Jack felt the administration was not transparent about how they were making decisions regarding who would be laid off. The impending dismissal created an intense level of anxiety and fear for the teachers in Jack’s department.

Socialization experiences. Jack continued to feel unsupported by his administration in implementing practices congruent with RBSI. While he did not assert that his colleagues were
undermining his efforts to implement elements of RBSI, his assistant principal reprimanded him for not adhering to the curriculum map and for rearranging a portion of a unit, Jack was uncertain how the matter came to his administrator’s attention. He continued to “not rock the boat” (Jack, 3:260) with colleagues, and he did not seek out their support when the assistant principal admonished him. Instead, he sought out his colleagues’ support to address behavioral issues with students. Similar to the first year, he drew support from his cohort through the Google Group by reading what others posted and sending an e-mail to the group when he decided to make public his decision to leave the district (and possibly secondary teaching). By leaving the district, Jack prevented one of his departmental colleagues from being laid off.

*Pedagogical considerations.* Jack continued to reflect on teaching in a manner that focused on how he navigated institutional constraints to implementing practices congruent with RBSI. His reflections consistently failed to draw upon the sophisticated understanding of teaching and learning he demonstrated at the end of the TEP and demonstrated his efforts to be “as compliant as humanly possible” (Jack, 3:216).

*Teaching practice.* During Jack’s second year of teaching he was observed teaching 13 lessons on seven separate occasions (in September, December, January, March, and May). A portion of each lesson was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 11. Jack’s interaction pattern demonstrated his further shift away from practices congruent with RBSI—spending even more time engaging in teacher talk (codes 1 & 2), asking a greater percentage of dichotomous and short-answer questions (codes 3a & 3d), and responding more often in a manner that limited student engagement and assessment of students’ thinking (codes 5 & 7–10).
The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 12, Jack scored low across all categories, and his mean capsule rating dropped to a score of 2 and is reflective of “Ineffective Instruction” (Appendix B). Such practice can be described as “little or no evidence of student thinking or engagement with important ideas of science. . . . Students are involved in hands-on activities or other individual or group work, but it appears to be activity for activity’s sake” (Horizon Research, 2005, p.11).

**Summary.**

*Socialization experiences.* Jack developed strong ties to his cohort members during his time in the TEP. Although he did not reach out to individual cohort members for support, he found the communication that occurred via their Google Group to be a source of encouragement. Throughout his first two years of teaching Jack’s attempts to implement RBSI were challenged by his administration, and he was directed to teach in a manner incongruent with RBSI. With colleagues, Jack did not openly promote RBSI, and while he did not perceive them to be hostile toward his efforts, he did not see them as allies supportive of RBSI.

*Pedagogical considerations.* While in the TEP Jack demonstrated that he deeply understood RBSI. However, during his first and second years, of teaching, Jack’s reflections were incongruent with RBSI and primarily focused on the decisions he made to survive in an environment inhospitable toward RBSI.

*Teaching practice.* Jack’s interaction pattern moved dramatically away from a desired interaction pattern during the three years of this study. He impressively implemented an interaction pattern congruent with RBSI while in the TEP, asking open-ended questions (codes 3c & 4) and responding in a student-centered manner (codes 11 & 12) to promote student mental engagement (see Figure 11). Unfortunately, with each passing year his interaction pattern and
LSC-COP scores regressed dramatically (see Figure 12), and during the end of his second year of teaching his interaction pattern and lessons were incongruent with RBSI as promoted by TEP.

*Figure 11.* The percent occurrence of Jack’s question and response types during his teacher education program (TEP), first year of teaching, and second year of teaching.
*Maximum Capsule rating is 8; Maximum rating for other categories is 5.

Figure 12. The mean rating of each LSC-COP category for observations conducted during Jack’s first and second years of teaching.

Case 7—Liam

Preservice.

Context. Prior to enrolling in the TEP, Liam was pursuing an MS degree in Geology. Liam considered teaching at a community college post-graduation, so he enrolled in The Nature of Science and Science Education: Practical Teaching Strategies for Accurately and Effectively Conveying the Nature of Science. Liam noticed that the type of instruction the science education faculty member modeled was different than instruction he had previously encountered, and he recognized its effectiveness.127 Liam experienced a significant cognitive change as a result of taking an TEP course while concurrently teaching for the first time in a postsecondary geology lab class:

I just thought I had to go up [to the front of the room] and dub everything I know about a topic and let students pick up the pieces. . . . I was not an effective teacher, and I knew that. I knew I had to take the MAT program. (Liam, 1:379)
Following a semester of contemplation, Liam enrolled in the TEP and simultaneously pursued two master’s degrees.

*Socialization experiences.* During Liam’s practicum, he worked with a cooperating teacher who neither rejected nor fully implemented RBSI. Despite the incongruities between her practices and the practices promoted and modeled by the TEP, Liam had a positive relationship with his cooperating teacher. He was able to identify his cooperating teacher’s strengths and analyze her teaching to identify ways she was incongruent with the practices promoted by his TEP.128

Liam felt supported by members of his cohort—he believed that they accepted him, that they leaned on each other, and that his learning benefited from working with them. Due to their shared content area expertise, he began collaborating with Chris on a lesson planning assignment. They became good friends and worked together extensively throughout the program.129

Liam’s interactions with his cooperating teacher likely influenced how he believed he would interact with colleagues who do not fully implement practices congruent with RBSI during his first years of teaching. In looking forward, Liam asserted, “My concerns aren’t that great” (Liam, 1:155) when discussing how he might navigate sometimes well-intentioned yet misguided support from colleagues who neither valued nor implemented RBSI. Liam was equally concerned about classroom management and how to navigate the practice of differentiating instruction through multiple intelligences, a practice that he knew was occurring at the school he would be teaching in during his first year.130

*Pedagogical considerations.* As Liam exited the TEP, he reflected upon teaching in ways that are congruent with the TEP and RBSI. In his oral defense of his Research-based Framework
for Teaching, he demonstrated a sophisticated understanding of teaching and learning. He perceived that his beliefs about his role as a teacher shifted dramatically prior to enrolling in the TEP—this conceptual change ultimately motivated him to seek another master’s degree and enroll in the program. In discussing the Draw a Science Teacher task he had completed at the start of the program, he attributed the alignment between his of his initial drawing and practices promoted in the program to his experiences in The Nature of Science and Science Education course. Nonetheless, he recognized how the depth of his understanding of the complexity of teaching grew as he moved through the program (Liam, 1:524).

Teaching practice. During Liam’s third semester in the TEP he audiorecorded and analyzed two lessons to qualitatively and quantitatively assess his teaching and complete the SATIC Self-evaluation of Teaching Behaviors assignment. Liam conducted one analysis in February and the other in March; the percent of each SATIC code occurrence is depicted in Figure 13. Early in that third semester, Liam primarily exhibited a SATIC pattern that, while incongruent with RBSI, included the use of behaviors congruent with RBSI. Liam’s pattern heavily employed teacher talking (codes 1 & 2). While he asked dichotomous or short-answer questions that limit student thinking (codes 3a & 3b), he also asked a similar frequency of open-ended questions (codes 3c & 4). Although he most frequently responded to students in a manner that limited engagement and assessment of their thinking (codes 5 & 7–10), he demonstrated the ability to respond in a student-centered manner (codes 11 & 12) to promote student mental engagement.

Liam defended an A- in Science Methods II (see Table 3 for grade criteria) at the end of his third semester in the TEP. He was categorized as an exceptional student in the program in his letter of recommendation (see Table 4 for categorization criteria). These assessments of Liam’s
understanding suggested he deeply understood learning and teaching, and he would most likely be a highly effective science teacher.

**The first year.**

*Context.* During Liam’s first year of teaching he worked in a public middle school in a suburban community. His middle school served 924 students enrolled in grades 6–8, 27% of whom qualified for free or reduced lunch. Liam taught one course, eighth-grade Physical Science, in an eight-period day. One other teacher taught eighth-grade Physical Science.

*Socialization experiences.* During the first few months of his teaching career, Liam openly implemented practices congruent with RBSI and advocated for effective science teaching practices with his superordinates. However, many of his superordinates admonished his efforts and left Liam feeling devalued. For example, Liam’s mentor teacher (who was also the other eighth-grade Physical Science teacher) told Liam early in his first semester of teaching that he should “‘stop doing so much inquiry’ because I ‘won’t have enough time to cover the curriculum’” (Liam, 2a:317). He also perceived that his mentor teacher was disparaging him to his principal, who would echo comments he originally heard from his mentor. Liam’s administration, then, became an additional source of resistance to the implementation of RBSI.

I felt pressured to have to teach like everyone else, because an administrator (at the beginning of the year) told me . . . “I sense some differences in your teaching. Actually it’s more than a sense. I know there’s some differences in your teaching, and by next year that has to be erased.” And I asked, “What do you mean by that? Does this mean I’m going to have to change my teaching?” And he was very vague, he said, “No, this just means we want students to be doing the same things.” I kept teaching the way I wanted to . . . because he didn’t specifically say, “You need to change your teaching.” I told him “Everything I do, I try to couch in research. I base a lot of the content I cover, the appropriateness of it, developmentally, on recommendations by things like AAAS benchmarks.” (Liam, 1a:243)
Finally, Liam drew intense criticism from colleagues for his selection of content, sequencing of content, and methods of classroom management.\textsuperscript{134} Despite the pressures his superordinates were exerting, Liam continued to implement practices congruent with RBSI.

[I stayed the course because] I feel a sense of alliance with the MAT program [because it was] a life-changing event. By far, the best teaching I’ve ever been exposed to was modeled for us [by the program’s science education faculty], so I know its effectiveness. And we constantly talked about teachers . . . [who] try out methods of teaching that are based on research, and if it doesn’t work the first time [they decide] it’s ineffective. There have been some things that I’m doing that maybe turned out ineffective. . . . I still trust the research. It’s my imperfection in carrying out the method. [My] methods of instruction that are based on research, and that’s the kind of teacher I want to be—an effective one that smiles a lot, and you leave with a fundamental change in your understanding of how the world works. (Liam, 2a:262)

During the second semester of his first year of teaching Liam began to experience support for implementing RBSI from some students, administrators,\textsuperscript{135} and colleagues.\textsuperscript{136} He also received encouragement from his cooperating teacher, TEP science education faculty, and his cohort.

But, when these people came along, [science education faculty members], you, and some conversation with [my cooperating teacher], very much got a sense of I was doing things that were good. Good for kids. Good for education. . . . So that has been a real morale booster interacting with these people. I got the sense to keep on keeping on, and actually the first recognition of me doing good work. (Liam, 2b:152)

By the end of the school year, Liam’s morale and levels of support had improved, even though he still encountered pockets of resistance.\textsuperscript{137}

\textit{Pedagogical considerations.} When discussing his first year of teaching, Liam continued to reflect upon teaching in a manner that was congruent with RBSI. Moreover, he included many specific examples from his classroom that illustrated the depth and interconnectedness of his thinking.\textsuperscript{138,139}

\textit{Teaching practice.} During the spring semester of Liam’s first year of teaching he was observed teaching eight lessons (in February, March, April and May). A portion of each lesson was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 13. Liam’s
SATIC pattern dramatically shifted to one that was congruent with RBSI. He reduced his frequency of teacher talking (codes 1 & 2) and dichotomous or short-answer questions that limit student thinking (codes 3a & 3b) while increasing the amount of time he spent asking open-ended questions (codes 3c & 4). He sharply decreased his tendency to respond to students in a manner that limited engagement and assessment of student thinking (codes 5 & 7–10), and he dramatically increased the frequency with which he responded in a student-centered manner (codes 11 & 12) to promote student mental engagement.

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 14, Liam scored high across all categories, and his capsule rating of 8 is reflective of “Exemplary Instruction” (Appendix B). Such practice can be described as “instruction that is purposeful and all students are highly engaged most or all of the time in meaningful work. . . . Instruction is highly likely to enhance most students’ understanding of the discipline and to develop their capacity to successfully ‘do’ science” (Horizon, 2005, p.11).

The second year.

Context. Liam remained at the same school and taught the same classes during his second year of teaching. His building principal was new. Liam continued to teach eighth-grade Physical Science; his mentor also remained the only other eighth-grade Physical Science teacher.

Socialization experiences. Liam felt “much more supported” during his second year of teaching (Liam, 3a:192). Liam’s new principal was highly supportive of his efforts to implement practices congruent with RBSI. He felt “liberated” not only in his freedom to teach the way he wanted to, but also to speak openly about RBSI with his principal. This was a stark contrast from his concerns the previous year that his mentor violated their mentor-mentee relationship and shared information with the principal, who held evaluative authority.
was purposeful in the types of support he obtained from his mentor. Nonetheless, he continued to struggle with how his mentor teacher interacted with her students, and he decided to confront her about her teaching practices toward the end of his second year of teaching.

Now that I have my principal’s support, I’ve gotten a little more confident. . . . On my last observation [with my mentor teacher], I went into this a little, prepared for battle, so to speak. [The student teacher with my mentor had just] reached the end of her teaching experience. . . . The desks were rearranged . . . where the students could [work] in groups of four, or two. And the first thing my mentor teacher did . . . she pointed at all the tables [to] the front, and was doing lectures for about a week. (It was lectures and a worksheet, lectures and a worksheet.) Having seen the practicum student [teaching with small groups and research-based practices] for an entire semester, she reverted right back to an extreme form of traditional instruction. . . . I SATIC-coded her teaching without her asking me to do it. . . . [Her pattern is] a pretty concerning pattern. We met afterwards and I talked to her about this. I was pretty serious in my approach and in my feedback, because what I was trying to do was really point out that she’s doing things that research makes clear are not in the best interest of kids. And when I did this, she got defensive, said “I know what the research says, but this is what I’m going to be doing, despite. You can judge me” and that’s the word she used “but I’m going to do it this way.” It was a little confrontational. (Liam, 3:938)

Instead of investing time in a relationship with his mentor teacher, Liam sought out colleagues in his building who “have similar approaches” to lunch and socialize with. Liam continued to stay in contact with members of his cohort (exchanging phone calls with Chris, Andrea, and Martin). Even though his interactions with his cohort members as a whole decreased, he found value in receiving e-mails from cohort members via their Google Group. Liam also expressed enjoying being able to connect with new cohorts and reconnect with the science education faculty.

Pedagogical considerations. Liam continued to reflect upon teaching in a manner that was congruent with RBSI. He continued to include many specific examples from his classroom that illustrated the depth and interconnectedness of his thinking about teaching and learning.
Teaching practice. During Liam’s second year of teaching he was observed teaching twelve lessons (in September, October, November, February, April and May). A portion of each lesson was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 13. Liam’s SATIC pattern continued to be congruent with RBSI—he asked open-ended questions (codes 3c & 4) and responded in a student-centered manner (codes 11 & 12) to promote student mental engagement.

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 14, Liam continued to score high across all categories, and his capsule rating of 8 remained reflective of “Exemplary Instruction” (Appendix B).

Summary.

Socialization experiences. Liam’s relationships with his superordinates changed dramatically throughout the three years of this study. He went through a transformative experience during the TEP, and he felt supported by his cohort members, his cooperating teacher, and the TEP science education faculty. However, during his first year of teaching Liam only received support from his mentor and administration to implement instruction incongruent with RBSI. In this environment, Liam relied heavily on support from members of his cohort, his cooperating teacher, the TEP science education faculty, and me. During his second year of teaching Liam experienced appropriate superordinate support within his school due to a new principal, and he felt liberated. This support emboldened him to have confidence in his teaching practices, challenge his mentor teacher’s practices, and seek out like-minded colleagues. Liam maintained relationships with his cohort members, but the amount he communicated with them decreased.
Pedagogical considerations. While in the TEP Liam demonstrated that he deeply understood teaching and learning. He synergistically reflected on his teaching in ways congruent with RBSI throughout this study.

Teaching practice. Even while under superordinate scrutiny during his first year, Liam improved upon the interaction pattern he employed while student teaching. He developed a desirable interaction pattern as promoted in the TEP—asking students thought-provoking questions (see codes 3c & 4 in Figure 13) and responding in a manner that mentally engages students (see codes 11 & 12 in Figure 13). Liam made decisions and implemented practices in a manner highly congruent with RBSI, as evidenced by his LSC-COP scores (see Figure 14).

![Figure 13](image_url)  
*Figure 13.* The percent occurrence of Liam’s question and response types during his teacher education program (TEP), first year of teaching, and second year of teaching
*Maximum Capsule rating is 8; Maximum rating for other categories is 5.

*Figure 14. The mean rating of each LSC-COP category for observations conducted during Liam’s first and second years of teaching.*

**Case 8—Martin**

**Preservice.**

*Context. Prior to enrolling in the TEP, Martin earned an undergraduate degree in Biology and then worked for multiple years in a genetics research laboratory. Martin joined the student chapter of the National Science Teachers Association (NSTA) two semesters before he began the program. He attributed interacting with students of the program during meetings as important factors in preparing him to engage meaningfully in the conceptual change process of the program.*

*Socialization experiences. Martin greatly enjoyed being a member of a cohort. He drew upon his cohort members for emotional support. He also found value in collaborating with members of his cohort to complete assignments and develop ideas while student teaching.*
Martin had two cooperating teachers for student teaching. One of his cooperating teachers modeled instruction as promoted by the TEP—with her science students and with Martin. His other cooperating teacher modeled instruction incongruent with practices promoted by the TEP. While she extended to Martin the freedom to implement practices congruent with RBSI in her classroom, when she intervened to support Martin while he was teaching, she did so in ways that undermined Martin’s teaching and short-circuited students’ mental engagement.

[Having these two cooperating teachers] showed me two paths that could be my future. I [have] got to remember I want this one path. . . . I would think about what are the things that I don’t want to do [that are happening in the incongruent classroom], what are the things that I have to do to bring [the incongruent] classroom into [the congruent] one. It was a valuable experience for sure, having two cooperating teachers that do different things, and you can see the difference between them. (Martin, 1:186)

Martin saw reflecting on his experiences with his cooperating teachers as a valuable activity to inform his practice.

**Pedagogical considerations.** As Martin exited the TEP, he reflected upon his experiences and teaching in ways that are congruent with the TEP and RBSI. For example, he considered the relationships between his student goals, classroom management, and how students learn.

Martin reflected deeply on how his beliefs about his role as a teacher shifted dramatically during his time in the TEP. In discussing the Draw a Science Teacher task he had completed at the start of the TEP, he recognized how he had held views about how to teach that were not aligned with his rationale for being a teacher and his initial purposes for teaching. At the end of the program, Martin perceived that he became “consistent with in” (Martin, 1:1365) himself and could, through his research base, effectively support his rationales and his original ideals.

**Teaching practice.** During Martin’s third semester in the TEP he audiostreamed and analyzed two lessons to qualitatively and quantitatively assess his teaching and complete the
SATIC Self-evaluation of Teaching Behaviors assignment. While Martin conducted two analyses, only the one completed in March was archived and available for analysis; the percent of each SATIC code occurrence is depicted in Figure 15. Early in that third semester, Martin exhibited a SATIC pattern that was incongruent with RBSI. He heavily employed teacher talking (codes 1 & 2), dichotomous and short-answer questions (codes 3a & 3d), and responses that limit student engagement and assessment of students’ thinking (codes 5 & 7–10). However, Martin demonstrated potential to transition toward practices congruent with RBSI by asking some open-ended questions (codes 3c & 4).

Martin defended an A- in Science Methods II (see for Table 3 grade criteria) at the end of his third semester in the TEP. He was categorized as an exceptional student in the program in his letter of recommendation (see Table 4 for categorization criteria). These assessments of Martin’s understanding suggested he deeply understood learning and teaching and he would most likely be a highly effective science teacher who could either overcome institutional constraints at his school, if any were present, or he would leave the school.

The first year.

Context. Martin did not acquire a teaching position directly after completing the TEP. He moved to a different state and encountered obstacles to obtaining the state’s teaching license. During the academic year he spent acquiring a license, he substitute taught and worked as temporary manual laborer. He stayed in close contact with his cohort through the Google Group to share his life experiences, disseminate educational research and resources, acquire support, and extend support to his cohort members during their first year of teaching. Through these e-mail exchanges Martin learned of the types of institutional constraints his peers were encountering, the struggles of navigating a new job, the effects those difficulties were
having on his peers’ ability to implement practices congruent with RBSI, and the effects on their morale.  

Martin’s first year of teaching occurred while the rest of his cohort was experiencing their second year. Martin worked in a public high school in a suburban community. His school served 2,103 students enrolled in grades 9–12, 17% of whom qualified for free or reduced lunch. Martin taught one course, Biology I, in a modified block schedule (three days each week were seven-period days, and two were four-period days). Five other teachers in the high school taught Biology I.  

*Socialization experiences.* While Martin did not describe colleagues who were implementing practices congruent with RBSI, he felt highly supported during his first year of teaching to make decisions congruent with RBSI. Martin’s superordinates granted him a lot of freedom to make decisions about what and how to teach. His principal neither actively supported nor opposed his efforts to implement practices congruent with RBSI, but he extended support for classroom management issues. Moreover, Martin perceived that his principal actively buffered district- and state-level mandates to empower Martin to bear the responsibility for making decisions concerning what and how to teach. Likewise, Martin’s department head did not dictate what or how he should teach. She supported him by helping him navigate his relationships with students, parents, colleagues, and administrators.  

Martin did not advocate RBSI in an attempt to change his colleagues’ practices. He did initially find it difficult to refrain from translating his critical stance toward the current state of science education into a judgmental and distrustful lens through which he viewed his colleagues. Nonetheless, he purposefully took actions to be a team player, garner emotional support, endear himself to colleagues, and understand his colleagues’ decision-making
frameworks. Overall, Martin did not experience conflict with his colleagues during his first year of teaching. He cited his furniture as his biggest constraint and stated, “I don’t spend a lot of time thinking about what I can’t do . . . that’s a waste of time” (Martin, 2:1004).

**Pedagogical considerations.** When discussing his first year of teaching, Martin reflected upon how people learn; his goals for students; and his selection of content, materials, and strategies in a manner that was largely congruent with RBSI. He included specific examples that illustrated his depth of understanding and demonstrated how he considers practices congruent with RBSI when making decisions. So he could easily refer to his student goals while in the act of teaching, Martin worked with a graphic designer to create a poster for each of his student goals for display in his classroom. In summing up his first year of teaching, Martin lamented, “I finished my first year of teaching, and one day I hope to become a teacher” (Martin, 1563). He understood that he was still working to more deeply understand and effectively implement RBSI.

**Teaching practice.** During Martin’s first year of teaching he was observed teaching eleven lessons on five separate occasions (in October, November, February, April, and May). A portion of each lesson was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 15 Martin’s pattern shifted from his TEP to a pattern more reflective of RBSI, but not wholly congruent with the pattern promoted by the TEP. While Martin is still asking a substantial number of short-answer questions (code 3b) he reduced his reliance upon responses that limit student engagement and spent more time responding in a manner that used students’ ideas (codes 11 & 12) and promoted mental engagement.

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As seen in Figure 16, Martin scored medium across all categories, and his mean capsule rating of 5 is reflective of practice that was in the “Beginning Stages of Effective Instruction”
Such practice can be described as “instruction that was purposeful and characterized by quite a few elements of effective practice. . . . Overall, the lesson was somewhat limited in its likelihood to enhance students’ understanding of the discipline or to develop their capacity to successfully ‘do’ science” (Horizon Research, 2005, p. 11).

**Summary.**

*Socialization experiences.* Martin experienced consistently supportive relationships throughout the three years of this study. He began the program prepared for conceptual change, and he looked upon his relationships with his cooperating teachers, cohort members, and the TEP science education as opportunities to reflect, challenge his understanding of teaching, and develop an understanding of RBSI as promoted by the TEP. During his first year of teaching, his superordinates were laissez-faire about his implementation of practices congruent with RBSI. While he was initially hesitant to engage with colleagues he did not view as like-minded, his colleagues approached him with welcoming demeanors and a willingness to assist. Martin experienced productive relationships with his superordinates, and he found them to be sources of emotional, instructional, and institutional support. Martin maintained communication with his cohort via the Google Group, and he visited the science education faculty of the TEP when he was in town over spring break of his first year of teaching.

*Pedagogical considerations.* While in the TEP, Martin demonstrated that he deeply understood RBSI. Moreover, he continued to deeply and synergistically reflect on his teaching in ways congruent with RBSI during his first year of teaching.

*Teaching practice.* Martin’s interaction pattern moved toward a pattern congruent with RBSI as promoted by the TEP during his first year of teaching—even after spending the year between the TEP and his first year of teaching working as a temporary construction worker and
substitute teacher. He spent less time responding to students in ways that decrease mental engagement (see codes 5 & 7–10 in Figure 15) and responding in a manner that mentally engages students (see codes 11 & 12 in Figure 15). He implemented lessons that were in the beginning stages of effective instruction, as evidenced by his LSC-COP scores (see Figure 16).

Figure 15. The percent occurrence of Martin’s question and response types during his teacher education program (TEP) and first year of teaching.
Case 9—Mason

Preservice.

Context. Prior to enrolling in the TEP, Mason was a successful undergraduate student who earned a Biology degree. Additionally, Mason’s father had been a teacher for 37 years. Mason entered the TEP with deeply held conceptions of his purpose as a teacher.¹⁷⁰

Socialization experiences. Mason was a self-described lone wolf when he began the TEP.¹⁷¹ He did not begin building deeper relationships with his cohort members until late in his second semester of the program, when he realized he was struggling to complete a major course assignment, the Research-based Framework for Science Teaching (RBF). Then, he reached out to his cohort, began collaborating, and started working closely with Emma.¹⁷² He also found engaging in the oral defense of his RBF to be a pivotal moment where he came to understand that the science education faculty of the TEP cared about him.¹⁷³ Mason was reluctant to be fully
accountable for actions that led to his sense of isolation and lack of reflection. Instead, he desired extrinsic motivation to address these issues in the form of accountability to his superordinates.\textsuperscript{174}

In looking forward to his first year of teaching, Mason was not concerned about having the institutional constraints related to his administration.\textsuperscript{175} He was concerned about not having continuous support interactions with his cooperating teacher and cohort members. He was also worried about building relationships with colleagues who do not implement RBSI, and as such he was preparing for a lonely start to his teaching career. While he was prepared to help his colleagues improve their practice by sharing the understanding of teaching and learning, he did not think that he was going to have to defend his teaching since he was going to be the only teacher of the courses he was assigned.\textsuperscript{176}

\textit{Pedagogical considerations.} As Mason exited the TEP, he reflected upon teaching in ways that rarely accounted for aspects of RBSI as promoted by the TEP.\textsuperscript{177,178} In discussing the Draw a Science Teacher task he completed at the start and end of the TEP, he recognized how when he began the TEP, his values concerning teaching remained consistent, but he felt he had new skills and tools to realize his ideals.\textsuperscript{179} He struggled to reflect on the structure of the TEP and his personal learning in ways that were congruent RBSI.\textsuperscript{180} The TEP was not a transformative experience for Mason.

\textit{Teaching practice.} During Mason’s third semester in the TEP he audio recorded and analyzed two lessons to qualitatively and quantitatively assess his teaching and complete the SATIC Self-evaluation of Teaching Behaviors assignment. Mason conducted one analysis in February and the other in March; the percent of each SATIC code occurrence is depicted in Figure 17. Early in that third semester, Mason primarily exhibited a SATIC pattern that was somewhat congruent with RBSI promoted by his TEP. Mason’s pattern heavily employed
teacher talking (codes 1 & 2). While he asked dichotomous or short-answer questions that limit student thinking (codes 3a & 3b), he more frequently asked open-ended questions that promote student mental engagement (codes 3c & 4). Although he most frequently responded to students in a manner that limited engagement and assessment of student thinking (codes 5 & 7–10), he demonstrated the ability to respond in a student-centered manner (codes 11 & 12) to promote student mental engagement.

Mason defended a B in Science Methods II (see Table 3 for grade criteria) at the end of his third semester in the TEP. This was the lowest grade defended by a member of his cohort. He was categorized as a very good student in the TEP in his letter of recommendation (see Table 4 for categorization criteria). These assessments of Mason’s understanding suggest he had a good understanding of learning and teaching. In a supportive environment and with time and effort, he had the potential to implement practices associated with highly effective teaching. However, one faculty member perceived him as being unable to implement highly effective teaching in an unsupportive environment, or one that has institutional constraints.

The first year.

Context. Mason worked in a public junior and senior high school in a rural community. His high school served 325 students enrolled in grades 7–12, 30% of whom qualified for free or reduced lunch. Mason taught four courses: Chemistry, Physics, Physical Science, and Principles of Technology. He was the only teacher who taught these classes.

Socialization experiences. Mason said that the greatest support he received for highly effective teaching during his first year came from attending the annual state practitioner conference. Seeing his cohort members again was an emotional support for Mason. For lesson planning support, he collaborated with Emma. Additionally, he considered my visits to observe
his teaching and our conversations as a reminder of “why I was doing what I was doing” (Mason, 2:63).

While Mason talked with his colleagues, he did not elaborate upon instances of support or collaboration that occurred between them during his first year of teaching. Mason was also very reserved in discussing his relationships with his superordinates. Mason encountered difficulties in his relationship with his principal. Sometimes he found his interactions with her to be supportive and of great value, but after other interactions with her, he was confused.

Whenever [my principal] would come in and observe me, she would always leave and say very, very positive things, made me feel like I was doing everything very well. And then I looked up the write-up and she would give me negative points. And that was the only thing I found in the write-ups. So I would get like a very positive face time with her and then once she actually wrote up the paper, her observations seemed very negative. I didn’t really know how to take her. I didn’t know if she was just trying to be nice to me to my face. . . . Specifically, I know that she commented on how my classroom management was good, and how I was going to table-to-table and making sure that all the students were engaged. And then when she wrote up her final observation form, she was saying how all the students were disengaged and I didn’t do anything to get them back on track. So I had very, very, black and white differences between how she was telling me how I was doing, and what she wrote about me (Mason, 2:73).

Mason knew he struggled with classroom management; he worked on improving his classroom management and implementing the recommendations of his principal. In the Mason’s principal decided he struggled to effectively implement practices congruent with RBSI. She did not feel that Mason was able to effectively use questioning to help students deepen their understanding of content or to help them make connections between activities and concepts. Most significantly, she was concerned that Mason’s emphasized thinking skills over content. She was troubled when Mason turned in lesson plans for one-and-a-half weeks that were identical for all of his classes, regardless of subject or grade level, and did not address science content. Instead, his lessons focused on the current state of the educational system. She explained that as a public school teacher he was responsible to address the state standards and could not disregard
science content. She decided not to renew Mason’s contract for another year. She thought Mason was more likely to thrive in an environment where he only had one or two classes to prepare for and supported his transition to a new school by offering to write a letter of recommendation for him (Field Notes, 4/12/12).

Pedagogical considerations. When discussing his first year of teaching, Mason’s reflections largely focused on keeping students interested. When discussing making teaching decisions, he did not reflect on his practice in ways congruent with RBSI as promoted by the TEP. He did not consider his student goals, and he did not draw upon how people learn.

Teaching practice. During the spring semester of Mason’s first year of teaching, he was observed teaching six lessons (in April and May). A portion of each lesson was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 17. Mason’s SATIC pattern shifted to one that was less congruent with RBSI. While he reduced his frequency of teacher talking (codes 1 & 2), he increased his use of dichotomous or short-answer questions that limit student thinking (codes 3a & 3b) and decreased the amount of time he spent asking open-ended questions (codes 3c & 4). He also decreased the frequency with which he responded in a student-centered manner to promote student mental engagement (codes 11 & 12) and increased the frequency with which he responded to students in a manner that limited engagement and assessment of student thinking (codes 5 & 7–10).

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 18, Mason scored low to medium-low across all categories, and his mean capsule rating of 3 is reflective of practice that had of “Elements of Effective Instruction” (Appendix B). Such practice can be described as “instruction that contains some elements of effective practice, but there are serious problems in design, implementation, content, and/or
appropriateness. . . . Overall, the lesson is very limited in its likelihood to enhance students’ understanding of the discipline or to develop their capacity to successfully ‘do’ science (Horizon Research, 2005, p.11).

**The second year.**

*Context.* During Mason’s second year of teaching, he worked in a public middle school in an urban community. His middle school served 708 students enrolled in grades 6–8, 51% of whom qualified for free or reduced lunch. Mason taught two courses: Sixth Grade Science and Eighth Grade Science. Five science teachers work at Mason’s middle school.

*Socialization experiences.* Mason felt well supported by his administration during his second year of teaching. In addition to the three required observations his assistant principal conducted, he invited her to observe on additional occasions to assist him with student motivation. Her support helped Mason identify strengths in his practice and boost his morale. After his negative experiences during his first year of teaching, Mason reported “being low . . . putting myself in this giant hole,” and he only acknowledged the aspects of his teaching he was struggling with (Mason, 2:66). Additionally, Mason collaborated more with his colleagues, felt his department was friendlier, and gained a colleague who “took me under her wing.” Mason continued to connect with his cohort at the annual state practitioner conference and via the online group, but during the second year he did not discuss these connections when discussing significant sources of support.

*Pedagogical considerations.* When discussing his second year of teaching, Mason continued to reflect in ways that were largely incongruent with RBSI. The list of goals he developed for students in his TEP had been reduced to the goals of “How do you have fun with science? Can you develop [student] interest?” Moreover, he did not convey how his
understanding of how students learn or of his students’ understanding influenced his decisions regarding his selection of content, materials, strategies, or behaviors.  

*Teaching practice.* During Mason’s second year of teaching he was observed teaching eight lessons (in September, November, February, March, and May). A portion of most lessons was SATIC-coded; the percent of each SATIC code occurrence is depicted in Figure 17. Mason’s SATIC pattern shifted again during his second year of teaching to a pattern situated between the patterns he exhibited in the TEP and during his first year of teaching. He increased his amount of teacher talking (codes 1 & 2) and decreased his use of dichotomous and short-answer questions (codes 3a & 3b). Meanwhile, he asked open-ended questions (codes 3c & 4) and responded in a student-centered manner to promote student mental engagement (codes 11 & 12). He primarily responded to students in a manner that decreased student engagement and assessment of student thinking (codes 5 & 5–10).

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 18, Mason continued to score between low and medium-low across all categories, and his capsule rating of 3 continues to reflect practice that had of “Elements of Effective Instruction” (Appendix B). Mason also continued to struggle with classroom management.

**Summary.**

*Socialization experiences.* Mason was a self-described lone wolf. He did go through the process of conceptual change while in the TEP and so he was not compelled to reach out to his peers until he felt he would be unsuccessful in completing the program without their support. During his first year of teaching, Mason was passionate about his goals for students, teaching, and learning. He was prepared to openly promote what he considered to be RBSI with his
students, parents, and superordinates. However, he was ineffective in navigating relationships with his superordinates, and he alienated his principal and his colleagues. As during his TEP, Mason did not rely heavily upon his cohort or the science education faculty of the TEP for support in implementing practices congruent with RBSI. During his second year of teaching, Mason experienced neutral superordinate support. Although the support he received was not deeply aligned with RBSI; Mason did not seem to perceive this incongruence.

Pedagogical considerations. While Mason demonstrated potential, he was unable to account for aspects of RBSI as promoted by the TEP at the end of the TEP. During his first year of teaching, Mason’s reflections on teaching and learning shifted to focus solely on keeping students interested, which continued to be the focus of his reflections during his second year of teaching.

Teaching practice. Without superordinate support to improve his implementation of practices congruent with RBSI, and with his aversion to seeking support from his cohort members, Mason’s interaction pattern shifted but did not become more congruent with RBSI. By his second year of teaching, Mason began exhibiting practices more congruent with RBSI; however, his overall pattern was largely incongruent with RBSI because he relied heavily upon teacher talk and employed responses that decrease student mental engagement and limit assessment of student thinking (see codes 1 & 2, and codes 5 & 7–10 in Figure 17). Moreover, Mason did not make teaching decisions and implement practices in a manner congruent with RBSI throughout his first two years of teaching, as evidenced his LSC-COP scores (see Figure 18).
Figure 17. The percent occurrence of Mason’s question and response types during his teacher education program (TEP), first year of teaching, and second year of teaching.

Figure 18. The mean rating of each LSC-COP category for observations conducted during Mason’s first and second years of teaching.

*Maximum Capsule rating is 8; Maximum rating for other categories is 5.
Case 10—Noah

Preservice.

Context. Prior to enrolling in the TEP Noah was a successful undergraduate student who earned a Biology degree and a minor in Psychology. As an undergraduate, Noah joined the student chapter of the National Science Teachers Association (NSTA) two semesters before he began the program. He attributes his positive attitude about entering the program to overhearing portions of science education courses prior to attending NSTA meetings.  

Socialization experiences. On multiple occasions, Noah referred the emotional struggles he encountered while participating in the TEP, although he did not say that he relied upon his cohort, cooperating teachers, or science education faculty in helping him through his difficulties. He collaborated with Martin and Jack and relied upon his other cohort members for support in setting up study groups and social gatherings.  

During his fall semester practicum, Noah described his cooperating teacher as “jaded” toward education, teaching “a very traditional class” (Noah, 1:238), and he did not feel comfortable discussing his developing ideas concerning how and what to teach with her. To address this issue, Noah sought out an additional practicum placement and, for a period of time, he worked with two cooperating teachers. Noah’s second cooperating teacher during the fall semester modeled and promoted practices congruent with RBSI. His cooperating teacher for spring semester student teaching “Had little expectations, both of me and of the students” (Noah, 1:210). For his first year of teaching, Noah took the vacated position of the strong cooperating teacher he had in the fall semester of his TEP—a teacher who promoted and implemented teaching practices congruent with RBSI despite meeting intense resistance from his colleagues.
Pedagogical considerations. Noah perceived that his beliefs about his role as a teacher shifted dramatically during his time in the TEP, but he reflected upon teaching in ways that were superficial and vague. In discussing the Draw a Science Teacher task he completed at the start and conclusion of the TEP, he recognized how when he began the TEP he valued outdoor education—much as he still did at the end—but he recognized that what he would teach was now different. When reflecting on his teaching experiences, Noah found working with teachers who had such different approaches to teaching and learning “interesting,” and he focused heavily on understanding each teacher’s rationale for his/her decisions. When reflecting upon his own practice, he did not reflect in a manner that demonstrated he was considering the relationships between his student goals, his selection of strategies, and how students learn. He was isolating specific strategies as ways to address specific classroom issues. While Noah considered aspects of RBSI and the conceptual change he went through concerning his understanding of how to teach, he lacked synergistic reflections between components of RBSI as promoted by the TEP.

Teaching practice. During Noah’s third semester in the TEP he audio recorded and analyzed two lessons to qualitatively and quantitatively assess his teaching and complete the SATIC Self-evaluation of Teaching Behaviors assignment. Noah conducted one analysis in February and the other in March; the percent of each SATIC code occurrence is depicted in Figure 19. Early in that third semester, Noah primarily exhibited a SATIC pattern that, while incongruent with RBSI, included the less frequent use of behaviors congruent with RBSI. Noah’s pattern heavily employed teacher talking (codes 1 & 2). While he asked dichotomous or short-answer questions that limit student thinking (codes 3a & 3b), he more frequently asked open-ended questions that promote student mental engagement (codes 3c & 4). He also demonstrated
the ability to respond in a student-centered manner to promote student mental engagement and assess student thinking (codes 11 & 12).

Noah defended an A- in Science Methods II (see Table 3 for grade criteria) at the end of his third semester in the TEP. He was categorized as excellent in his letter of recommendation (see Table 4 for categorization criteria). These assessments of Noah’s understanding suggest he understood a great deal about learning and teaching and had the potential to be a science teacher who could effectively implement RBSI-congruent practices.

The first year.

Context. During Noah’s first year of teaching he worked in a public high school in a suburban community. His high school served 669 students enrolled in ninth grade, 21% of whom qualified for free or reduced lunch. Noah taught two courses, General Science and Biology, with five other teachers.

Socialization experiences. While Noah received support for RBSI by remaining in contact with his cohort via their Google-group, the support Noah experienced from his school was for direct instruction and not RBSI. Often, Noah felt he was getting mixed messages from his departmental colleagues about the importance of aligning what and how they taught. Noah was trying to serve two masters; attempting to (1) stay true to the conceptual change he went through in his TEP about what and how to teach and (2) appease his colleagues.

And then I kind of realized that even though we had all agreed to do . . . this one worksheet and give this one test, that we weren’t even close to doing it. And it kind of became this battle between myself of going, “I said I would do this. I should, at least to some extent.” And then, “No one else is doing it; why would I even care?” . . . Which upset me, because I realized after four or five nights of having that run back and forth in my head, “Why haven’t I even considered what would be best for students here?” . . . How did this get involved so much in these personal things that the student thing wasn’t even in the question? So it became this weird middle ground that I’m trying to run, and I’m trying to navigate it, and right now I feel I’m swinging a little too far to what the department agreed to and not to what would probably be best for students all the time.
That being said, my predecessor in this position happened to swing on the what would be best for students and was a villain within the building because of it, outside of maybe three people. But I would prefer my first year not to get that kind of flack; I couldn’t handle it. So I swing the other way. (Noah, 2:259)

To avoid being criticized like his predecessor, Noah made teaching-decisions that were incongruent with RBSI but aligned with his need to establish positive working relationships with his colleagues. Coming to the realization that he had more freedom to teach what and how he wanted tormented Noah throughout his first year of teaching. In looking forward to his second year of teaching Noah was still trying to find a way to value both the research-base and the dominant conception of teaching and learning at his school that is incongruent with RBSI: “Somewhere along the line the buck’s got to stop. Part of it is, I haven’t been able to get that balance right between what I should do for students and what I need to do to appear right and save face” (Noah, 2:1599).

**Pedagogical considerations.** When discussing his first year of teaching, Noah reflected upon his goals for students, how people learn, and his selection of content, materials, and strategies in a manner that included themes largely congruent with RBSI. However, his responses were perfunctory. His examples from his classroom demonstrated that his considerations were of isolated RBSI practices and lacked synergism.

**Teaching practice.** During the spring semester of Noah’s first year of teaching he was observed teaching four lessons on three separate occasions (in April and May). A portion of each lesson was SATIC-coded; the percent of each SATIC-code occurrence is depicted in Figure 19. Noah’s SATIC pattern shifted to be even less congruent with RBSI. While he reduced his frequency of teacher talking (codes 1 & 2), he increased his use of dichotomous or short-answer questions that limit student thinking (codes 3a & 3b). He also decreased the amount of time he spent asking open-ended questions (codes 3c & 4) and increased the frequency with which he
responded to students in a manner that limited engagement and assessment of student thinking (codes 5 & 7–10).

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 20, Noah scored low to medium-low across all categories, and his mean capsule rating of 3 is reflective of practice that had of “Elements of Effective Instruction” (Appendix B). Such practice can be described as “instruction that contains some elements of effective practice, but there are serious problems in design, implementation, content, and/or appropriateness. . . . Overall, the lesson is very limited in its likelihood to enhance students’ understanding of the discipline or to develop their capacity to successfully ‘do’ science (Horizon Research, 2005, p.11). Noah struggled with managing his classroom and keeping his students engaged, which greatly impacted his implementation and his ability to address difficulties students were having understanding concepts.

The second year.

Context. Noah remained at the same school during his second year of teaching, taught the same classes, and worked with the same administration and colleagues.

Socialization experiences. Noah still did not feel supported in implementing practices congruent with RBSI by his departmental colleagues,\textsuperscript{197} his mentor, or new teacher meetings he attended.\textsuperscript{198} Nonetheless, Noah shifted his actions away from keeping his word to his colleagues to a fault. He began subverting suggestions by colleagues to tightly align both what and how they were teaching.\textsuperscript{199} Noah interpreted a lack of administrative presence in his classroom coupled with administrative support to attend conferences and workshops, as tacit support for his attempts to implement practices congruent with RBSI.\textsuperscript{200} Moreover, in looking forward to his third year of teaching, he feels even more secure since he no longer holds a probationary
teaching license. Even though Noah rejected the support extended by his colleagues to implement practices incongruent with RBSI, he still wanted department-level accountability. This dissonance rose out of his desire to influence the practices of colleagues and improve the educational experiences of their students.

So [alignment is] still so optimistic, it’s nuts. It’s crazy. I should just totally give up on everything and just do my own thing. But I’m still idealistic. I still want us to be close to the same. I still want every kid to have a decent education. (Noah, 3:524)

Noah’s contact with members of his cohort decreased during his second year of teaching, and while he still found value in receiving e-mails through the Google Group, he did not initiate communication with any of his cohort members.

Pedagogical considerations. In his second year of teaching, Noah felt empowered to make decisions about what and how to teach that he believed were more congruent with RBSI. While Noah still struggled to consider the synergistic relationships between aspects of his research-based framework for teacher decision making, he was still actively working toward a goal of implementing RBSI practices as promoted by the TEP.

Teaching practice. During Noah’s second year of teaching he was observed teaching nine lessons (in September, November, February, and May). A portion of each lesson was SATIC-coded; the percent of each SATIC-code occurrence is depicted in Figure 19. Noah’s interaction pattern demonstrated a continued shift away from practices congruent with RBSI—spending even more time engaging in teacher talk (codes 1 & 2), decreasing his use of open-ended questions that promote student mental engagement (codes 3c & 4), and continuing to respond in a manner that limits student engagement and assessment of students’ thinking (codes 5 & 7–10).

The extent to which each lesson was congruent with RBSI was scored using the LSC-COP. As shown in Figure 20, Noah scored low across all categories, and his capsule rating of 3
continued to reflect practice that had of “Elements of Effective Instruction” (Appendix B). Noah also continued to struggle with managing his classroom.

**Summary.**

*Socialization experiences.* During Noah’s first year of teaching his primary concern when engaging in relationships with his superordinates was to avoid being criticized like his predecessor. Throughout Noah’s first year of teaching, he was torn between his desire for collegial relationships and teaching what he believed best, but he came to the realization that he had more freedom to teach what and how he wanted. During his second year of teaching, Noah did not feel supported in implementing practices congruent with RBSI by his departmental colleagues, his mentor, or his new teacher meetings.

*Pedagogical considerations.* While in the TEP, Noah reflected on teaching and learning in ways that were superficial and vague. During Noah’s first year of teaching he made teaching decisions that were incongruent with RBSI but aligned with his need to establish positive working relationships with his colleagues. Noah reflected on his teaching in a manner where he stated themes that were largely congruent with RBSI; however, his responses were perfunctory. During his second year of teaching Noah still struggled to consider the synergistic relationships between aspects of his research-based framework for teacher decision making, but he was still actively working toward a goal of implementing RBSI practices as promoted by the TEP.

*Teaching practice.* Throughout his first two years of teaching, Noah’s interaction pattern steadily shifted away from the RBSI-congruent pattern promoted by the TEP. He spent the majority of his time in teacher talk and responding to students in a manner that limits student mental engagement and assessment of student thinking (see codes 1 & 2, and codes 5 & 7–10 in Figure 19). Moreover, Noah did not make teaching decisions or implement practices in a manner
congruent with RBSI throughout his first two years of teaching, as evidenced his LSC-COP scores (see Figure 20).

Figure 19. The percent occurrence of Noah’s question and response types during his teacher education program (TEP), first year of teaching, and second year of teaching.
Cross-Case Analyses

Cross-case analyses were conducted to explore what relationships, if any, that existed between participants’ socialization experiences, pedagogical considerations of teaching, and teaching practices during this study. These analyses helped build a general explanation that fit the cohort (Yin, 2009). Cross-case analysis was an iterative process employing a constant comparative method whereby data were reduced across cases using analytic coding and category formation to compare data within and between categories and across cases (Anfara et al., 2002; Strauss & Corbin, 1998; Merriam, 2009).

Research Question 1: Considerations of Science Teaching and Learning

Participants’ considerations of RBSI in pedagogical decision making as they prepared to exit the TEP were derived from analysis of multiple artifacts from their TEP (e.g., Research-based Framework for Teaching Science, SATIC Self-evaluation of Teaching Behaviors, Draw a
Science Teacher assessments, Lesson Plans developed for Science Methods II, grades in the science education portion of the TEP, and letters of recommendation from faculty of the science education portion of the TEP). To identify participants’ considerations of RBSI in pedagogical decision making near the end of their first and second years of teaching (see Appendix A for interview questions), transcripts of the semistructured interviews were analyzed using the following procedures.

Initially, participants’ responses to questions concerning learning theory, student goals, and their teaching practice were coded using a priori categories (traditional, instructive, transitional, responsive, and reform-based) from research on science teacher beliefs conducted by Luft and Roehrig (2007). However, given the scope and nature of this study (which was not solely focused on teacher beliefs) a coding scheme was developed which was more conducive to analyzing the congruency of participants’ reflections on RBSI to those promoted by TEP, reform documents, and the research base on effective science teaching. The emergent categories used to code participants’ considerations of RBSI in pedagogical decision making were superficial, satisfactory, or deep. Descriptions of each category are provided below, and Table 1 includes examples derived from the data.

Pedagogical considerations coded as superficial are characterized by reflections that used educational terms imitative of the TEP but in a vague, perfunctory, and obligatory manner. These reflections were comparable to the practice described by Abell, Bryan, and Anderson (1998) as “noises that sound pedagogical” (p. 502). Superficial considerations were narrowly focused, limited to specific aspects of RBSI, and lacked application or explanation to demonstrate understanding. Superficial reflections were frequently more focused on teaching constraints than on the implementation of practices congruent with RBSI.
Pedagogical considerations coded as satisfactory are characterized by reflections on teaching and learning congruent with RBSI. Moreover, satisfactory considerations included some specific examples that illustrated the depth and interconnectedness of thinking between certain aspects of teaching and learning. However, other significant aspects of teaching and learning are not accounted for. Satisfactory reflections may be deep within certain constructs, but may either lack connections to other constructs, or reflections on certain aspects of RBSI are absent. For example, a teacher’s reflection may focus entirely on a specific implication of developmental learning theory (such as the concrete to abstract representation continuum) without reference either to other significant implications of developmental learning theory or to significant implications that follow from other learning theories.

Pedagogical considerations coded as deep demonstrate a sophisticated understanding of teaching and learning that are congruent with TEP and RBSI. These reflections are grounded in application via specific examples. Moreover, through the examples both depth and interconnectedness of understandings concerning teaching and learning are demonstrated.
Table 6. Categories of Participants’ RBSI Considerations, with Examples

<table>
<thead>
<tr>
<th>Category</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial</td>
<td>[When deciding how to teach] I’ve kind of just been following the general outline of the learning cycle where we do the activities and you can talk about it and then you do a reading . . . and then I think this year I want to do a lot more concept mapping with my students. So have them do a concept map first, kind of get where their current understanding is on the ideas, then do activities that would help further their understanding and then maybe re-address the concept map, then do discussion. But a lot of it really comes from following the learning cycle, having that really general lab discussion. “Here’s what it meant,” kind of a thing and then do the readings over it. (Emma, 2a:118)</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>[The greatest influence on my decision making is] obviously that I need to cover topics that I am told I need to cover. . . . [I also try to decide] what sort of interesting, engaging activities can I weave in . . . [because] when I have to barrel through tons of content in sort of [a] lecture format, better get these in somehow, sooner or later, so they can actually learn something. (Jack, 2:356)</td>
</tr>
<tr>
<td>Deep</td>
<td>I need to have student engagement in order to even assess [when learning is taking place], so that’s a really tricky thing. You never want to assume that learning has happened, even if it seems like it has. All my assessments are formative in nature, and even my summative assessments. If I need to I will go back and present additional experiences that I think the students might need to learn some concept that they didn’t learn before. For example, a lot of my assessments are always applications to a novel situation, so here’s something you’ve never seen in class before; can you apply your understanding to this different situation? . . . I do quizzes, tests, extended-responses, always. Even my multiple choice ones always have the extended response to why did you choose that. But like today, I didn’t collect anything, but I walked around and read students’ notes, what they were writing in their notebooks. I ask questions, I get people to share from around the room, sometimes not as much as I’d like. . . . [Then I say,] “Okay, discuss it at your tables, and then pick someone from the table.” Then I went back and got four or five different people at different tables to talk, so that gives me a general sense of how well we’re progressing. I didn’t ask 25 students, but I get a sampling. . . . Whiteboards are good because I can see what they’re thinking, even the people who don’t talk, which is also why I go around and look at notebooks. I try not to directly challenge, I mean, evaluate the student responses when they provide them, but I'll make mental notes of, okay, so that’s a key idea. I’ve got to go back and look at it, and I’ll try to adjust it maybe five minutes down the road, so it’s not like, “What you’re saying, John, is wrong.” (Liam, 3:452)</td>
</tr>
</tbody>
</table>
Table 7 lists how participants’ considerations of RBSI in pedagogical decision making were coded as they exited the TEP and progressed through their first years of teaching. Four participants demonstrated deep considerations of RBSI, five demonstrated satisfactory, and one demonstrated superficial considerations. Participants’ considerations of RBSI in pedagogical decision making shifted during their first year of teaching; by the end of that year, only two demonstrated deep considerations of RBSI, two demonstrated satisfactory considerations, and superficial considerations of RBSI increased to six participants. During participants’ second year of teaching, their considerations of RBSI in pedagogical decision making shifted once again. Four participants demonstrated deep considerations of RBSI and the remaining four participants were superficial in their considerations.

**Research Question 2: Science Teaching Practices**

Participants’ implementation of practices congruent with RBSI was scored using the LSC-COP (Appendix B) for most class periods observed. Additionally, participants’ interaction patterns were assessed using the Modified SATIC Coding Sheet (Appendix C). While the LSC-
COP and the Modified SATIC Coding Sheet both assess aspects of instruction, the constructs they assess overlap in only one portion of one domain (classroom implementation). Therefore, a low LSC-COP score does not always result in a correspondingly ineffective interaction pattern that is incongruent with RBSI. For example, a teacher may earn a low LSC-COP capsule rating for a lesson that is developmentally inappropriate and focused on trivial content, but his or her interaction pattern may be semicongruent or congruent with RBSI. However, the reverse scenario is unlikely. That is, a participant with an interaction pattern that is incongruent with RBSI would be unable to implement a lesson that earns high LSC-COP scores in the accomplished or exemplary categories. This is because lessons in these categories are implemented with flexibility and responsiveness to students’ needs—attributes that are incongruent with an ineffective interaction pattern of lecturing, asking short-answer questions, and responding in a manner that decreases student engagement.

Participants’ LSC-COP scores and interaction patterns were analyzed to construct composite RBSI scores (see Table 8) To create these scores, first, the average LSC-COP capsule rating was calculated for all classroom observations scored during participants’ first year of teaching. Average scores could range from 1 (ineffective RBSI) to 8 (effective RBSI). Then, each participant’s overall SATIC pattern was determined by evaluating the percent occurrence of each SATIC code category group for all classroom observations SATIC-coded during participants’ first year of teaching. For example, the percent occurrence of code 1 (lecturing or giving directions) was combined with the percent occurrence of code 2 (makes statement or asks rhetorical question) to determine the amount of time the participant spent initiating interactions with students through statements instead of questioning (i.e., codes 3a, 3b, 3c, & 4). Once the percent occurrence of each code group was calculated and displayed in a chart, then each
participant’s interaction pattern was assigned one of the following classifications:

- **Congruent with RBSI**—a pattern primarily consisting of the codes 3c & 4 (asking open-ended questions), code 6 (acknowledging student responses), and codes 11 & 12 (responding in a student-centered manner to promote student mental engagement).

- **Semicongruent with RBSI**—a pattern that does not primarily consist of the codes 3c & 4, 6, and 11 & 12. However, the participant sometimes exhibits these behaviors.

- **Incongruent with RBSI**—a pattern that primarily consists of the codes 1 & 2 (teacher talking without questioning), 3a & 3b (dichotomous and short-answer questions), and/or 5 & 7–10 (responses that limit student engagement and assessment of students’ thinking). The participant either rarely, or never, was coded with 3c & 4, code 6, and codes 11 & 12.

Next, the participant’s SATIC pattern classification was translated into a SATIC pattern score: congruent with RBSI = 3, semicongruent with RBSI = 2, incongruent with RBSI = 1. The LSC-COP capsule rating and the SATIC pattern score were summed to calculate a composite RBSI score. This score was then translated into the composite RBSI implementation level ranging from low (composite scores 2–5), to medium (composite scores 6–8), to high (composite scores 9–11). This procedure was repeated with observations conducted throughout participants’ second year of teaching to determine their second year composite RBSI. Table 8 lists participants’ composite RBSI implementation levels during their first and second years of teaching.
Table 8. Composite RBSI Implementation Level

<table>
<thead>
<tr>
<th>Participant</th>
<th>Year Teaching</th>
<th>LSC-COP Capsule Rating*</th>
<th>SATIC Pattern Score^</th>
<th>Composite RBSI Score</th>
<th>Composite RBSI Implementation Level+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrea</td>
<td>First</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>medium</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>6</td>
<td>3</td>
<td>9</td>
<td>high</td>
</tr>
<tr>
<td>Chris</td>
<td>First</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>medium</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>8</td>
<td>3</td>
<td>11</td>
<td>high</td>
</tr>
<tr>
<td>Emma</td>
<td>First</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>medium</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>low</td>
</tr>
<tr>
<td>Ethan</td>
<td>First</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>low</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>—</td>
<td>3</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Hannah</td>
<td>First</td>
<td>6</td>
<td>3</td>
<td>9</td>
<td>high</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>7</td>
<td>3</td>
<td>10</td>
<td>high</td>
</tr>
<tr>
<td>Jack</td>
<td>First</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>low</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>low</td>
</tr>
<tr>
<td>Liam</td>
<td>First</td>
<td>8</td>
<td>3</td>
<td>11</td>
<td>high</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>8</td>
<td>3</td>
<td>11</td>
<td>high</td>
</tr>
<tr>
<td>Martin</td>
<td>First</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>medium</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Mason</td>
<td>First</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>low</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>low</td>
</tr>
<tr>
<td>Noah</td>
<td>First</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>low</td>
</tr>
<tr>
<td></td>
<td>Second</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>low</td>
</tr>
</tbody>
</table>

*Scores range from 1 (ineffective RBSI) to 8 (effective RBSI). ^Patterns range from 1 (incongruent with RBSI) to 3 (congruent with RBSI). +Implementation levels range from low (composite scores 2–5), to medium (composite scores 6–8), to high (composite scores 9–11).

Table 9 summarizes participants’ implementation levels near the end of the TEP and their composite RBSI implementation levels during their first and second years of teaching. During their TEP, one participant had low, eight participants had medium, and one participant had high RBSI-Implementations levels. During their first year of teaching, four participants had low, four had medium, and two had high composite RBSI-implementation levels. During their second year of teaching four participants had low composite RBSI-implementation levels and four had high.
Ethan and Martin do not have composite RBSI implementation levels for their second year of teaching. Ethan was not teaching science during his second year and therefore could not be scored using the LSC-COP; Martin completed his first year of teaching during the third year of this study and was therefore a first-year teacher when the members of his cohort were second-year teachers.

Table 9. Participants’ RBSI Implementation Levels

<table>
<thead>
<tr>
<th>Participant</th>
<th>Implementation Level TEP</th>
<th>Composite Implementation Levels* by Year of Teaching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hannah</td>
<td>medium</td>
<td>high high</td>
</tr>
<tr>
<td>Liam</td>
<td>medium</td>
<td>high high</td>
</tr>
<tr>
<td>Chris</td>
<td>medium</td>
<td>medium high</td>
</tr>
<tr>
<td>Emma</td>
<td>low</td>
<td>medium low</td>
</tr>
<tr>
<td>Martin</td>
<td>medium</td>
<td>medium high</td>
</tr>
<tr>
<td>Andrea</td>
<td>medium</td>
<td>medium high</td>
</tr>
<tr>
<td>Ethan</td>
<td>medium</td>
<td>low —</td>
</tr>
<tr>
<td>Jack</td>
<td>high</td>
<td>low low</td>
</tr>
<tr>
<td>Mason</td>
<td>medium</td>
<td>low low</td>
</tr>
<tr>
<td>Noah</td>
<td>medium</td>
<td>low low</td>
</tr>
</tbody>
</table>

* See Table 8 for a description of the factors used to calculate the composite RBSI implementation level.

Research Question 3: Cohort Relationships

To construct an understanding of the nature of participants’ relationships with members of their cohort, analyses were conducted across case reports to identify common themes. Each resulting theme is supported by a quotation to exemplify the theme. The quotations were drawn from the case reports earlier in this chapter. Three themes were identified across the case reports concerning participants’ approach to support relationships with their cohort members during their time in the TEP. These themes persisted throughout participants’ first two years of teaching. Participants:
• *Hesitated in participating in cohort relationships (reluctant)*—reaching out to cohort members only after realizing they were struggling and would likely not successfully make it through the TEP without the assistance of their cohort members.

  Early in the program I was more the lone wolf. I was still very much in the, “I’m here for myself” [mode] but . . . [people] were reaching out for me to join in and participate. . . . [I started to become a member of the cohort at] the end of November, which was basically right when the first huge draft of the RBF was due. Once that pressure really started to get to me and I was just kind of lost, and I was like, “Well, they’re always working together” so I went to join them. . . . For me it was a, “Oh my goodness” moment, “I need help.” And that really pushed me to extend myself to join the group. (Mason, 1:89)

• *Solely engaged in group cohort support relationships (group)*—attending study groups or social gatherings and connecting with their cohort members via group e-mails.

  I certainly read everything [posted to the online group]. . . . I’m not being as proactive as I should. . . . Maybe I’m just not the guy to try to initiate that stuff. I’m much better at responding to someone else. (Noah, 3:654)

• *Developed and participated in personal cohort support relationships (personal)*—sharing phone calls, sending e-mails, and/or arranging meetings with individual members of their cohort. These participants may have participated in study groups, but they also spent time collaborating on schoolwork with select individuals, developing friendships.

  I just find comfort talking to [Andrea], and she helps me just kind of like defuse situations and tell me everything’s going to be okay—and same for her, too. So we bonded a lot over a lot of things. Chris I talk to a lot because him and I share content area. So him and I would kind of share activities, talk through things, “How did that work for you? Why’d you choose to do that? When did you put that in your sequence?” (Hannah, 2a:540)

Table 10 details how participants engaged in support relationships with members of their cohort throughout the study.
Table 10. Approach to Cohort Support Relationships

<table>
<thead>
<tr>
<th>Participant</th>
<th>Approach to Cohort Relationships Over Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>During TEP*</td>
</tr>
<tr>
<td>Andrea</td>
<td>personal</td>
</tr>
<tr>
<td>Chris</td>
<td>personal</td>
</tr>
<tr>
<td>Liam</td>
<td>personal</td>
</tr>
<tr>
<td>Martin</td>
<td>personal</td>
</tr>
<tr>
<td>Hannah</td>
<td>reluctant/personal</td>
</tr>
<tr>
<td>Emma</td>
<td>group</td>
</tr>
<tr>
<td>Jack</td>
<td>group</td>
</tr>
<tr>
<td>Noah</td>
<td>group</td>
</tr>
<tr>
<td>Ethan</td>
<td>reluctant</td>
</tr>
<tr>
<td>Mason</td>
<td>reluctant</td>
</tr>
</tbody>
</table>

*Participants’ approach to support relationships with their cohort members ranged from (1) hesitated in participating in support relationships (reluctant), to (2) engaged solely in group support relationships (group), to (3) developed and participated in personal support relationships (personal).

Research question 4: Superordinate relationships

Themes regarding the nature of participants’ superordinate relationships—intended to support and promote RBSI—emerged from a cross-case analysis of the case reports.

The first year. Three themes describe how participants’ superordinates supported participants’ attempts to implement practices congruent with RBSI; these themes persisted during participants’ second year. Administrators, mentors, and colleagues:

- Undermined participants’ attempts to implement teaching practices congruent with RBSI—using their authority to coerce participants into implementing practices incongruent with RBSI.

One of the [School Improvement Leaders] SILs . . . told us that [the school district] is now mandating that we all give common formative assessments. They all must be given at the same time and they must be exactly the same. So, no matter where your kids are at, or anything, by Friday, every student has to have the same quiz in your building. . . . I said, “Well, that concerns me because we, as teachers, need to make decisions as to what’s best for students, and something that this other teacher is doing might take less time with their students that it will
take with my students, but that’s not a reflection of intelligence of those students or anything else, but [of] those students’ misconceptions and the ideas that they’re trying to develop; and I’m concerned that if you’re mandating that these kids take this quiz, then, (1) we might harm concept development if students aren’t there yet, and discourage students, and their self efficacy is really important. So, if we’re giving it too early, it’s harmful. If we’re giving it too late, it’s pointless. Now kids are like, ‘Why are you giving me this if I knew this already so many days ago?’” After I had done that, I was approached by another SIL and told that he had heard that I was being a problem, and he would really encourage me to have a better attitude. (Andrea, 2a:525)

- **Were ambivalent toward practices congruent with RBSI**—neither promoting nor hindering participants’ attempts to implement practices congruent with RBSI. Participants with these types of superordinates often felt encouraged; however, the participants were rarely being encouraged to improve their RBSI in a meaningful manner.

  The science department, it’s just nice to talk about ideas. . . . How can we improve their graph interpretation? How can we improve their [ability to make logical inferences]? It’s nice to spend time actually talking about those issues . . . to have that [be] the highlight topic for a conversation to stem around. So data teams have been great. Then, the 7th grade science teacher, she has been my motivator. She took me under her wing. I went over there and observed one of her classes. It’s just nice to see how other people teach. She is the one that invited me to her classroom, so she’s very open and she wants me to do well. . . . It just seems like a friendlier staff, I would say, overall. (Mason, 3:87)

- **Supported—but did not promote—practices congruent with RBSI**—providing participants with emotional support that encouraged them to implement practices congruent with RBSI, although they were ill equipped to offer useful support that could help participants improve their teaching.

  [One of my colleagues was the state teacher of the year, the year before I started, and when I would go to her for support] she would just say, “Oh, Martin, you’re doing fantastic, don’t worry about any of that, you’re doing great. No, it’s going to be so good. Things I hear about you from the students are great, [you] just need to stay in it, stick in there.” So very much “hang in there” kind of support. And she is, I’m going to be honest . . . my graduate student Martin would be highly critical of her science [teaching] approach. However, monk Martin would be super pleased with her investment in the welfare of her students. . . . [She] picks up students from home and brings them to school, and takes them back home and makes sure that they have enough food to eat. (Martin, 2:666)
Two themes describe how participants navigated relationships with superordinates in their schools during their first year of teaching. Participants promoted practices congruent with RBSI in one of two ways:

- **Open promotion of practices congruent with RBSI**—actively promoting RBSI with their superordinates. These participants may have been attempting to change their colleagues’ practice, and/or they may have been trying to persuade their administrators to support their implementation of RBSI.

  [I have] collaboration time with my other science instructors within the building. . . . [During these meetings] eventually someone, typically me, has to go “All right, this physics unit we’re going through, what do we want students to know from the end of this?” . . . The meaningful discourse never occurs; it’s always on the “this is how we practically do this,” which again, that’s how I see it. My fellow colleagues tell me I’m too philosophical and really want to get into the research and overanalyze everything. So maybe a little bit of bias there I can admit to. . . . As many of the people and colleagues in this building will tell you, I tend to be the one who will overanalyze anything. So if anybody wants somebody to read research, they hand it to me and I read it then I give them a pretty serious summary and they go, “I don’t care, Noah. I just want to know what I’m supposed to do.” (Noah, 2:38)

- **Silence concerning RBSI**—not discussing RBSI with their superordinates. These participants either taught in a manner that was perceived by superordinates to be incongruent with RBSI, or was incongruent with RBSI.

  If I did something differently, I would be reprimanded by my administrator. And I have been in the past for not doing exactly the same thing my other instructor was doing. . . . On the one hand, who will find out? They are not keeping really close tabs on us, but on the other hand, that could get me into a lot of trouble. Trouble that I try to avoid. . . . A lot of the things I do in my classroom are different from what other teachers do. It’s not great to try to draw too much attention to myself. If I am doing some things differently, I am going to just do those and will kind of leave the rest for some other time. It’s just not worth trying to draw out battles like that. It is certainly not a battle I am going to win. . . . I didn’t really discuss [the reprimand I received] with my colleagues. (Jack, 3:156)

In response to superordinates who were unsupportive of practices congruent with RBSI, participants were:
• **Fearful of repercussions**—worried about losing their jobs, not acquiring supportive letters of recommendation, and not being recommended for promotion to a standard teaching license from their initial probationary license.

This is why at the beginning of the year I felt pressured to have to teach like everyone else, I think this is how [my administrator] said it, “I sense some differences in your teaching. Actually it’s more than a sense. I know there’s some differences in your teaching, and by next year that has to be erased.” . . . Like this week, I’m cramming what should be a two-week unit into two days, because I know I have to cover this, because I’ve been told I need to cover this if I want to keep my job. (Liam, 1a:243)

• **Intentional in the types of support they sought from their superordinates**—seeking out support from colleagues and mentors for issues unrelated to RBSI (e.g., access to supplies) and seeking out support for practices congruent with RBSI from cooperating teachers, cohort members, and science education faculty of the TEP.

I had support from colleagues for all sorts of things that were useful: they helped me find equipment; they helped me, “Here are things you can do with kids,” . . . but my colleagues are not necessarily in tune to the sorts of instruction that I am . . . so I couldn’t get much support from them on that front. However . . . they certainly are supportive with what I am trying to do in the classroom. So I mean, when I tell them this is what I’m trying to do and for these reasons they usually say, “Okay, that seems good; you should do that.” So they may not be doing what I’m doing but they’re not feeling like that’s a problem. (Jack, 2:233)

*The second year.* Three new themes emerged with respect to participants’ relationships with their superordinates during their second year of teaching.

• **Traumatization**—responding to superordinates during their second year of teaching—even in a new school—with fear, cautiousness, and avoidance if they had experienced intense superordinate constraints and/or retaliation to their attempts to implement RBSI during their first year of teaching.
I have this innate feeling when I’m told that . . . colleagues or people who have authority . . . have something to talk to me about. I worry that it’s going to be negative. And then I have to catch myself really listening to what they’re trying to say, because I do go on the defensive really quickly, too, which is not needed. But I panic and I think, “Oh my gosh, this person’s going to be attacking me again.” Then I have to take a step back and say they’re not trying to attack me. Gosh, they’re just trying to be helpful. (Andrea, 3:916)

- **Leadership**—adopting roles of instructional leaders, even though they are novices, when in schools where superordinates valued their implementation of practices congruent with RBSI.

  [My principal] was incredibly supportive [of the collaborative project I was implementing with another teacher], loves it, thinks it is amazing, wants more of this, told us we need to go to the school board to present it because she wanted the school board to see that this type of stuff is happening in the school; which was a great opportunity. (Hannah 3:548)

- **Listening carefully**—placing more value on listening to their superordinates to understand their views on teaching and learning and to identify like-minded collaborators.

  I’ve definitely socialized more with [other teachers] trying to identify teachers who have similar approaches. Even if it’s not the same content, there are similar approaches to how to work with kids. There are two camps that I’ve identified: the control camp, and the working with kids camp. I like the working with the kids camp, and I’ve identified a handful of teachers in that [camp]. They always have good ideas to share and good stories to share. It’s always much more positive, too, that environment. So I like that. So instead of eating alone I eat with colleagues, so I actually have lunch with people, so I’m not as lonely as I used to be, which is just really good. One guy that came in, he’s a special [education] teacher and works with me. We have a lot of good things to say about each other, and our work, and it’s always positive, which I really like. (Liam, 3:215)

**Superordinates’ Impact on RBSI Implementation.** Participants perceived their practice to be impacted by their superordinates in four significant ways during their first and second years of teaching:

- **They felt their implementation of practices congruent with RBSI was supported.** Although none of the participants had superordinates who could assist them in improving their
implementation of practices congruent with RBSI, some felt encouraged in their implementation efforts.

The admin, when they come in they’re nothing but glowing. This is kind of concerning because they can’t just give me one thing that you would like me to work on, just give me one thing. I don’t get any feedback from them. I know I’m not that good. . . . Sometimes [the administration will] bring somebody in from the county office. . . . I do know that I have full support of my principal. I think I have evidence that would support that. My principal has kind of been talking me up in a positive way. Just for some things in some conversations that we’ve had and he’s shared that with some of the other admin office people, the county office, the head of curriculum for the county, I know that when Liam and I were able to get [an] article, published in [a state peer reviewed science teaching practitioner journal], I shared a copy of that with my principal and then he forwarded it on to the curriculum director person. She’s really nice to me now. She said that it’s really nice to see that there are teachers out there that are putting in the time. Really understand what effective teaching looks like. You can do it. I think I have a lot of fans out there as far as they understand what I’m doing. . . . They do pop in very often. (Chris 3:371)

- They were covert in implementing practices congruent with RBSI. Participants did not speak up about their instructional practices with their superordinates. They selectively sought out advice and minimally implemented practices that were incongruent with RBSI, as needed, to appear as though they were implementing district mandates. They shared evidence of successfully implementing district mandates with their superordinates. They thanked colleagues for lesson plans and curricular materials, which they did not use.

  [School Improvement Leaders] have big egos, they really do. . . . If you approach them and say this is what I’m looking at, this is what I want to do. . . . So if you just go and seek out their advice for things that they’re incorporating, they get really excited about that. And if you do that enough, then it’s perceived that you are being a team player, and if they do walk in unannounced, you really, really do have to understand . . . you don’t necessarily have to agree with it, but when they walk into the room . . . you need to be able to turn on that switch and be able to use those buzzwords. . . . [Following their suggestions] I made a copy of some of the better [student work] and . . . I put it in their mailbox, and I just had this “Thanks for the advice. This is some sample work. This is a typical student response.” . . . Don’t ever challenge them. I mean at least not [as] a first or second year teacher. . . . We ought to ask questions and we want our students to be able to ask questions, but we’re in a situation. They don’t want to be challenged. (Chris, 2:224)
They struggled as they were torn between their school’s predominant conception of teaching and learning and the research-base regarding effective teaching. Instead of being covert and subverting the recommendations of their superordinates, these participants attempted to maintain their ideals concerning teaching and learning (to be in alignment with their TEP) while fully implementing practices incongruent with RBSI (to be in alignment with their superordinates). While they implemented some practices promoted by the TEP, they did so in a manner that was incongruent with RBSI.

And then I kind of realized that even though we had all agreed to do . . . this one worksheet and give this one test, that we weren’t even close to doing it. And it kind of became this battle between myself of going, “I said I would do this. I should, at least to some extent.” And then, “No one else is doing it; why would I even care?” . . . Which upset me, because I realized after four or five nights of having that run back and forth in my head, “Why haven’t I even considered what would be best for students here?” . . . How did this get involved so much in these personal things that the student thing wasn’t even in the question? So it became this weird middle ground that I’m trying to run, and I’m trying to navigate it, and right now I feel I’m swinging a little too far to what the department agreed to and not to what would probably be best for students all the time. That being said, my predecessor in this position happened to swing on the what would be best for students and was a villain within the building because of it, outside of maybe three people. But I would prefer my first year not to get that kind of flack; I couldn’t handle it. So I swing the other way. (Noah, 2:259)

They knowingly implemented practices incongruent with RBSI. With awareness, they compromised their personal and professional ethics to mitigate sanctions by their superordinates.

Clearly, we get told pretty much from the higher ups they expect us to be in the same place at the same time throughout the year. I haven’t tried to rock the boat on that. . . . I will follow this map and I will do everything that we need to do, and all this. Honestly, I have taken things out of various places, various units. I have done things differently than other teachers. Usually, it’s not something that anybody would notice, but I get the very strong sense that if I decided not to do a unit that another teacher did, that would be a serious problem. . . . I haven’t changed things very often, but I’m not trying to rock the boat too much. I make small changes where I can and just go from there. I modified labs, I have modified the way certain things are done. I’ve worked with people to remove
certain things from the curriculum or change things around, but, you know, I don’t want to be a rogue teacher here. That is not a good place to be in a lot of different levels (Jack, 3:184).

The themes that were developed from the cross-case analysis of participants’ relationships with their superordinates during their first two years of teaching form the basis of a model of RBSI support—the Superordinate Support of RBSI Continuum (see Figure 21).

### Figure 21. Model of RBSI Support

<table>
<thead>
<tr>
<th>Superordinate Support of RBSI Continuum</th>
<th>Saboteur</th>
<th>Neutral</th>
<th>Cheerleader</th>
<th>Advocate</th>
<th>More Knowledgeable Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undermines RBSI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creates fear in beginning teacher</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leverages contract renewal and/or recommendation for standard teaching license</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leverages relationships with administrators</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Promotes curriculum, instruction, and assessment practices incongruent with RBSI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambivalent toward RBSI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does not implement RBSI-congruent practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will neither help nor hinder beginning teachers’ attempts to implement RBSI-congruent practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>May suggest curriculum, instruction, and assessment practices incongruent with RBSI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encourages implementation of RBSI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does not implement RBSI-congruent practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will not hinder beginning teachers’ attempts to implement RBSI-congruent practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotionally supports beginning teachers’ attempts to implement RBSI-congruent practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encourages implementation of RBSI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recognizes effectiveness of RBSI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provides leadership opportunities related to implementation of RBSI-congruent practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provides resources to support beginning teachers’ attempts to implement RBSI-congruent practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encourages implementation of RBSI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implements and models RBSI-congruent practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaborates with beginning teachers to scaffold effective implementation of RBSI-congruent practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 11 summarizes where each participant’s superordinates fell on the continuum during participants’ first two years of teaching.

**Table 11. Superordinates’ Support of RBSI**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Superordinate Support* by Year of Teaching</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First</td>
</tr>
<tr>
<td>Martin</td>
<td>cheerleader</td>
</tr>
<tr>
<td>Emma</td>
<td>neutral</td>
</tr>
<tr>
<td>Hannah</td>
<td>neutral</td>
</tr>
<tr>
<td>Andrea</td>
<td>saboteur</td>
</tr>
<tr>
<td>Chris</td>
<td>saboteur</td>
</tr>
<tr>
<td>Ethan</td>
<td>saboteur</td>
</tr>
<tr>
<td>Jack</td>
<td>saboteur</td>
</tr>
<tr>
<td>Liam</td>
<td>saboteur</td>
</tr>
<tr>
<td>Mason</td>
<td>saboteur</td>
</tr>
<tr>
<td>Noah</td>
<td>saboteur</td>
</tr>
</tbody>
</table>

*See Figure 21 for a description of the Superordinate Support of RBSI Continuum (RBSI support types range from saboteur to more knowledgeable other).

Despite the possibility and intention of superordinates to support the growth of new teachers, no participant in this study was in a setting where a RBSI more knowledgeable other (MKO) was placed in a superordinate role to provide useful assistance in instructional improvement. During participants’ first year of teaching, the strongest superordinate relationship encountered was one instance of a cheerleader. During participants’ second year of teaching, the strongest superordinate relationship encountered was four instances of advocates. Also notable is that four of the seven teachers who were in saboteur settings were able to change schools to ones that had less hostile superordinate support, and one of the seven teachers remained at the same school but the administration changed toward one advocating RBSI.
Table 12. *Participants’ Cohort and Superordinate Relationships*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Cohort Relationships</th>
<th>First Year</th>
<th>Second Year</th>
<th>Support Type</th>
<th>Participant Response</th>
<th>Support Type</th>
<th>Participant Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrea</td>
<td>personal</td>
<td>personal</td>
<td>personal</td>
<td>saboteur</td>
<td>fearful &amp; intentional</td>
<td>advocate</td>
<td>traumatized</td>
</tr>
<tr>
<td>Chris</td>
<td>personal</td>
<td>personal</td>
<td>personal</td>
<td>saboteur</td>
<td>fearful &amp; intentional</td>
<td>advocate</td>
<td>traumatized</td>
</tr>
<tr>
<td>Liam</td>
<td>personal</td>
<td>personal</td>
<td>personal</td>
<td>saboteur</td>
<td>fearful &amp; intentional</td>
<td>advocate</td>
<td>ID like-minded colleagues</td>
</tr>
<tr>
<td>Martin</td>
<td>personal</td>
<td>personal</td>
<td>—</td>
<td>cheerleader</td>
<td>intentional</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Hannah</td>
<td>reluctant/ personal</td>
<td>personal</td>
<td>personal</td>
<td>neutral</td>
<td>listening to be invisible</td>
<td>advocate</td>
<td>ID like-minded colleagues</td>
</tr>
<tr>
<td>Emma</td>
<td>group</td>
<td>group</td>
<td>reluctant/ group</td>
<td>neutral</td>
<td>superficial collaboration</td>
<td>saboteur</td>
<td>superficial collaboration</td>
</tr>
<tr>
<td>Jack</td>
<td>group</td>
<td>group</td>
<td>reluctant/ group</td>
<td>saboteur</td>
<td>fearful &amp; intentional</td>
<td>saboteur</td>
<td>fearful &amp; intentional</td>
</tr>
<tr>
<td>Noah</td>
<td>group</td>
<td>group</td>
<td>group</td>
<td>saboteur</td>
<td>fearful</td>
<td>saboteur</td>
<td>superficial collaboration</td>
</tr>
<tr>
<td>Ethan</td>
<td>reluctant</td>
<td>reluctant</td>
<td>reluctant</td>
<td>saboteur</td>
<td>fearful</td>
<td>—</td>
<td>traumatized</td>
</tr>
<tr>
<td>Mason</td>
<td>reluctant</td>
<td>reluctant</td>
<td>group</td>
<td>saboteur</td>
<td>disengage</td>
<td>neutral</td>
<td>superficial collaboration</td>
</tr>
</tbody>
</table>

**Summary of socialization experiences findings.** Participants who established and maintained personal collaborative collegial relationships with members of their cohort during their TEP continued to seek out individual cohort members throughout their first two years of teaching for collaboration. Participants who interacted with their cohort members through group interactions continued using a group approach during their first two years of teaching. However, two participants relied upon group support grew reluctant to reach out, even through group e-mails, during their second year of teaching. Participants who were reluctant to seek out their cohort members for support during their TEP were also reluctant to seek such support during their first year of teaching. However, one of these participants shifted by his second year of teaching and began more openly seeking support from the group.
Two of the five teachers who were in saboteur superordinate relationships did not leave the school or experience a change mentors/administrators. The second year, not surprisingly, also consisted of saboteur superordinate relationships. Six participants’ superordinate support of RBSI improved during this study, and this was due to five participants changing schools and changes in one participant’s school administration.

**Research Question 5: Relationships Between Variables**

During participants’ first year of teaching, those who implemented RBSI at a medium to high level reflected on RBSI in different ways that were coded as superficial \((n=1)\), satisfactory \((n=2)\), and deep \((n=1)\). However, all participants who implemented RBSI at a low level reflected on RBSI in a manner that was coded as superficial \((n=5)\). Table 13 summarizes these results.

**Table 13. RBSI Implementation Level and Considerations of Teaching—First Year**

<table>
<thead>
<tr>
<th>Composite RBSI Implementation Level*</th>
<th>Considerations of RBSI</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>deep</td>
<td>Liam</td>
</tr>
<tr>
<td>high</td>
<td>satisfactory</td>
<td>Hannah</td>
</tr>
<tr>
<td>medium</td>
<td>deep</td>
<td>Martin</td>
</tr>
<tr>
<td>medium</td>
<td>satisfactory</td>
<td>Chris</td>
</tr>
<tr>
<td>medium</td>
<td>superficial</td>
<td>Emma</td>
</tr>
<tr>
<td>medium</td>
<td>superficial</td>
<td>Andrea</td>
</tr>
<tr>
<td>low</td>
<td>superficial</td>
<td>Ethan</td>
</tr>
<tr>
<td>low</td>
<td>superficial</td>
<td>Jack</td>
</tr>
<tr>
<td>low</td>
<td>superficial</td>
<td>Mason</td>
</tr>
<tr>
<td>low</td>
<td>superficial</td>
<td>Noah</td>
</tr>
</tbody>
</table>

*See Table 8 for calculation of composite RBSI Implementation Levels (implementation levels range from low to high).

During participants’ second year of teaching, the data diverged. Those who implemented RBSI at a medium to high level reflected on RBSI in a manner that was coded as deep \((n=4)\). All participants who implemented RBSI at a low level reflected on RBSI in a manner that was coded at superficial \((n=4)\). Table 14 summarizes these results.
Table 14. RBSI Implementation Level and Considerations of Teaching—Second Year

<table>
<thead>
<tr>
<th>Composite RBSI Implementation Level*</th>
<th>Considerations of RBSI</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>deep</td>
<td>Andrea</td>
</tr>
<tr>
<td>high</td>
<td>deep</td>
<td>Chris</td>
</tr>
<tr>
<td>high</td>
<td>deep</td>
<td>Hannah</td>
</tr>
<tr>
<td>high</td>
<td>deep</td>
<td>Liam</td>
</tr>
<tr>
<td>low</td>
<td>superficial</td>
<td>Mason</td>
</tr>
<tr>
<td>low</td>
<td>superficial</td>
<td>Emma</td>
</tr>
<tr>
<td>low</td>
<td>superficial</td>
<td>Jack</td>
</tr>
<tr>
<td>low</td>
<td>superficial</td>
<td>Noah</td>
</tr>
<tr>
<td>—</td>
<td>—</td>
<td>Ethan</td>
</tr>
<tr>
<td>—</td>
<td>—</td>
<td>Martin</td>
</tr>
</tbody>
</table>

*See Table 8 for calculation of composite RBSI Implementation Levels (implementation levels range from low to high).

Relationships between RBSI implementation levels and socialization experiences. During participants’ first year of teaching, those who implemented RBSI at a medium to high level had superordinates who ranged on the RBSI support continuum from saboteur (n=2), to neutral (n=2), to cheerleader (n=1). However, all participants who implemented RBSI at a low level had superordinates who were saboteurs (n=5). Table 15 summarizes these results.
### Table 15. RBSI Implementation Level and Superordinate Support—First Year

<table>
<thead>
<tr>
<th>Composite RBSI Implementation Level*</th>
<th>Superordinate Support^</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>neutral</td>
<td>Hannah</td>
</tr>
<tr>
<td>high</td>
<td>saboteur</td>
<td>Liam</td>
</tr>
<tr>
<td>medium</td>
<td>cheerleader</td>
<td>Martin</td>
</tr>
<tr>
<td>medium</td>
<td>neutral</td>
<td>Emma</td>
</tr>
<tr>
<td>medium</td>
<td>saboteur</td>
<td>Chris</td>
</tr>
<tr>
<td>low</td>
<td>saboteur</td>
<td>Andrea</td>
</tr>
<tr>
<td>low</td>
<td>saboteur</td>
<td>Ethan</td>
</tr>
<tr>
<td>low</td>
<td>saboteur</td>
<td>Jack</td>
</tr>
<tr>
<td>low</td>
<td>saboteur</td>
<td>Mason</td>
</tr>
<tr>
<td>low</td>
<td>saboteur</td>
<td>Noah</td>
</tr>
</tbody>
</table>

*See Table 8 for calculation of composite RBSI Implementation Levels (implementation levels range from low to high).

^See Figure 21 for a description of the Superordinate Support of RBSI Continuum (RBSI support types range from saboteur to more knowledgeable other).

During participants’ second year of teaching, the data diverged. Those who implemented RBSI at a medium to high level had superordinates who were advocates on the RBSI support continuum (n=4). Participants who implemented RBSI at a low level had superordinates who were neutral (n=1) or saboteurs (n=3). Table 16 summarizes these results.
Table 16. *RBSI Implementation Level and Superordinate Support—Second Year*

<table>
<thead>
<tr>
<th>Composite RBSI Implementation Level*</th>
<th>Superordinate Support^ Participant</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>advocate</td>
<td>Andrea</td>
</tr>
<tr>
<td>high</td>
<td>advocate</td>
<td>Chris</td>
</tr>
<tr>
<td>high</td>
<td>advocate</td>
<td>Hannah</td>
</tr>
<tr>
<td>high</td>
<td>advocate</td>
<td>Liam</td>
</tr>
<tr>
<td>low</td>
<td>neutral</td>
<td>Mason</td>
</tr>
<tr>
<td>low</td>
<td>saboteur</td>
<td>Emma</td>
</tr>
<tr>
<td>low</td>
<td>saboteur</td>
<td>Jack</td>
</tr>
<tr>
<td>low</td>
<td>saboteur</td>
<td>Noah</td>
</tr>
<tr>
<td>—</td>
<td>—</td>
<td>Ethan</td>
</tr>
<tr>
<td>—</td>
<td>—</td>
<td>Martin</td>
</tr>
</tbody>
</table>

*See Table 8 for calculation of composite RBSI Implementation Levels (implementation levels range from low to high).^ See Figure 21 for a description of the Superordinate Support of RBSI Continuum (RBSI support types range from saboteur to more knowledgeable other).

Relationships between pedagogical considerations, RBSI implementation, and socialization experiences. The relationships between participants’ considerations of RBSI in pedagogical decision making, composite RBSI implementation levels, and socialization experiences during their first year of teaching are displayed in Figure 22. A double solid oval (=) symbolizes participants’ considerations of RBSI coded as deep, a single solid oval (—) symbolizes considerations coded as satisfactory, and a dashed oval (---) symbolizes considerations coded as superficial (see Table 6 for code descriptions and Table 7 for a summary of coding). The placement of ovals within horizontal categories signifies participants’ superordinates’ location on the RBSI continuum. The placement of ovals within vertical categories signifies participants’ composite RBSI implementation levels. Horizontal and vertical positioning of ovals within categories (e.g., saboteur or high) is not significant. Arrows represent participants who personally interacted with each other to support their implementation of practices congruent with RBSI.
During their first year of teaching, none of the participants experienced superordinates who were classified as advocates or more knowledgeable others. Nonetheless, two participants implemented teaching practices congruent with RBSI at a high level, and four participants implemented RBSI at a medium level. While these six participants spanned the range of considerations of RBSI, they all were in personal contact with members of their cohort.

The relationships between participants’ considerations of RBSI in pedagogical decision making, composite RBSI implementation levels, and socialization experiences during their second year of teaching are displayed in Figure 23. During their second year of teaching, none of the participants experienced superordinates who were classified more knowledgeable others. Nonetheless, four participants implemented teaching practices congruent with RBSI at a high level, and four participants implemented RBSI at a low level. The participants who implemented practices congruent with RBSI to a high level were engaged in personal collegial relationships with members of their cohort, while the participants who implemented RBSI congruent practices at a low level mostly, were not.
Figure 22. Relationships between considerations of teaching, RBSI implementation, and socialization experiences during participants first year of teaching. Arrows represent participants who personally interacted with each other to support implementation RBSI. Considerations of RBSI: = deep, — satisfactory, - - superficial. Red ovals represent participants who interacted with superordinates in intentional ways. Horizontal and vertical positioning of ovals within categories (e.g., the left to right positioning of ovals in the saboteur column) is not significant.
Figure 23. Cohort interactions, superordinate support, response to superordinates, considerations of RBSI, and composite RBSI implementation levels during participants second year of teaching. Arrows represent participants who personally interacted with each other to support implementation RBSI. Considerations of RBSI: = deep, —satisfactory, - - superficial. Red ovals represent participants who interacted with superordinates in intentional ways. Horizontal and vertical positioning of ovals within categories (e.g., the left to right positioning of ovals in the saboteur column) is not significant. (Ethan did not teach science during his second year and is not represented in this figure. Martin’s second year of teaching occurred following the conclusion of this study, thus he is also not represented.)

Summary of relationships. From the case reports and cross-case analyses that resulted in the findings described for research questions 1–2, eight themes with 31 subthemes were developed (see Table 17). From these data-derived categories, time-series displays were constructed to follow changes over time and across cases, “with contrasting time-series patterns postulated for different cases” (Yin, 2009, p. 146). Time-series analyses were conducted to understand if participants who became high-level implementers of RBSI shared a pattern and, likewise, if participants who became low-level implementers of RBSI followed a distinctive pattern.
Table 17. *Key to the codes used in Figure 24 and Figure 25.*

<table>
<thead>
<tr>
<th>Code—Theme</th>
<th>Code—Subtheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consideration—participants’ considerations of RBSI</td>
<td>1—superficial</td>
</tr>
<tr>
<td></td>
<td>2—satisfactory</td>
</tr>
<tr>
<td></td>
<td>3—deep</td>
</tr>
<tr>
<td>Implementation—alignment of participants’ interaction pattern to RBSI</td>
<td>1—incongruent</td>
</tr>
<tr>
<td></td>
<td>2—semicongruent</td>
</tr>
<tr>
<td></td>
<td>3—congruent</td>
</tr>
<tr>
<td>Cohort—approach to engaging in relationships with cohort members</td>
<td>1—reluctant</td>
</tr>
<tr>
<td></td>
<td>2—group</td>
</tr>
<tr>
<td></td>
<td>3—personal</td>
</tr>
<tr>
<td>Superordinates—superordinates’ location on the RBSI support continuum</td>
<td>1—saboteur</td>
</tr>
<tr>
<td></td>
<td>2—neutral</td>
</tr>
<tr>
<td></td>
<td>3—cheerleader</td>
</tr>
<tr>
<td></td>
<td>4—advocate</td>
</tr>
<tr>
<td></td>
<td>5—MKO</td>
</tr>
<tr>
<td>Promotion—participants’ promotion of RBSI to change colleagues’ practice</td>
<td>1—open</td>
</tr>
<tr>
<td></td>
<td>2—selective</td>
</tr>
<tr>
<td></td>
<td>3—none</td>
</tr>
<tr>
<td>Response—participants’ primary response to superordinates’ “support” of RBSI</td>
<td>1—traumatized</td>
</tr>
<tr>
<td></td>
<td>2—disengagement</td>
</tr>
<tr>
<td></td>
<td>3—fearful</td>
</tr>
<tr>
<td></td>
<td>4—superficial collaboration</td>
</tr>
<tr>
<td></td>
<td>5—fearful &amp; intentional</td>
</tr>
<tr>
<td></td>
<td>6—intentional</td>
</tr>
<tr>
<td></td>
<td>7—listening to be invisible</td>
</tr>
<tr>
<td></td>
<td>8—listening to identify like-minded colleagues</td>
</tr>
<tr>
<td>Value—draw from the research-base or the school’s predominant conception of teaching and learning</td>
<td>1—school (with predominant considerations of teaching and learning incongruent with the research)</td>
</tr>
<tr>
<td></td>
<td>2—torn between research-base and school</td>
</tr>
<tr>
<td></td>
<td>3—research-base</td>
</tr>
<tr>
<td>Self-awareness—participants’ self-awareness of their RBSI implementation attempts</td>
<td>1—unaware incongruent</td>
</tr>
<tr>
<td></td>
<td>2—aware incongruent</td>
</tr>
<tr>
<td></td>
<td>3—aware covert congruent</td>
</tr>
<tr>
<td></td>
<td>4—aware open congruent</td>
</tr>
<tr>
<td>RBSI level—participants’ composite RBSI implementation level</td>
<td>1—low</td>
</tr>
<tr>
<td></td>
<td>2—medium</td>
</tr>
<tr>
<td></td>
<td>3—high</td>
</tr>
</tbody>
</table>

A time series display of the subthemes that describe the participants who had low levels of RBSI implementation at the end of this study (n=5) appears in Figure 24. Following a list of the participants in the first column, the horizontal axis is divided into three primary categories that represent time—participants’ time in the TEP, first year of teaching, and second year of teaching. Within each of these time periods, the relevant theme codes are listed. Then, vertically stacked above each theme are the related subtheme codes. Participants each have a distinct line type that traces their path throughout the course of this study.
Figure 24. Time-series display for participants with low RBSI composite scores at the end of the study.
Figure 25. Time-series display for participants with medium and high RBSI composite scores at the end of this study.
Pathways of low level RBSI participants. During their first year of teaching, participants who had low levels of RBSI implementation at the end of this study were more likely than participants who had high levels of RBSI implementation to:

- primarily interact with their cohort members en masse or reluctantly, they do not personally interact with cohort members who have deeper understandings of RBSI
- openly promote RBSI in attempts to change colleagues’ practice
- respond to superordinates by becoming fearful or disengaging from interactions
- value their school’s predominant conception of teaching and learning, even if it was incongruent with the research base on effective science teaching, or attempt to simultaneously value their school and the research-base
- be unaware that their teaching practices are incongruent with RBSI
- superficially consider RBSI when discussing pedagogical decision-making
- have low levels of RBSI implementation

During their second year of teaching, participants who had low levels of RBSI implementation were more likely than participants who had high levels of RBSI implementation to:

- primarily interact with their cohort members en masse or reluctantly, they do not personally interact with cohort members who have deeper understandings of RBSI
- have superordinates who were coded as saboteurs or neutral on the Superordinate RBSI Support Continuum
- respond to superordinates by engaging in superficial collaboration
- value their school’s predominant conception of teaching and learning, even if it was incongruent with the research-base on effective science teaching, or attempt to simultaneously value their school and the research-base
• be unaware that their teaching practices are incongruent with RBSI
• superficially consider RBSI when discussing pedagogical decision-making

Pathways of high-level RBSI participants. Conversely, during their first year of teaching, participants who had high levels of RBSI implementation at the end of this study were more likely than participants who had low levels of RBSI implementation to:

• personally interact with cohort members who can serve as MKOs in certain domains
• refrain from engaging promotion of RBSI with superordinates
• value the research base on effective science teaching over their school’s predominant conception of teaching and learning if it was incongruent with the research base
• be aware that their teaching practices are congruent with RBSI
• consider RBSI when discussing pedagogical decision-making in satisfactory or deep ways
• have medium to high levels of RBSI implementation

During their second year of teaching, participants who had high levels of RBSI implementation were more likely than participants who had low levels of RBSI implementation to:

• personally interact with cohort members who can serve as MKOs in certain domains
• have superordinates who were coded as advocates on the Superordinate RBSI Support Continuum
• selectively promote RBSI with superordinates
• respond to superordinates either with a posttraumatic stress response or by listening to identify like-minded colleagues
• value the research base on effective science teaching over their school’s predominant conception of teaching and learning if it was incongruent with the research base
be aware that their teaching practices are incongruent with the dominant practices of their school and openly enact practices congruent with RBSI

deply consider RBSI when discussing pedagogical decision-making

**Summary of Findings**

**Pedagogical Considerations and Practice**

*Research Question 1: How congruent are study participants’ considerations of teaching and learning with research-based science instruction at the end of their TEP, first year of teaching, and second year of teaching?*

- At the end of their TEP, one participant demonstrated superficial considerations of RBSI in pedagogical decision making, five satisfactory, and four participants demonstrated deep considerations.

- At the end of their first year of teaching, six participants demonstrated superficial considerations of RBSI in pedagogical decision making, two satisfactory, and two participants demonstrated deep considerations.

- At the end of their second year of teaching, four participants demonstrated superficial considerations of RBSI in pedagogical decision making and four participants demonstrated deep considerations. (One participant conducted his second year of teaching following the conclusion of this study and one participant did not teach science during his second year of teaching.)

*Research Question 2: To what extent are study participants implementing teaching practices congruent with research-based science instruction at the end of their TEP, first year of teaching, and second year of teaching?*
• At the end of their TEP, one participant demonstrated low levels of implementation of practices congruent with RBSI, eight demonstrated medium, and one participant demonstrated high levels of implementation.

• During their first year of teaching, four participants demonstrated low levels of implementation of practices congruent with RBSI, four demonstrated medium, and two participants demonstrated high levels of implementation.

• During their second year of teaching, four participants demonstrated low levels of implementation of practices congruent with RBSI and four participants demonstrated high levels of implementation. (One participant conducted his second year of teaching following the conclusion of this study and one participant did not teach science during his second year of teaching.)

Socialization Experiences

*Research Question 3: What is the nature of study participants’ relationships with members of their cohort during their TEP, first year of teaching, and second year of teaching?*

• At the end of their TEP, five participants were reluctant to participate in support relationships with members of their cohort and/or solely engaged in support relationships through group settings—attending study groups or social gatherings and connecting with their cohort members via group e-mails; and five participants developed and established support relationships with individual members(s) of their cohort.

• During their first year of teaching, five participants were reluctant to participate in support relationships with members of their cohort and/or solely engaged in support relationships through group settings, and five participants engaged in support relationships with more than one member of their cohort.
During their second year of teaching, five participants were reluctant to participate in support relationships with members of their cohort and/or solely engaged in support relationships through group settings, and four participants engaged in support relationships with more than one member of their cohort. (One participant conducted his second year of teaching following the conclusion of this study.)

Research Question 4: What is the nature of study participants’ relationships with the superordinates charged with supporting them during their first years of teaching?

During their first year of teaching, seven participants experienced saboteurs, two experienced neutral superordinates, and one experienced a cheerleader. In response to sabotaging superordinates: One participant disengaged from relationships with his superordinates; two participants were fearful of their superordinates; four participants were fearful and intentional. The two participants in neutral environments kept quite, to the ends of being invisible and not drawing attention. The one participant who experienced cheerleaders was intentional about getting different kids of support from different superordinates.

During participants’ second year of teaching, three participants experienced saboteurs, and in response, two of these participants engaged in superficial collaborations and one participant was fearful and intentional in his superordinate interactions. One participant experienced neutral superordinates and engaged in superficial collaborations with them. Four participants experienced advocates, and two of these participants experienced post-traumatic stress response when interacting with their superordinates. These two participants carried trauma from their first year of teaching over into their second year of teaching. The other two participants who experienced advocates, sought out like-minded
colleagues. (One participant conducted his second year of teaching following the conclusion of this study and another did not teach science during his second year.)

**Relationships Between Variables**

*Research Question 5: What relationships exist, if any, between study participants’ considerations of teaching and learning, teaching practices, and their socialization experiences during this study?*

- Participants who had low-levels of RBSI implementation at the end of this study were more likely than participants who had high-levels of RBSI implementation to:
  - Express superficial considerations of RBSI in pedagogical decision making.
  - Implement RBSI at low levels during their first year of teaching.
  - Never develop personal collaborative collegial relationships with members of their cohort.
  - Have superordinates that were saboteurs throughout their first two years.
  - Initially openly promoted RBSI in attempts to change colleagues’ practice, and were admonished for doing so.
  - Respond to superordinates by becoming fearful, disengaging from interactions, or engaging in collaboration that is superficial.
  - Make decisions aligned with the predominant conception of teaching and learning espoused by their school and/or school colleagues instead of valuing and drawing from the research-base regarding effective teaching; or attempt to simultaneously orient themselves with he predominant conception of teaching and learning espoused by their school and/or school colleagues and the research-base, despite incongruences.
Be unaware that their teaching practices had become incongruent with RBSI—even though they were attempting to promote RBSI with their colleagues.

Participants who had high-levels of RBSI implementation at the end of this study were more likely than participants who had low-levels of RBSI implementation to:

- Demonstrate satisfactory or deep considerations teaching and learning.
- Have medium to high levels of RBSI implementation at the end of their first year of teaching.
- Establish and maintain personal collaborative collegial relationships with members of their cohort.
- Have superordinates during their second year of teaching who were advocates.
- Refrain from openly promoting RBSI with superordinates during their first year of teaching, and selectively and cautiously promote RBSI with superordinates during their second year of teaching.
- Sought out specific types of support (often unrelated to what truly matters regarding effective teaching) to appear as valuing the ideas and support of superordinates who did not understand or implement RBSI, for political reasons.
- Value and draw from the research-base regarding effective teaching, while strategically avoiding the predominant conception of teaching and learning espoused by their school and/or school colleagues.
- Personally acknowledge that their teaching practices are incongruent with the dominant practices of their school and either openly enact practices congruent with RBSI, or do so covertly.
CHAPTER 5: DISCUSSION AND IMPLICATIONS

In her 2001 framework of teacher development, Feiman-Nemser calls for paying “attention to teachers as learners” (p. 1025) during their TEP and induction years. In discussing the findings for each component of this study, this chapter will heed that call and consider study participants’ development through the lenses of conceptual change and social and developmental learning theories to make sense of the relationships between beginning science teachers’ considerations of teaching and learning, teaching practices, and their socialization experiences during their TEP and their first and second years of teaching.

The Understanding and Practices of Beginning Science Teachers

1. Considering RBSI in pedagogical decision making is necessary by the end of the program, but insufficient for high implementation at the end of the second year.

The first-year science teachers in Fletcher and Luft’s (2011) study “tended to revert to more traditionally held beliefs, despite the strong reform-based mission of the program” (p. 20). Similar to Fletcher and Luft’s finding, the depth of RBSI thinking when discussing pedagogical decision-making diminished for six of the ten participants in this study during their first year of teaching (five of whom experienced environments hostile to RBSI and one who experienced a neutral environment). However, during their second year of teaching, two of these six participants (Chris and Andrea) moved to schools with superordinates who advocated for RBSI, and the depth of their RBSI thinking when discussing pedagogical decision-making increased to a deep level. This increase returned Chris back to the deep level of RBSI thinking he was engaging in at the end of the TEP, and for Andrea, this increase surpassed the depth of thinking she was engaged in at the end of their TEP.

In contrast to Fletcher and Luft’s finding, three of the ten participants in this study
(Hannah, Liam, and Martin) maintained the depth of their RBSI thinking from the end of their TEP through their first year of teaching. Liam did so in an environment hostile to RBSI, Hannah was in a neutral environment, and Martin was in a cheerleading environment. Then, during their second year of teaching, Hannah moved to an environment with superordinates who advocated for RBSI and increased her depth of RBSI thinking, and Liam’s administration changed to RBSI advocates and he maintained a deep level of RBSI thinking. (Martin did not conduct his second year of teaching before this study was completed.) The one participant in this study who superficially considered RBSI when discussing pedagogical decision-making at the end of the TEP, Mason, continued to do so throughout his first two years of teaching. Mason encountered a hostile RBSI environment during his first year of teaching and a neutral environment during his second year of teaching.

Possessing the ability to consider teaching and learning in a manner congruent with RBSI prior to the first year of teaching appears to be a crucial factor for continued beginning science teacher development during their induction years. An important addition to Fletcher and Luft’s conclusions can be supported with findings from this study—beginning science teachers whose considerations and implementation of RBSI-congruent practices decline in their first year of teaching can reverse course in their second year. However, this reversal only occurred in instances where beginning science teachers were receiving superordinate support in the form of advocacy. Moreover, the participant who had superficially considered RBSI in pedagogical decision making throughout the study (Mason), encountered RBSI sabotage during his first year of teaching and a neutral RBSI environment during his second; and the participant whose considerations were deep at the end of the TEP and reverted to superficial throughout his first and second years of teaching (Jack), encountered sabotaging superordinates both years.
Therefore, the ability to consider teaching and learning in a manner congruent with RBSI prior to the first year of teaching appears to be a necessary, but insufficient, condition for deep understanding and practice of RBSI by the end of the second year of teaching.

A longitudinal study of first and second year secondary science teachers in different induction programs identified that the school context had a greater effect than the induction programs on the beginning science teachers (Luft et al. 2011). Although this study did not examine specific induction programs, similarly, the predominate conceptions of teaching and learning held by the participants’ superordinates impacted participants’ implementation of RBSI. While context is helpful in understanding beginning science teacher development, the following sections will illustrate how it does not fully account for the development (or lack of development) of pedagogical considerations and practices congruent with RBSI as science teachers transition from their TEP through their first two years of teaching.

2. Not one graduate was in a school setting where an administrator, instructional coach, mentor, or colleague could help them improve during the first year of teaching. During the second year, the most support received was encouragement from advocates. RBSI more knowledgeable others were not a part of beginning teachers’ school settings.

At best, one participant in the study was a first year teacher in a school that had superordinate support at the level of a cheerleader. At worst, 7 participants in this study found themselves in hostile environments during their first year of teaching that actively worked against the preparation they had received in the TEP. Superordinates in these schools actively sabotaged their efforts to implement RBSI. This finding has many implications. First, teacher education programs that reduce coursework and primarily conduct preparation and induction by immersing teacher candidates and beginning teachers in schools are likely to perpetuate the
status quo in schools rather than promote teacher growth toward RBSI. Programs such as Teach for America and school district teacher internship licensure programs make the assumption that learning to teach is best supported in a school rather than in a university-based program. However, this study illustrates that the schools faced by these beginning science teachers were not supportive of RBSI, and most actively worked against it. Second, the assumption is faulty that those in the school with a greater number of years of experience or a higher administrative title are in a position to know more about RBSI than the new teacher. Participants in this study were happy to receive help with superficial issues (e.g., where to find supplies, how to navigate district policies), but felt that instructional support was either lacking or antithetical to effective teaching.

3. Beginning science teachers in schools where RBSI efforts are sabotaged need to leave as soon as possible. Those who stayed for a second year were not effective in their implementation RBSI, and worse, they failed to accurately assess how poor their teaching had become.

If beginning science teachers are (a) implementing practices congruent with RBSI at a low level during their first year of teaching, and (b) remain in environments without RBSI advocates or more knowledgeable others (MKOs), then they are unlikely to implement practices congruent with RBSI during their second year of teaching. This is even the case for participants who exited the TEP implementing teaching practices congruent with RBSI. Furthermore, one participant—with a medium RBSI implementation level at the end of her first year of teaching—was in an environment unsupportive of RBSI during her second year of teaching, and decreased her implementation to low levels. All participants who implemented practices congruent with RBSI at low levels during their first year of teaching continued to do so during their second.
Implementing practices congruent with RBSI at a medium level by the end of the TEP appears to be a necessary, but insufficient, condition for high-level RBSI implementation at the end of beginning science teachers’ second year of teaching.

4. Effective implementation of RBSI is possible during the first year.

The implementation of practices congruent with RBSI by six out of ten participants during their first year of teaching, and four out of eight participants during their second year of teaching, is contrary to the literature suggesting that practices congruent with RBSI are too complex for beginning science teachers to implement during their first years of teaching (Meyer, 2004; Simmons et al., 1999). Moreover, findings concerning participants’ practices lend additional support to Roehrig and Luft’s (2004) research that identified beginning science teachers capable of implementing inquiry instruction in their classrooms. However, an important nuance follows from this study—developing medium to high implementation levels of practices congruent with RBSI prior to the first year of teaching and maintaining those practices during the first year of teaching are necessary conditions to high levels of implementation during the second year of teaching. This lends further evidence that TEPs can have a lasting positive impact on how teachers teach (Darling-Hammond, 2000), but only if beginning science teachers are in a minimally neutral RBSI environment during their induction years.

5. Individuals take one of several conceptual pathways through a TEP, and this is associated with later teaching practice.

The lens of conceptual change (Posner et al., 1982) is useful when considering teachers as learners and sheds light on beginning science teachers’ pedagogical considerations and practices that deviate from the RBSI thinking and practices emphasized in their TEPs. Appleton’s (1993) conceptual change model, grounded in “a constructivist perspective” (p. 269),
describes possible routes a learner may take when a new idea is encountered:

*Assimilation.* The learner who perceives that a new experience/information fits with what is already known exits learning with their previous conception reinforced, regardless of its accuracy. “Such learners may even be able to use vocabulary appropriately so that, to themselves and their teachers, they appear to understand the experience” (p. 269). In discussing the Draw a Science Teacher Task completed at the beginning and end of the TEP, Mason exemplifies a learner who exits a TEP via this route.

What I wrote at the very beginning is exactly still, like everything is just was almost perfect. When I read it I was like, “[Those are] actually good ideas.” Behind it I think I just learned how to actually accomplish those ideas along the way. And I found that very surprising. Because I felt like I’d changed a lot, but my key ideas of how I wanted to teach were still there, . . . but now I actually have some tools available to accomplish them. So I felt like I grew in skill but my main ideas did not change. (Mason, 1:765)

Mason’s deeply held misconceptions of teaching and learning remained unchanged at the end of the program; he had altered the RBSI research to fit his naïve conceptions of learning and teaching. Learners unlike Mason who perceive that a new experience/information does not fit with what they already know may follow one of three following pathways.

*False Accommodation.* In this pathway the learner’s preexisting ideas remain unchanged, and they have a new set of ideas that they use in certain situations. Emma exemplifies this practice when discussing her first year of teaching:

[When deciding how to teach.] I’ve kind of just been following the general outline of the learning cycle where we do the activities and you can talk about it and then you do a reading . . . and then I think this year I want to do a lot more concept mapping with my students. So have them do a concept map first, kind of get where their current understanding is on the ideas, then do activities that would help further their understanding and then maybe readdress the concept map, then do discussion. But a lot of it really comes from following the learning cycle, having that really general lab discussion. “Here’s what it meant,” kind of a thing and then do the readings over it. (Emma, 2a:118)

Emma uses terminology and strategies addressed in her TEP to talk about her experiences during
her first year of teaching, but she and similar beginning science teachers who exemplify this route, make “noises that sound pedagogical” (Abell et al., 1998, p. 502).

*Opting out of learning.* Another pathway that may be taken by learners who perceive that a new idea does not fit with what is already known is to opt out of learning. In this pathway learners either “may not consider the effort involved . . . as worthwhile” or “may have experienced repeated failure . . . and to avoid further failure, opt out of the learning situation” (Appleton, 1993, p. 270). These learners exit instruction with their previous ideas unchanged. None of the participants in this study exemplify this route, which is unsurprising given that they (a) chose to pursue a science teaching career, (b) completed the TEP, and (c) entered the teaching profession.

*Accommodation.* Learners who restructure their existing ideas to more accurately account for new ideas take the pathway of accommodation. Liam demonstrated accommodation when he discussed why he continued to implement practices congruent with RBSI despite pressures from his superordinates to teach differently:

> The MAT program [was] a life-changing event. By far, the best teaching I’ve ever been exposed to was modeled for us [by the program’s science education faculty] so I know its effectiveness. And we constantly talked about teachers . . . [who] try out methods of teaching that are based on research, and if it doesn’t work the first time [they decide] it’s ineffective. There have been some things that I’m doing that maybe turned out ineffective . . . I still trust the research. It’s my imperfection in carrying out the method. [My] methods of instruction that are based on research, and that’s the kind of teacher I want to be—an effective one that smiles a lot, and you leave with a fundamental change in your understanding of how the world works. (Liam, 2a:262)

Liam exemplifies a participant whose conceptions of teaching and learning changed as a result of his experiences in TEP.

The conceptual change model coupled with the theoretical framework of teacher development helps explain why participants may have exited the TEP along different conceptual change pathways. That is, how participants’ considerations of teaching and learning and
implementation of RBSI-congruent teaching practices unfold during their first years of teaching may be partially linked to their conceptual change route. Researchers who assume that novices exited the process of conceptual change having restructured inaccurate preexisting ideas about teaching and learning risk attributing false accommodation, assimilation, or incomplete accommodation to backtracking (i.e., moving away from conceptions developed in a TEP). In some cases the beginning teacher may not have gone through conceptual change at all, but he or she could have instead employed the terminology and mimicked the practices promoted by the TEP. Alternatively, conceptual change may not have been completely internalized and the learner may still be on a conceptual change journey. To continue on a path towards conceptual change for such learners, further restructuring of connected concepts may be required and/or repeated exposure and application of the new concept may be necessary:

A single experience of accommodation (Piaget, 1978) as described would be inadequate for any major changes to a learners’ cognitive structure so the new structure would need to be used and tested in a variety of situations to be useful and accessible (Osborne & Wittrock, 1983). Many learners would need assistance in accessing and interpreting new information relevant to the experience, so that appropriate modifications to schemata, and links between them could be made. (Appleton, 1993, p. 269)

While conceptual change theory is helpful in understanding beginning science teacher development, it does not fully account for their development of pedagogical considerations and practices congruent with RBSI. For example, if beginning science teachers who are still working through accommodation were placed in environments during their first years of teaching that diligently promoted RBSI, the model predicts they would likely move toward accommodation.

**The Socialization of Beginning Science Teachers and Relationships to Practice**

6. Induction programs, designed to help beginning teachers improve, had inherent design flaws and thus failed to support improvement.

Extensive literature addresses the importance of induction programs that support
beginning teachers (Bianchini, 2012; Luft, Dubois, Nixon, Campbell, & Bang, 2014; Gold, 1996; Wang, Odell, & Schwille, 2008). However, many induction programs and mentors have been found lacking for promoting reform-oriented thinking and practices (Feiman-Nemser & Parker 1993; Luft, 2012; Wang, Odell, & Schwille, 2008). The findings of this study provide further evidence that beginning science teachers are encountering mentors and superordinates who cannot or will not support the use of science teaching practices congruent with RBSI, and in many instances overtly and actively reject and even undermine RBSI thinking and practice.

So while beginning teachers could benefit from mentoring and professional learning community components in induction programs, that was not the case for any of the participants in this study. This study supports the contention that “Most induction mandates do not rest on an understanding of teacher learning, a vision of good teaching or a broad view of the role formal induction can play in new teacher development” (Feiman-Nemser, 2001, p. 1031). Or, as Luft (2012) describes from her research on beginning science teachers and subject-specific induction programs:

All these studies have underlying assumptions that (1) induction is an important component in the development of a teacher, and (2) an essential aspect of the induction process is mentoring and collegial support. . . . From these studies, it is evident that certain environments in a school can impact the instruction of teachers. Because some mentors do not have the impact they should, and certain school characteristics influence school instruction, beginning teachers are in a tenuous position. . . . Even though the teachers were meeting with their mentors, over half of the new teachers did not find their mentors to be helpful in building their understanding of teaching and in developing science lessons. . . . Well-meaning mentors provide materials that meet immediate instructional needs (e.g., PowerPoint presentations, worksheets), but there is little emphasis on cultivating learner-centered dispositions in the new teachers. (pp. 428–435)

The findings of this study suggest that the problems go much deeper than mentors who mean well, yet are not positively impacting beginning science teachers. Seven of the ten participants experienced superordinates during their first year of teaching who actively undermined their attempts to implement RBSI. These superordinates simply would not tolerate RBSI and
sabotaged beginning teachers’ attempts in order to promote curriculum, instruction, and assessment practices incongruent with RBSI. They coerced beginning science teachers by leveraging: (a) contract renewals, (b) recommendations for standard teaching licensure, and (c) administrator relationships.

Education literature is replete with calls to create “high-quality” professional learning communities and/or opportunities for new teachers to collaborate with their more experienced peers (Bieler, 2012; Feiman-Nemser, 2012; Grossman & Davis, 2012). For instance, in an Educational Leadership interview (Scherer, 2012), Darling-Hammond responded to the question of what “schools and education leaders . . . might do to support their teachers” by saying:

What great schools, great principals, and great school teams know is that you support teachers by structuring group collaboration for planning curriculum, by building professional learning communities, by encouraging ongoing inquiry into practice. (p. 23)

Some participants in this study encountered collaboration time for planning curriculum, and all participants had mentors and senior colleagues. However, in most cases, participants in this study experienced collaboration, mentors, and colleagues who did not support their efforts to implement RBSI thinking and practice or foster the sense that they were joining professional learning communities. For example, during her second year of teaching Hannah encountered a supportive principal and superintendent but felt she could not share her ideas with her colleagues during their group collaboration planning time. When Hannah did collaborate with another beginning teacher on the team, other teachers were vicious in their accusations that Hannah and her collaborator were trying to make the rest of the team look bad.

However, what often goes unaddressed in idealistic discussions of mentoring and learning communities are the political relationships and differential power that is inherent in such systems. For example, a mentor is usually selected by school administration, and thus, the mentor has a direct line of communication to the principal, who controls the contract renewal of
the new teacher. Therefore, the very person who is supposed to listen to the new teacher’s struggles can easily become a distrusted spy rather than a helpful colleague. In this study, several mentors directly reported perceived weaknesses of the new teachers to administrators, and the new teachers were later reprimanded by the administrators.

Thus, the results of this study question the prevailing wisdom of school-based mentoring and induction. Contrary to the common conception that experienced teachers and administrators make for effective mentors, the beginning science teachers in this study encountered superordinates who threatened, sabotaged, and imposed sanctions in response to participants’ attempts to implement practices congruent with RBSI. Cloaked in a veil of support, superordinates exerted tremendous pressure to push beginning science teachers to align themselves with the existing culture of the school—a culture that often had a conception of effective teaching and learning that is not supported by research. The fact that this is happening should not be surprising. Many studies and science education reform documents extensively describe the persistent problems in the way science is taught (AAAS, 1990; Banilower, Smith, Weiss, Malzahn, Campbell, & Weis, 2013; NGSS Lead States, 2013; NRC, 1996; Pasley, Smith, Banilower & Heck, 2003), and thus, the existing school climate of poor science teaching is foisted upon the new teacher in the name of “mentoring.” Calls for requiring all beginning science teachers to be paired with a mentor as a part of an induction program ignore the well-documented ubiquitous problems in science teaching and the political vulnerability of the new teacher.

School-based induction programs with mentoring and professional learning community components like those experienced by the majority of participants in this study undermine beginning science teachers’ implementation of RBSI-congruent practices and traumatize
beginning teachers who experienced transformative conceptual change in their understanding of teaching and learning in their TEP. Ethan’s summary of his experiences during his first year of teaching illustrate this trauma:

I should plot a path of my emotions, like how [my first year of teaching] affected me and twisted me. It’s almost like Anakin Skywalker turning into Darth Vader. It’s weird, because I see a lot of similarities to that story line. . . . He’s got a lot of talent and these guys see it in him, and then he goes out and he keeps getting burned and no one’s listening to him and the no one’s taking him serious, and he speaks out. He gets put in his place . . . [and then turns to the] dark side. . . . That’s my analogy for me, because . . . I see similarities in how his demise came about. He had a lot of potential and, then, he turned into Darth Vader. . . . I’m on the verge of turning to the dark side, which means quitting teaching and walking away. . . . There’s still hope right now, but it’s running out. All because of the first year. (Ethan, 2:1286)

Ethan went through a transformative conceptual change concerning his understanding of teaching and learning during his TEP; nonetheless, after his first year of teaching he was questioning his ability to stay in a profession where (1) he was not allowed to enact practices congruent with RBSI, and (2) he was intensely punished for doing so.

In discussing the experiences of the participants in this study—especially their experiences during their first year of teaching when seven participants experienced superordinates who sabotaged their attempts to implement RBSI—the following conclusions from Goodlad’s study of schools in the early 1980s are still relevant today.

Common, too, is the deliberate sustaining of a socialization process believed essential to the conduct of schooling. . . . The dominant role of the teacher, limited opportunity for student-initiated activity, and quiet passivity of the class group become virtues to be reinforced. Deviation may be tolerated but it is neither condoned nor rewarded. Usually the socialization process, as powerful among teachers as among students, simply discourages or ultimately suppresses deviation. (Goodlad, 2004, pp. 265–266).

The findings from this study make clear that ill-conceived and poorly enacted mentoring and induction programs are common and have fierce consequences for beginning science teachers. All participants in this study who implemented RBSI at a low level during their first year of teaching had superordinates who were saboteurs on the RBSI support continuum (n=4). Likewise
all of the participants who experienced saboteurs during their second year of teaching \((n=4)\) implemented RBSI at a low level. A false veil of support is being used to aggressively impair the development of many beginning science teachers’ considerations and implementation of RBSI.

7. Induction programs lacked RBSI more knowledgeable others who could help new teachers improve. Personal collegial cohort interaction at a personal level was necessary for teachers to have a support system to promote improvement.

Social learning theory assists in further understanding the development of beginning teachers. Vygotsky’s concept regarding the zone of proximal development (ZPD) refers to “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under [the guidance of more knowledgeable others (MKO)]” (Vygotsky, 1978, p. 86). Learners working within their ZPD with the assistance of an MKO can accomplish tasks they alone cannot (Dixon-Kraus, 1996).

Most teachers early in their career require the presence of MKOs in order to continue on their journey toward accommodation—developing deep RBSI thinking and high levels of practices congruent with RBSI. However, the findings of this study suggest that beginning science teachers will rarely encounter mentor teachers or school-based induction programs that can function as RBSI-knowledgeable MKOs. Without such MKOs, beginning science teachers are unlikely to develop deeper considerations of RBSI or practices more congruent with RBSI. When induction and mentoring programs are at odds with RBSI, instead the superordinate will assist beginning science teachers in developing misconceptions regarding effective teaching and learning.
Several study participants recognized early in their first year of teaching that their mentor/induction program was at odds with RBSI. They accurately determined that their superordinate was in fact, not an MKO. Some of these participants intentionally and selectively sought interaction with others who understood RBSI and could serve as an MKO. Those who did were the same individuals who also sought such interaction during their TEP. For example, Chris and Andrea both developed personal collaborative relationships with some of their cohort members during their TEP. When the time came that they needed assistance during their first year of teaching, they recognized each other’s strengths and reached out to each other. Chris speaks to how he and Andrea were MKOs for each other during their first year of teaching:

There were very, very few times in the beginning of the day where I wouldn’t go over and say, “This is my question. Please help me word this.” So [Andrea and I] were really supported in that way. To that end she would very frequently email, call, stop in my classroom and say, “Okay, this is the idea that I want to try and develop.” (Specifically for her science unit that she was planning for 7th grade weather unit.) “What do students need to know to understand this concept?” So I would share my logical flow, or my pathways, that I thought students would need to know. (Chris, 2:295)

With Andrea’s assistance, Chris was able to ask more effective questions during his first year of teaching. Likewise, because of Chris’s guidance, Andrea was able to plan units that worked with students’ thinking in a more meaningful way.

Indeed, if beginning science teachers do not develop a strong rationale for establishing and maintaining personal collaborative relationships with their cohort members during their TEP, then they are unlikely to draw upon their cohort members for support during their first years of teaching. All of the participants in this study who implemented practices congruent with RBSI to a high level by the end of their second year of teaching personally sought out the assistance of peers they perceived as MKOs in specific domains, during their TEP and first years of teaching. By seeking out the support of their cohort members during their first years of teaching, these participants engaged in interactions that were intensely promoted throughout their TEP.
Conversely, the participants in this study who implemented RBSI-congruent practices at a low level by the end of their second year of teaching did not seek out their peers as MKOs during their TEP or during their first years of teaching.

Two ways beginning science teachers develop relationships with RBSI-knowledgeable MKOs became apparent in this study: (1) they develop these relationships in their TEP, and (2) they enter schools with supportive colleagues. Without such MKOs, beginning science teachers’ learning and development is constrained, and the naïve conceptions of teaching and learning they held prior to their TEP are reinforced through socialization pressures and the direction in which their RBSI-antagonistic superordinates attempt to guide them. Therefore, collaborating with genuine MKOs (those understanding and valuing RBSI) is a necessary counterbalance to negative superordinate influence that promotes regression in considerations and implementation of practices congruent with RBSI during beginning science teachers’ first years of teaching. These RBSI MKOs are also crucial for the continued development of beginning science teachers.

8. **Advertising one’s RBSI is more likely to result in making political enemies than garnering support or improving how science is taught in a school.**

Remarkably, most participants were unconcerned about encountering resistance or political pressures when they began their first year of teaching. Perhaps a misconception exists that schools are places where teachers genuinely talk about and share teaching practices with the goal of collective improvement for the welfare of the students, and administrators value RBSI practices, teacher collaboration, and efforts to improve. When participants entered schools with this naïve view, and eagerly shared their RBSI teaching with others, they were stunned by the fierce consequences that immediately followed. Despite the TEP emphasizing “lying low” and “going stealth” the first few years, several teachers in this study exposed their practices and paid
dearly for that decision. Unfortunately, the schools in this study were places where success was defined as fitting in with the dominant practices of the other teachers, or the latest administrative initiative being enforced throughout the school. Only during participants’ second year of teaching were there isolated instances of participants’ colleagues being interested in improving their practices due to the RBSI contributions of the new teacher.

9. Sabotaging administrators result in lasting negative impacts on teachers, even if they leave the school. Future superordinate relationships are approached with distrust, stress, fear, and withholding of information by those undermined during their first year of teaching.

Administrators exert a powerful influence on the socialization of beginning teachers. Participants whose administrators were saboteurs were deeply affected by those behaviors, even after leaving the school or district. In future encounters with more supportive administrators, participants who had been sabotaged were frequently suspicious, judgmental, and potentially hostile. Contacts with administrators were said to have caused fear responses by several participants, despite the fact that the interaction was neutral or even positive. These responses were necessary for survival in a hostile environment, but are counterproductive in a more supportive environment. Nevertheless, for some participants, even schools advocating for their RBSI were viewed as negative places where they acted in a guarded way. Such behavior is a far cry from Darling-Hammond’s ideal school for growth, where professional learning communities of collegial teachers promote honest dialogue about teaching and learning in an “ongoing inquiry into practice” (Scherer, 2012).

10. Principals and other site leaders more often promoted generic or fad practices that promised quick fixes over practices consistent with research. Further, principals and site
leaders did not know what good science teaching looked like, yet exerted authority to shape science teaching in ways consistent with more experienced teachers in the school.

The term “principal” originated from the longer phrase “principal teacher.” Such an individual was a respected teacher who used part of the school day to perform administrative functions. The image of the principal as the instructional leader of the school remains with us today, despite the fact that principal preparation is predominated by courses in legal matters, budgets, and meeting state and federal mandates, and principals themselves report very little time for instructional leadership (Maxwell, 2014). Principals also have limited expertise in many of the subject areas they are expected to evaluate. Given the demands on principals and their limited expertise, not surprising is the adoption and promotion of generic practices that promise quick results. This was seen at Andrea, Chris, and Ethan’s school, where “gradual release of responsibility” and “writing to learn” strategies were supposed to be visible to any administrator at any time in any subject matter during classroom “walk-throughs.” Participants were told that using such strategies would result in higher test scores. Interesting to note is that participants in this study comprised the sixth grade team in the school, and they actively pretended to implement the strategies while doing other things, and their team was the only grade level to show improvement on the standardized tests that year. The participants recognized that “gradual release of responsibility” consisted of a new name for direct instruction, where modeling was followed by guided and then independent practice—fine for skills, but inappropriate for most science concepts. Unfortunately, the administrators at this school insisted that this strategy would work and that all teachers should use it. Participants, especially during their first year, were frequently assumed to have no expertise. Administrators, with less knowledge of RBSI, exerted considerable authority to suppress any expression of new teacher expertise and enforce the
chosen fad, which was usually contradictory to RBSI.

11. **Socialization is associated with beginning science teachers’ RBSI considerations and practices.**

Findings of this study support the conclusion that science teachers entering the teaching profession with a minimally satisfactory level of RBSI decision making are unlikely to implement RBSI practices if (a) they encounter superordinates who are saboteurs or neutral, and (b) do not interact with cohort members who have deeper understandings of RBSI. However, science teachers who enter the teaching profession with a minimally satisfactory level of RBSI decision making will likely implement RBSI if they encounter superordinates who are cheerleaders or advocates, and interact with cohort members who also consider RBSI in a satisfactory or deep manner. Adult cognitive development theory can be used to understand participants who: (a) are absorbed by the RBSI-incongruent culture of their school, (b) spend their first years of teaching torn between the culture of their TEP and the culture of their school, or (c) seek MKOs outside of their school.

Adult cognitive development stage theory (Kegan, 1994) further illuminates how participants navigated their first two years of teaching. Kegan’s stage theory uses “orders of consciousness” as a measure of how people make meaning and construct reality. While orders range from first through fifth, Kegan’s third and fourth orders of consciousness are most relevant to this study.

Berger (2002) applied Kegan’s stage theory of adult development to research on beginning teachers. Berger investigated beginning teachers’ orders of consciousness and how they perceived their enactments of what they believed they learned in TEP. Berger describes teachers operating at a third order as teachers who:
are excellent followers of strong cultures because they have internalized the ideas and philosophies of others and work out of loyalty to a larger group. . . . It is not fair to assume, however, that these teachers are necessarily chameleons who change their ideas and philosophies to fit in with the dominant ones as they move from place to place; instead, there are particular ideologies, institutions, or people to which they remain loyal and with which they remain identified. (pp. 45–46)

Heavily relying upon the opinions of others and allowing the expectations of others to greatly influence decision making is referred to by Kegan as allowing a board of directors into one’s decision making. For third order teachers, when the culture of their school and their TEP are in conflict, either their TEP or school may serve the role of the entity from which they make decisions and feel accountable.

Fourth order teachers are self-directed and make meaning from a self-authored way of knowing that can account for complexity and nuance between systems, institutions, and roles. In contrast to the third order, teachers operating at a fourth order become the board chair. They make decisions and are accountable to their own value system, which exists independently of any single institution, culture, or role. As Berger explains:

A teacher at the Third order might be strongly identified with a particular theory of teaching—one that he learned in his teacher education program and is supported in his current school. As he becomes Fourth order . . . others around him might still even think of him as a kind of devotee, but they are less likely to accuse him of being “unquestioning.” They may find him more persuasive about the theory rather than less because he now has a more complex understanding of it and will sound less like he is giving a party line. Unlike those at the Third order, Fourth order adults don’t feel torn apart by the conflicts of different meaning systems because they have their own system with which to make decisions. (Berger, 2002, pp. 51–52)

Fourth order beginning science teachers may strive to enact practices congruent with RBSI, not because they were instructed to do so by the TEP, but because doing so aligns with their self-authored orientation as a teacher and their larger purposes for teaching.

The complexity of superordinate relationships—specifically when the predominant conception of teaching and learning of the beginning science teacher’s school is incongruent
with the research base on effective science teaching promoted by their TEP—may be outside of the developmental capabilities of some beginning teachers. Such circumstances may halt any continued meaningful learning and conceptual change on the part of the beginning teacher that would result in RBSI thinking and implementation. Although the orders of consciousness of participants in this study were not assessed, their orders of consciousness may well have influenced how participants made meaning of their experience as a beginning teacher. Noah, for example, discussed his conflict with his science department in a way that reflects he was torn between the dominant culture of his department and that which he perceived was best for students:

And then I kind of realized that even though we had all agreed to do . . . this one worksheet and give this one test, that we weren’t even close to doing it. And it kind of became this battle between myself of going, “I said I would do this. I should, at least to some extent.” And then, “No one else is doing it; why would I even care?” . . . Which upset me, because I realized after four or five nights of having that run back and forth in my head, “Why haven’t I even considered what would be best for students here?” . . . How did this get involved so much in these personal things that the student thing wasn’t even in the question? So it became this weird middle ground that I’m trying to run, and I’m trying to navigate it, and right now I feel I’m swinging a little too far to what the department agreed to and not to what would probably be best for students all the time. That being said, my predecessor in this position happened to swing on the what would be best for students and was a villain within the building because of it, outside of maybe three people. But I would prefer my first year not to get that kind of flack; I couldn’t handle it. So I swing the other way. (Noah, 2:259)

Noah was unable to see himself separate from these events and was therefore unable to turn to another conception of teaching and learning. Moreover, third order teachers may be more likely strongly identify with their TEP and, therefore, openly promote RBSI in attempt to change their colleagues’ practice, resulting in giving colleagues the appearance, as Berger described, of a devotee. In contrast, Liam developed an external authority in the research base:
I felt pressured to have to teach like everyone else, because an administrator (at the beginning of the year) told me . . . “I sense some differences in your teaching. Actually it’s more than a sense. I know there’s some differences in your teaching, and by next year that has to be erased.” And I asked, “What do you mean by that? Does this mean I’m going to have to change my teaching?” And he was very vague, he said, “No, this just means we want students to be doing the same things.” I kept teaching the way I wanted to . . . because he didn’t specifically say, “You need to change your teaching.” I told him “Everything I do, I try to couch in research. I base a lot of the content I cover, the appropriateness of it, developmentally, on recommendations by things like AAAS Benchmarks.” . . . And we constantly talked about teachers . . . [who] try out methods of teaching that are based on research, and if it doesn’t work the first time [they decide] it’s ineffective. There have been some things that I’m doing that maybe turned out ineffective. . . . I still trust the research. It’s my imperfection in carrying out the method. [My] methods of instruction that are based on research, and that’s the kind of teacher I want to be—affective one that smiles a lot, and you leave with a fundamental change in your understanding of how the world works. (Liam, 2a:243)

Liam discussed the pressures he experienced from his administration during his first year of teaching, but he was able to see his implementation shortcomings and his administrative pressure as separate from his source of decision making as a teacher.

Fourth order beginning science teachers strove to enact practices congruent with RBSI, not because they were instructed to do so by the TEP but because doing so aligns with their self-authored orientation as a teacher and their larger purposes for teaching. However, third order teachers cannot do this by definition. They may wish to enact RBSI-congruent practices, but they do so from an externally-authored orientation. This raises the issue of what supports are needed during a TEP for third order beginning science teachers to meaningfully understand the purposes of schooling and science education. Helping third order beginning science teachers develop a deep understanding of the importance of these purposes may help them author their own orientations as teachers and develop a higher order of thinking. More research into how beginning science teachers make meaning, how their ability to make meaning influences how they navigate relationships during their TEP and their first years of teaching, and how these factors are related to their implementation of practices congruent with RBSI may have important
implications for teacher education, mentoring, and induction programs.

**Implications**

Explicitly using the lenses of conceptual change, social and developmental learning theories to more deeply understand teacher science development and paying “attention to teachers as learners” (Feiman-Nemser, 2001, p. 1025) has implications for science teacher education, mentoring, and induction programs.

**Teacher Education**

This study highlighted some problems with routes to teaching licensure that minimize pedagogical knowledge:

- Participant decision making based on RBSI did not develop during the induction years without first possessing both a minimum satisfactory level of understanding prior to the first year of teaching and superordinate support.
- School-based superordinates that can act as RBSI-knowledgeable mentors were not seen in this study; therefore, teacher development efforts should not rely upon school-based programs for teacher development of practices congruent with RBSI.
- The current state of science education is unlikely to be transformed through models of teacher development that rely on beginning science teachers acquiring pedagogical knowledge congruent with RBSI during their first years of teaching.
- Findings from this study suggest that beginning science teachers would likely benefit if the TEP formally provided additional supports to mitigate constraints encountered during the first years of teaching.
- The development of collaborative collegial relationships among beginning science teachers requires time and fervent promotion during the TEP in order for beginning
science teachers to establish and maintain personal collaborative relationships to support
the implementation of RBSI. Moreover, for some beginning teachers, formal MKO
support during the induction years is likely required for the continued development and
reliance upon such relationships.

**Induction and Mentoring Programs**

- Efforts to improve science teaching and learning must acknowledge that the current
  science teaching workforce possesses too few MKOs for the purposes of implementing
  practices congruent with RBSI.

- The conversation around the constraints science teachers face during their first years of
  teaching (e.g., teaching the most challenging students, teaching a number of different
  science courses, teaching in multiple classrooms) must be expanded to include
  superordinates who fiercely promote practices incongruent with RBSI. Efforts to improve
  science teaching and learning by eschewing science teacher education programs in favor
  of site-based preparation/mentoring/induction programs will rarely be successful. The
  dialogue around science teacher induction and mentoring must change from vague goals
  of “supporting beginning science teachers” to “supporting RBSI” through teacher
  education, mentoring, and induction programs grounded in a shared understanding of
  meaningful learning and RBSI practices.

- In framing teachers as learners, research on beginning teachers should acknowledge that
  conceptual change concerning meaningful learning and effective teaching may not have
  been transformative. That is, beginning teachers may leave their TEPs with false
  accommodation, rejecting the conceptions of the program, or possessing tentative or
  fragile conceptions that will not persist in the face of constraints.
• Given the (1) dominant conceptions of teaching and learning found in many schools, (2) brutal reception of beginning teachers’ attempts to implement RBSI by their superordinates, and (3) developmental levels of beginning science teachers, the continued development of beginning science teachers may well require mentoring and induction programs based outside of the culture and power structure of the school that use RBSI MKOs.

• Given the manner in which superordinates coerced beginning science teachers to abandon practices congruent with RBSI by leveraging (a) contract renewals, (b) recommendations for standard teaching licensure, and (c) administrator relationships, the evaluation of beginning science teachers should be done by people outside of the power structure of the school.

• Principal preparation programs should include an explicit focus on: 1) power relationships in the school (including problems of mentors and experienced teachers) and how to foster more healthy collaborations; 2) RBSI and how to support it among beginning teachers; 3) the dangers of “one size fits all” instructional strategies and the ineffectiveness of generic professional development (Loucks-Horsley & Matsumoto, 1999).

Conclusion

Teacher effectiveness is a major subject of our national dialogue. Although the general public largely contends that anyone with content knowledge is equipped to teach, that view does not hold up to scrutiny. Entering into that assessment are policymakers’ and school administrators’ concerns with teacher shortages in particular areas and the lack of qualified teachers available to fill those vacancies. These problems are being attributed to too few new
teachers entering the profession and a high attrition rate among beginning teachers. In response to teacher shortages, two primary policy responses have emerged: (1) increase the quantity of teachers supplied by opening up alternative routes to teacher preparation and decreasing licensure requirements (both content and pedagogy), and (2) support beginning teachers through induction programs (that often have a mentoring component) to decrease attrition.

However, policies aimed at addressing the teacher shortage are likely contributing to the problem of teacher effectiveness. First, policies designed to make it easier for administrators to have teachers designated as “qualified” to fill positions are reducing science content requirements to make it easier to endorse teachers in multiple content areas. Second, policies designed to entice those with content knowledge into classrooms are reducing the pedagogical preparation required to qualify for a teaching license. Policies that reduce licensure requirements also add to the teacher attrition problem (Ingersoll, 2012). Science teachers with content knowledge but without pedagogical knowledge leave the profession after one year of teaching at twice the rate of science teachers with content and pedagogical knowledge. The results of these policies are science teachers that possess insufficient science content and understanding of RBSI, and leave the profession at greater rates than other teachers. If TEPs required content preparation and effectively prepared teachers to implement RBSI practices, and if these teachers’ efforts to implement such practices were truly supported (both through meaningful continued professional development and effective mentoring) in schools, then the retention and effectiveness of science teachers would likely improve.

This study supports the contention that teachers effectively educated to make research-based science teaching decisions and practices will do so if they are supported through collegial relationships with cohort members and advocacy from superordinates. Equally important, this
study supports the contention that teachers leaving their TEP with little understanding of RBSI are unlikely to develop such understanding and implement such practices during their first two years of teaching. Because the socialization process largely promotes ineffective science teaching practices, such teachers regress quickly and are unlikely to ever develop effective science teaching decision-making and practices. Thus, teacher education programs play an essential role in promoting among beginning science teachers, at the very least, a satisfactory understanding of RBSI decision-making and practices before they begin teaching.

For those teachers who have completed such a science teacher education program, policies such as school-based mentoring and induction programs often do not support them in their efforts to implement those practices. Instead, many of the first-year science teachers in this study encountered superordinates who threatened, sabotaged, and imposed sanctions on those who attempted to implement RBSI-congruent practices. No participants in this study experienced superordinates who were RBSI-knowledgeable MKOs. Thus, participants who effectively implemented RBSI decision-making and practices intentionally and selectively sought out the support of more knowledgeable peers. Given these findings, the conversation concerning how schools haze beginning teachers (Patterson, 2005) needs to broaden to include how superordinates (1) are frequently not RBSI-knowledgeable MKOs, (2) are too often intolerant of beginning science teachers who can effectively implement RBSI-congruent practices, and (3) use the existing power structures of the school-based mentoring, evaluation, and licensure programs to bully beginning science teachers.

**Recommendations for Further Study**

- To further understand the relationships between adult cognitive development and implementation of RBSI-congruent practices, beginning science teachers’ developmental
level should be formally assessed and compared to their socialization experiences and, RBSI considerations and implementation.

- This study reported that teachers who were implementing practices congruent with RBSI intentionally sought support from peers whom they considered to be MKOs. The participants’ TEP fervently promoted such practices, yet half of the participants in this study did not engage in these types of interactions. Aspects of TEPs that are designed to promote positive interdependence among cohort members should be studied, and their effect on implementation. To what extent can peer collaboration during the induction years be fostered during a TEP? What collaborative practices implemented during a TEP are more likely to carry over into meaningful peer collaboration supportive of practices congruent with RBSI during the induction years? What formal supports are necessary during beginning science teachers’ first years of teaching to support and foster meaningful peer interaction?

- This study reports that school-based mentoring and induction programs are likely ill-suited to promote RBSI among science teachers during their induction years. Continuing to build upon the existing research on the design and implementation of university-based, science-specific mentoring and induction programs raises multiple questions for further investigation.
  - If beginning teachers participated in such programs following an RBSI-oriented TEP, to what extent would their practices be congruent with RBSI, even if faced with severe institutional constraints?
  - What features of university-based, science-specific induction programs are associated with implementation of RBSI-congruent practices in a variety of
school contexts?

- If induction programs were explicitly designed to support beginning science teachers in their abstract thinking abilities, to what extent would their experiences with superordinates who are unsupportive of RBSI change?

- If induction programs were explicitly designed to support beginning science teachers in accessing and engaging in peer collaborations, to what extent would their collaborative experiences with their cohort members change as beginning science teachers transitioned from their TEP to their induction years?
REFERENCES


APPENDIX A. SEMI-STRUCTURED INTERVIEW QUESTIONS

1. What do you perceive are your strengths and weaknesses in your teaching practices?
   o What actions do you take to improve?

2. What kind of support have you received for highly effective teaching?

3. How much freedom do you have to instruct the way you want to?
   o What do you feel are the greatest influences on your decision making as a teacher?
     - During the first year? Now?
   o What factors impact your instructional practices and how do they do it?
   o How do you determine what and how to teach?
   o To what extent are you expected to teach like your colleagues?
     - How do you deal with that?
   o What external factors impact your instructional practices?

4. What do you perceive have been the most significant specific conflicts you have faced in your teaching career?
   o How did this issue start?
   o What was your role in the issue?
   o How did you handle this issue?
   • What other constraints have you faced this year?
     o How have you attempted to mitigate these constraints?

5. To what extent have you kept in contact with TEP graduates or faculty?
   o Who have you kept in touch with?
   o How has this influenced your practice?
   o How would your practice be different if you had or hadn’t kept in contact?
   o Why did you choose or not choose to stay in contact with these people?
   • To what extent have you collaborated with other like-minded people, not from your TEP?
     o Who have you collaborated with?
     o How has this influenced your practice?

6. How do you know when learning is occurring in your classroom?
   o How do you know when your students understand?
   o How do you maximize student learning in your classroom?
   o How do you decide when to move on to a new topic in your classroom?
   o Why do you think this approach is important?

7. Based on your experience, what recommendations do you have for the TEP as whole?
   o What do you perceive was effective and ineffective about the program based on what you have found with your own teaching practice?
   o What did you perceive was or ineffective of the NOS component of the TEP?
   o What else, if anything, do you want to tell me about these issues or TEP?
### Table 18. Modified Scoring Rubric

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Indicators</th>
<th>Synthesis Rating</th>
</tr>
</thead>
</table>
| **Design**          | Likelihood that lesson will promote student progress in investigative science | • Purpose and goals  
• Investigative science  
• Engaged, challenged and used participants’ ideas  
• Utilized interactions and various groupings  
• Explored central issue, activity  
• Consolidated ideas and promoted sense-making  
• Planned assessment | Not at all reflective of NSES 1 |
|                     |                                                                              |                                                                          |                               |
|                     |                                                                              |                                                                          | Extremely reflective of NSES 5 |
| **Implementation**  | Degree to which lesson contributed to student progress in investigative science | • Demonstrated modified learning cycle  
• Used questioning to challenge ideas, promote ideas  
• Used students’ prior knowledge  
• Encouraged public discussion of ideas  
• Provided time for private reflection  
• Paced activities and managed classroom | Not at all reflective of NSES 1 |
|                     |                                                                              |                                                                          |                               |
|                     |                                                                              |                                                                          | Extremely reflective of NSES 5 |
| **Science Content** | Quality of science content (concepts, processes and habits-of-mind)          | • Content was significant and worthwhile  
• Content was age and developmentally appropriate  
• Students were intellectually engaged  
• Teacher displayed understanding and confidence  
• Science presented as dynamic, inquiry, conjecture  
• Connection made to real-world and cross-disciplines | Not at all reflective of NSES 1 |
|                     |                                                                              |                                                                          |                               |
|                     |                                                                              |                                                                          | Extremely reflective of NSES 5 |
| **Classroom Culture** | Judgment of the appreciation of diversity (gender, race/ethnicity, culture), cooperative/collaborative and intellectual climate | • Active participation encouraged and valued  
• Respects students’ ideas, questions, contributions  
• Interactions reflected collaboration  
• Encourages students to generate ideas, questions, conjectures and propositions  
• Intellectual rigor, constructive criticism, challenging ideas and supportive help | Not at all reflective of NSES 1 |
|                     |                                                                              |                                                                          |                               |
|                     |                                                                              |                                                                          | Extremely reflective of NSES 5 |
Table 19. *Capsule Ratings*

<table>
<thead>
<tr>
<th>Level of Effective Instruction</th>
<th>Ineffective</th>
<th>Elements</th>
<th>Beginning Stages</th>
<th>Accomplished</th>
<th>Exemplary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ineffective</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>A Low</td>
<td>B Solid</td>
<td>C High</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* See descriptions of capsule ratings in Table 8.

Table 20. *Capsule Description of the Quality of the Lesson (HRI, 2005, p. 11)*

<table>
<thead>
<tr>
<th>Level of Effective Instruction</th>
<th>Description</th>
<th>Score*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ineffective</td>
<td>There is little or no evidence of student thinking or engagement with important ideas of science. Instruction is highly unlikely to enhance students' understanding of the discipline or to develop their capacity to successfully “do” science. Lesson was characterized by either:</td>
<td>1</td>
</tr>
<tr>
<td>Passive “Learning”</td>
<td>Instruction is pedantic and uninspiring. Students are passive recipients of information from the teacher or textbook; material is presented in a way that is inaccessible to many of the students.</td>
<td>2</td>
</tr>
<tr>
<td>Activity for Activity's Sake</td>
<td>Students are involved in hands-on activities or other individual or group work, but it appears to be activity for activity's sake. Lesson lacks a clear sense of purpose and/or a clear link to conceptual development.</td>
<td></td>
</tr>
<tr>
<td>Elements</td>
<td>Instruction contains some elements of effective practice, but there are serious problems in the design, implementation, content, and/or appropriateness for many students in the class. For example, the content may lack importance and/or appropriateness; instruction may not successfully address the difficulties that many students are experiencing, etc. Overall, the lesson is very limited in its likelihood to enhance students’ understanding of the discipline or to develop their capacity to successfully “do” science.</td>
<td>3</td>
</tr>
<tr>
<td>Beginning Stages</td>
<td>Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are weaknesses, ranging from substantial to fairly minor, in the design, implementation, or content of instruction. For example, the teacher may short-circuit a planned exploration by telling students what they “should have found”; instruction may not adequately address the needs of a number of students; or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the lesson is somewhat limited in its likelihood to enhance students’ understanding of the discipline or to develop their capacity to successfully “do” science.</td>
<td>4</td>
</tr>
<tr>
<td>Accomplished</td>
<td>Instruction is purposeful and engaging for most students. Students actively participate in meaningful work (e.g., investigations, teacher presentations, discussions with each other or the teacher, reading). The lesson is well-designed and the teacher implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is quite likely to enhance most students' understanding of the discipline and to develop their capacity to successfully “do” science.</td>
<td>7</td>
</tr>
<tr>
<td>Exemplary</td>
<td>Instruction is purposeful and all students are highly engaged most or all of the time in meaningful work (e.g., investigation, teacher presentations, discussions with each other or the teacher, reading). The lesson is well-designed and artfully implemented, with flexibility and responsiveness to students’ needs and interests. Instruction is highly likely to enhance most students' understanding of the discipline and to develop their capacity to successfully “do” mathematics/science.</td>
<td>8</td>
</tr>
</tbody>
</table>

*Note.* Scores were derived for this study.
# APPENDIX C. MODIFIED SATIC* CODING SHEET

Teacher: ________________________  Course: ________________________  Date: ________

Lesson goals: _____________________________________ _____________________________

Lesson objectives: _____________________________________ _____________________________

<table>
<thead>
<tr>
<th>Teacher Behaviors</th>
<th>1st five minutes</th>
<th>2nd five minutes</th>
<th>3rd five minutes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initiatory (talking)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Lectures or gives directions</td>
<td></td>
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<tr>
<td>2. Makes statement or asks rhetorical question</td>
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</tr>
<tr>
<td><strong>Initiatory (questioning)</strong></td>
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</tr>
<tr>
<td>3. a) yes/no or dichotomous question</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) short-answer question</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>c) thought-provoking short-answer question</td>
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<tr>
<td>4. Extended-answer question</td>
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<td></td>
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<tr>
<td><strong>Responding (does not encourage student mental engagement)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5. Rejects student comment</td>
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<tr>
<td>6. Acknowledges student comment</td>
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<tr>
<td>7. Confirms student comment</td>
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<td></td>
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<tr>
<td>8. Repeats student comment</td>
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<tr>
<td>9. Clarifies or interprets what student said</td>
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<tr>
<td>10. Answers student question</td>
<td></td>
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<tr>
<td><strong>Responding (encourages student mental engagement)</strong></td>
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<tr>
<td>11. Asks student to clarify or elaborate</td>
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<tr>
<td>12. Uses student question or idea</td>
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<tr>
<td><strong>Non-verbal Behaviors</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>13. a) Inappropriate wait-time I</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Inappropriate wait-time II</td>
<td></td>
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<tr>
<td>14. Passive non-verbal behaviors</td>
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<tr>
<td>15. Annoying mannerisms</td>
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</tbody>
</table>

*A teacher behavior assessment devised by Dorothy M. Schlitt and Michael Abraham (Abraham & Schlitt, 1973) and modified by Michael P. Clough
APPENDIX D. Research Questions and Interview Questions

Table 21. *Relationships Between Research Questions and Interview Questions*

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Interview Question</th>
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</thead>
<tbody>
<tr>
<td>1. How congruent are study participants’ considerations of teaching and learning with research-based science instruction at the end of their TEP, first year of teaching, and second year of teaching?</td>
<td>1. What do you perceive are your strengths and weaknesses in your teaching practices?</td>
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<tr>
<td></td>
<td>3. How much freedom do you have to instruct the way you want to?</td>
</tr>
<tr>
<td></td>
<td>6. How do you know when learning is occurring in your classroom?</td>
</tr>
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<td></td>
<td>7. Based on your experience, what recommendations do you have for the TEP as whole?</td>
</tr>
<tr>
<td>3. What is the nature of study participants’ relationships with members of their cohort during their TEP, first year of teaching, and second year of teaching?</td>
<td>5. To what extent have you kept in contact with TEP graduates or faculty?</td>
</tr>
<tr>
<td>4. What is the nature of study participants’ relationships with the superordinates charged with supporting them during their first and second years of teaching?</td>
<td>2. What kind of support have you received for highly effective teaching?</td>
</tr>
<tr>
<td></td>
<td>3. How much freedom do you have to instruct the way you want to?</td>
</tr>
<tr>
<td></td>
<td>4. What do you perceive have been the most significant specific conflicts you have faced in your teaching career?</td>
</tr>
<tr>
<td>5. What relationships exist, if any, between study participants’ pedagogical considerations, teaching practices, and their socialization experiences during this study?</td>
<td>1. What do you perceive are your strengths and weaknesses in your teaching practices?</td>
</tr>
<tr>
<td></td>
<td>2. What kind of support have you received for highly effective teaching?</td>
</tr>
<tr>
<td></td>
<td>3. How much freedom do you have to instruct the way you want to?</td>
</tr>
<tr>
<td></td>
<td>4. What do you perceive have been the most significant specific conflicts you have faced in your teaching career?</td>
</tr>
<tr>
<td></td>
<td>5. To what extent have you kept in contact with TEP graduates or faculty?</td>
</tr>
<tr>
<td></td>
<td>6. How do you know when learning is occurring in your classroom?</td>
</tr>
<tr>
<td></td>
<td>7. Based on your experience, what recommendations do you have for the TEP as whole?</td>
</tr>
</tbody>
</table>
NOTES

1 First, I struggled with not believing that I was going to be able to do it and I was angry because if I can’t do it well, then I don’t want to do it. And then I didn’t trust that [my science education professors] could bring me to the point of being able to do it. And so now that I’ve gotten past those things, I know how to be an effective teacher. That [knowledge] has absolutely changed me in ridiculous amounts of ways. (Andrea, 1:1314)

2 I would say having a group of people is integral to the experience in the [TEP] MAT program. And further, I don’t think that any of us would have developed to the level we have without having a group of people to discuss with and challenge our thoughts. (Andrea, 1:100)

3 I saw the things that [my science education professors] were kind of telling us about in the research. They seemed out there, and my [practicum] experience showed me that it could be done in the classroom, and it started showing me that you have to make decisions in your classroom, like not every time is this the right answer but you have to be an educated teacher and have the ability to make those decisions for your students. So observing him was amazing (Andrea, 1:148)

4 There were some things that [my cooperating teacher] took away and he practiced and some things he decided not to use. And we disagreed both on what content was important and some of those behaviors, what some of those behaviors were that were important. But it was always in a respectful manner and his strengths, like classroom management, were invaluable for me to learn from. He was, he never yelled at the students, he never had to raise his voice, he never had to be rude, he just had a calm, controlled way of having a class and a lot of it came from having very clear expectations, and so I was able to kind of imitate that in my own classrooms as well. (Andrea, 1:187)

5 I feel good! I’m pretty excited. I am going to a school that’s 90% poverty rate and so classroom management’s going to be a little different there. Like there’s three movements at our school. Gradual release of responsibility, writing to learn, and behavior first. So behavior is one of the three things that we focus on. So I think my classroom management is going to be tried but I think every first year teacher is going to struggle a little bit with classroom management. But I feel very well prepared and the only thing, if anything, is my content. I know that I’m a middle school teacher, and I’ll be teaching mostly Biology, so that’s kind of nice because that’s what I just got done teaching at a high school level. But figuring out what’s developmentally appropriate—how to teach osmosis to 7th graders—that’s going to be interesting. Or those kinds of things that the county, the school district requires me to teach. But I’m prepared to do that, and if I’m not then I know who to talk to and I know where to gain support from. (Andrea, 1:1201)

6 My goals for students . . . I want students to problem solve, I want students to critical think, and if I just give them the information, then what I found was that they will just latch onto the information, and they won’t spend any time actually learning the content. But also I know that students hold their ideas deeply, and so if we give them these readings they’re going to do what they’ve historically done in schools for a long time, which is maintain two types of understanding: their school understanding and their home understanding—their real
understanding. And so the book cannot bring them to the disequilibrium that they need to get to. And so I needed to find experiences that would bring them to that point, and then we would get into the reading later, because reading is completely important, but it’s just where we place it. (Andrea, 1:233)

7I distinctly remember what I drew because I drew a huge science teacher standing in front of a lab table with chemistry stuff on the lab table and, I don’t know, some sciencey words on the background. I didn’t draw any students in the picture; I know that I didn’t. I put myself in a lab coat. I would think I would change it entirely, I think I would have a teacher amongst her students talking to her students, having her students talk to each other. Having her students write on whiteboards, having her students actively engaged in the classroom. In the first picture I had it focused on the teacher. In the second picture I would want it focused on the students and the teacher would be there to kind of guide the students in very intentional ways. (Andrea, 1:921)

8My mentor teacher told me that I was conceited, condescending, and disrespectful because I asked questions and I probably had [more] conversations with her than I should have. . . . I was being told to do the gradual release by people who had no content-understanding for my subject matter, and they were telling me it worked anyway, and I told her I was frustrated because there were four people in the building with master’s degrees and teaching science and not one of us, even the veteran teacher—who had been teaching for seven years and had a great record with the district—not one of us had been consulted for how to teach science effectively. I think that I couldn’t fathom that, and so I was expressing that to her. Unfortunately, most of the things that I said were twisted and told to administration. (Andrea, 2a:626)

9[My mentor’s] view of teaching science is having kids do cute little plays and sing songs. She gave me her stuff and encouraged me to use it. “This is what the building wants you to do. You should do that.” Then, eventually, I sensed that she was being threatening. Indeed, I don’t think I was picking that up at first, but she would say strange things like, “These are the expectations of the building. . . . If you’re not doing this, well, this is what this building does. So, you need to figure it out. . . . Per some of the things that were reported back to the administration, I truly believe that she was being threatening. I really do. (Andrea, 2a:751)

10One of the SILs [School Improvement Leaders] . . . told us that [the school district] is now mandating that we all give common formative assessments. They all must be given at the same time and they must be exactly the same. So, no matter where your kids are at, or anything, by Friday, every student has to have the same quiz in your building. . . . I said, “Well, that concerns me because we, as teachers, need to make decisions as to what’s best for students, and something that this other teacher is doing might take less time with their students than it will take with my students, but that’s not a reflection of intelligence of those students or anything else, but [of] those students’ misconceptions and the ideas that they’re trying to develop; and I’m concerned that if you’re mandating that these kids take this quiz, then, (1) we might harm concept development if students aren’t there yet, and discourage students, and their self efficacy is really important. So, if we’re giving it too early, it’s harmful. If we’re giving it too late, it’s pointless. Now kids are like, ‘Why are you giving me this if I knew this already so many days ago?’” After I had done that, I was approached by another SIL and told that he had heard that I was being a problem, and he would really encourage me to have a better attitude. (Andrea, 2a:525)
After talking to [the TEP science education faculty] I decided that my best move, moving forward, would be to get on the good side of the vice principal, because he had liked me for my classroom management and, also, just start smiling and not saying anything, because I wasn’t being listened to anyway. And, at some point, I think you have to accept that your words aren’t being heard. . . . So, by the end of the school year . . . I got approved for a large field trip to take the whole seventh grade on, and I got approved for a large event where all the sixth grade gets to see animals from Pella Wildlife. So, the message that they were really trying to sell me is, “We don’t want you to think. We want you to act like you’re doing what we’re telling you to do.” So, my exit interview with my principal, she was telling me that she was really sorry that she was losing me. She felt like I was the leader in the building, and she really thinks that this was a good fit for me, and I said, “Your research base and my research base do not line up, and what you think is best for children and what I know is best for children are not congruent. So, I had to go somewhere that would encourage me to teach in ways that I know that are best for children.” And she said, “Well, I’m sorry you see it that way. I don’t really see it that way.” And I said, “Well, here’s the reality. There are people in this building who are mentors, who are older individuals, who specifically told me to smile, say I was doing one thing and do another, and I am not okay with that. I will not be a deceitful person, and I’m not going to lie to you. So, I need to go somewhere else, because I don’t think that’s a fair position for me to be in.” And again she just said, “Well, I’m really sorry. I respect that about your character, but I really think that you were a good fit here.” And I couldn’t believe that she was hearing me say, “I feel like to stay here, I have to lie,” and she [was] saying, “We would have liked to keep you.”

I also was able to talk to [the TEP science education faculty, and one faculty member] came and observed us teach. He spent time in our classrooms, to make sure that we were supported, in case if anything was to happen to us. He encouraged me to come in and talk to other students about some of the things that I was experiencing, and then, just, you know, continued to be an encouragement. [The TEP science education faculty] were incredibly helpful.

Still, my biggest weakness is logic flow. I have a hard time with logic flow, but that’s what colleagues are for, because you have colleagues who are strong in logic flow and you can meet with them—like I did with Liam and Chris—and we can kind of talk things out and help me develop them. So, that’s kind of how I’ve been addressing that weakness, as I’m developing it further.

So horrible experiences have value, if you can survive them, and I don’t think that most people do, and I do think that communication with people who are like-minded and understand what you’re doing is what keeps you in it.

My way of formatively assessing students would be things like starter questions. And so, I sometimes asked a question about prior knowledge. I’d ask a question about the day’s activities. And then I would go around and read what students wrote, and that would give me an idea of where they are or what they remember from yesterday, those kind of things. Questioning students is a continual process of identifying where students are and what they’re learning and what they’re still struggling through. And then, you know, the district-standard tests were supposed to be our big assessment for the unit. I found that they often didn’t really tell me where kids were. So, I used those common formative assessments to kind of direct my teaching. If I
needed to go back and reteach a concept, or if I really felt like they were completely understanding something that we had gone through. (Andrea, 2b:25)

16 Doing things according to the learning cycle, providing [students] with concrete activities or experiences before you move into something that might be more abstract. I’m a big fan of decontextualizing things, taking it out of the different context, so that students don’t try and apply the things they’ve memorized from other classes, but that they’re actually kind of evaluating something outside of context. And then I can help them bring it into context through questioning, discussion and reflection. I think it’s my job to make sure that I’m providing an environment that is conducive for how people learn and that I’m reflecting behaviors that are supported by research that promotes student learning. (Andrea, 2b:58)

17 My mentor teacher is wonderful. At first, because of my experience last year, I was really reserved. I was like: I’m not going to give her any ideas; I’m not going to do any of this stuff, because I can’t have . . . I can’t be attacked again . . . Instead of her saying “You are my mentee and you’re going to listen to me,” she’s done the opposite. She’s come to me and said well, can you help me think through this? (Andrea, 3:223)

18 I have this innate feeling when I’m told that . . . colleagues or people who have authority . . . have something to talk to me about, I worry that it’s going to be negative. And then I have to catch myself really listening to what they’re trying to say, because I do go on the defensive really quickly, too, which is not needed. But I panic and I think, “Oh my gosh, this person’s going to be attacking me again.” Then I have to take a step back and say they’re not trying to attack me. Gosh, they’re just trying to be helpful. (Andrea, 3:916)

19 Chris I’m still very much in contact with. Liam, more at the beginning of the year. Toward the middle of the year, both of us ended up getting busy toward the end, and that drives me nuts. Hannah is one that I talk to regularly, and I still am keeping contact with Ethan but not nearly as much as those others . . . [for] understanding how to sequence [content] so that the students could learn deeply is what I was struggling with, and I think that that’s kind of what I’ve grown with. Last year, I grew a lot from talking with [a previous TEP graduate] and Chris. Both are MAT graduates. But then this year it would still be Chris and Liam and Hannah. I would say Liam and Hannah are the ones that I kept in contact with often. Hannah and I often have conversations driving to work thinking through what we’re going to be doing. So that’s been fantastic. (Andrea, 3:26)

20 I’ve received a lot of support from people in the MAT program, and I’ve received a lot of encouragement from people of the MAT program. So I think that that’s the best way I can put it is as far as what is helping me become a more effective teacher. I know that talking to my colleagues and staying in close contact with you and with [the TEP science education faculty] and the current cohort—doing all those things—having an intern in my classroom: all of those things help me pursue highly effective teaching. (Andrea, 3:104)

21 How students learn dictates a lot of my decision making. I have to think about okay, I have this concept and this idea is abstract. What am I going to do to make it more concrete? And then sometimes I have to look and say okay, I understand they want me to teach this but it’s not developmentally appropriate. And so yeah, I’ll spend a couple of days on it, and then I’m going to move on because I’d rather teach something that the students are going to be able to create a better understanding at the end, you know? And I was actually just explaining this in the hallway
to the student who keeps skipping my class. I said the difficulty that I have with you skipping class is, my class is designed around you students working together. And it’s designed around that because research supports that you learn best when you are talking with your classmates and when I am asking you questions and helping you think through things. And it also supports that you learn best when you are given concrete examples. And so yeah, you could probably memorize a bunch of this stuff and not need to be here. . . . And so I had to communicate that with my students. I make these decisions because I want this to be learning, not memorization. I also make my decisions about how I’m going to implement things based on research-supported teaching behaviors like asking questions. I know that if I ask dichotomous questions, the students are going to seem like they know a lot, and probably not be challenged to think deeply about things. And likely, their misconceptions will hold. (Andrea, 3:314)

22 When [Liam and I] started developing the 10-day lesson plan is when [working with other people] really started to kick into high gear . . . also, we did a lot of RBF feedback, and we hung out quite a bit outside of class, and then also during the Restructuring course, because we had the same content endorsements. (Chris 1:62)

23[My experience with my cooperating teacher] was great. And I contribute that to a couple of different factors, one being that we were the same age, and we definitely had the same interests. We had different endorsements, for the most part, but I almost consider him a friend. . . . He also was a like-minded person, since he graduated from this program. So, that really helped out I believe. . . . He was a great model. I was able to observe him teach two courses, actually, that I did not teach. I taught environmental science, and I was able to observe him teach geology, so just from observation as an effective model to observe to implement these research-based practices, that was really good in itself. If I ever had a question, he would definitely give me his insight. Every now and then, he would pull me aside and say, “I suggest maybe you do this next time,” but really, I was on my own for the most part. Which was good, but if I needed something on a Sunday, and I called him up and said, “I don’t really know where I’m going with this lesson. I’m about to wrap up with this one area, and I don’t know where to go to,” he would definitely help out. (Chris, 1:74)

24I feel my concerns do not lie with implementing effective teaching practices. My anxieties lie with understanding my content, to the point where I need to, [in order to] teach my students. Coming into the program, and even to a certain extent, while in the program, I always thought that you need to be a step or two ahead of the students, but that’s just simply not the case. That’s how you teach ineffectively. That’s how you teach at the students. I need to, myself, deeply understand this material so I can be able to come at it from different angles if I need to. I need to understand the content that I’m teaching today, how that’s applied, or how that’s connected to the stuff we just learned about four weeks ago, or how that’s connected to where we’re going to go four weeks in the future. So, my content understanding is something that could be concerning, and I just have to work at that. (Chris 1:878)

25This is why teacher behavior interaction patterns—this is why we ask these extended answer questions, and the value of wait time, and using positive non-verbal communication with students. This is how we can actually pull these ideas out. And, it’s not about the teacher, in the sense that we’re teachers. It’s about the students, and everything we do is about the students. That’s why we’re there. It’s to help these kids out. (Chris 1:289)
To be an effective science teacher—you have to teach the nature of science. Science is not in a cute little box. Science is not in a nice little package. It’s still something that I even have a hard time talking about, because I don’t know that I truly get it well enough that I can talk about it. But I can sit and I can think about the nature of science. For instance—and I don’t do this that well but, if I want to talk about atomic theory—atomic theory is a great science idea, or science concept to address: the tentative nature of science, scientists use models, science is collaborative, science is inventive and creative. That one theory really just hits so much. To say that this is what an atom looks like, you’re perpetuating the problems that are associated with the current state of science education. Everything is just interwoven. The nature of science is kind of interwoven with the current state of science education and the problems that are associated with it. But, it’s really difficult. I have a hard time talking about the nature of science, I really do. (Chris, 1:361)

Teaching is extremely dynamic, and it’s very difficult . . . you have your student goals and actions, and then your learner, and you have the connections between your teacher behaviors. Then, [the framework for teach decision-making] just [has] these straight lines, and it’s really not straight lines. I use the analogy that it’s like a bowl of spaghetti, because it’s just all over the place, and everything goes back to your student goals and their actions, and the foundation, the learner itself. It just goes back and forth between there, and as a teacher, what are you going to do? That’s crucial. Your students are your number one responsibility, and then how they learn, and your goals, of course, what you want these kids to do. But, just how complex teaching is. (Chris 1:315)

I came in motivated, and I took it seriously, and then right away, that first course, the readings and the literature that we had to keep up with, that was also quite intense. But, it was a serious nature, because even when we talk about learning theories, I’ve always thought that there were different styles of how people learn, and that’s what I was always told. People learn by doing, they learn by touching, they learn by seeing and reading. . . . Actually come to realize that it’s all of that, but it’s not really a style. It’s these theories, and they all overlap, and that’s a very serious nature. But, right away, just with the readings and the internship, and then the follow-up practical, fairly right away. (Chris: 1:27)

He offered some good real-life, like “How do I manage my life?” suggestions, because I put in easy, 14 hours a day and I can’t do that anymore now that I’m married. That was when I by myself. (Chris, 2:321)

I invited [administrators] into my classroom to watch activities. That worked out pretty well, so they saw what I was doing. I invited them in, [and] then I made sure that I was incorporating some of the things initially that they wanted us to incorporate. So you know this is where I do, “This is what my class looks like, here’s me being a team player by putting up . . . the gradual release.” I was starting to implement [gradual release] just so it looked like I was being a team player. (Chris, 2:210)

[School Improvement Leaders] have big egos, they really do. . . . If you approach them and say this is what I’m looking at, this is what I want to do; it’s coming to understand, say, the rock cycle. . . . So I want to work this in, there’s a good opportunity for writing, a writing-to-learn opportunity. That’s what they want to hear, that buzzword “write-to-learn”. That was one their big professional development things. So if you just go and seek out their advice for things
that they’re incorporating, they get really excited about that. And if you do that enough, then it’s perceived that you are being a team player, and if they do walk in unannounced, you really, really do have to understand whatever crazy, crazy business they’re trying to shove down your throat or into your heads. You do have to know it. You don’t necessarily have to agree with it, but when they walk into the room . . . you need to be able to turn on that switch and be able to use those buzzwords. . . . I made a copy of some of the better ones and just made a history of them. Well, I blacked out the student’s name, I put it in their mailbox, and I just had this “Thanks for the advice. This is some sample work. This is a typical student response.” I mean they really just have really big egos, at least in my experience where I was, and if you feed into their ego, you’re going to work their ego in your favor. (Chris, 2:224)

32 All right so, on a peer-to-peer level, Andrea, and [a teacher who graduated from the TEP in an earlier cohort], and Ethan we worked pretty closely together. I know [the other teacher] and Ethan worked really close together and Andrea and I were pretty close. I mean there were very, very few times in the beginning of the day where I wouldn’t go over and say, “This is my question. Please help me word this.” So we were really supported in that way. To that end she would very frequently e-mail, call, stop in my classroom and say, “Okay, this is the idea that I want to try and develop.” (Specifically for her science unit that she was planning for 7th grade weather unit.) “What do students need to know to understand this concept?” So I would share my logical flow, or my pathways, that I thought students would need to know. So it was a good working relationship with teachers that way, like-minded teachers, very rare. (Chris, 2:295)

33 I would think of a big idea, myself, and then just think about what do students need to know to understand continental drift and what plate tectonics is. So they need to understand how scientists perceive or model of the structure of the earth. I mean we provide them with an opportunity to kind of discover why the scientists believe this. What methods do scientists use? Well, they use seismic waves, okay. So seismic waves will produce earthquakes, so now [they] are starting to develop this whole idea in [the] case of earthquakes, and is actually my starting point. If I can engage students in some kind of an engaging activity dealing with earthquakes, okay so good, we’ve got that down. Maybe talk about that, develop that idea just a little bit, that’s my engaging. Then I really want them to understand what seismic waves are. So we need to talk about the properties of wave, you know, the P waves and S waves. What do they look like and then how do scientists actually understand or actually use the seismic waves from earthquakes [to] help determine the structure of the earth? Then with that, then we get in and start talking about very briefly the properties of the earth, and I was more concerned with the properties of the mantle. So then we brought in [an] Oobleck activity and so we’re able to tie that in. And then we talk about how certain waves can go through solids, where other waves they can’t go through solids. So then that’s pretty much how we started to develop what the interior structure of the earth looked like, and then from there, then I need to know and now the students need to know that there’s internal convection that’s happening within the earth. So then you understand convection and density and particle motion, you have to understand all of that, so a little bit of kinetic molecular here, which I’ve never cited. Still I never mentioned that term to my students. They understood it, but I never mentioned it. So I was able to bring in the density concept that we previously developed and apply it. So you’re still using the learning cycle. You’re still supplying it. You were still picking things up that were already developed, you know how many months ago, and then we’re going to reintroduce that and apply it in a different setting. Then through convection we can talk about plate movements, continental drift, and then
the unifying theory of what plate tectonics is. And we can take a look at evidence on earth, because these continents were once together. What evidence would we see? And so, just kind of posing these [types of] questions. (Chris, 2:25)

34How people best learn was always in the forefront in my planning. . . . I think I did fairly well at developing this logical sequencing, intellectual pathways to help students learn. That was really fun. I enjoyed that a lot. What do kids need to know to understand, I don’t know hurricanes. (Chris, 2:130)

35Well, I understand that learners need to learn with developmentally appropriate lessons, and concrete activities. . . . I said before about prior experience and how those essential prior experiences help people to learn. And if they didn’t have the experience, I would provide them with an experience to draw from. Just making sure that the students are talking about things, they’re sharing their ideas in some little groups, and they’re even questioning me and questioning things that I’m having them do. So really the learning theory it’s really, really huge. It’s really big, and really as a first year teacher, if there’s any advice it’s if I could just say, if you know your learning theories and you know the implications of your learning theories and you know how to restructure activities to better facilitate what learning is, and you go from concrete to abstract, you’re fine . . . it is a big scaffolding what students need to know, so you can at least introduce deeper ideas, bigger ideas. (Chris, 2:464)

36I was very cautious going into the school year. I don’t think it was until after Christmas I actually felt comfortable with the administration. They weren’t going to come down as hard on teachers as they did at the last school I was at. I was a little nervous about that. (Chris, 3:945)

37Our principal, he is not a micromanager. He likes to know what’s going on, but he’s not going to tell us what to do. He likes to be in the loop, he’s actually said that before to me. He likes to know, but he’s not going to be a micromanager. (Chris, 3:720)

38The admin when they come in they’re nothing but glowing. This is kind of concerning because they can’t just give me one thing that you would like me to work on, just give me one thing. I don’t get any feedback from them. I know I’m not that good. I know that for sure because there’s a lot of things that I can do to be better. (Chris, 3:445)

39Sometimes [the administration will] bring somebody in from the county office. . . . I do know that I have full support of my principal. I think I have evidence that would support that. My principal has kind of been talking me up in a positive way. Just for some things in some conversations that we’ve had and he’s shared that with some of the other admin office people, the county office, the head of curriculum for the county. I know that when Liam and I were able to get that article . . . published in [a practitioner journal] I shared a copy of that with my principal and then he forwarded it on to the curriculum director person. She’s really nice to me now. She said that, it’s really nice to see that there are teachers out there that are putting in the time. Really understand what effective teaching looks like. You can do it. I think I have a lot of fans out there as far as they understand what I’m doing. . . . They do pop in very often. The administrators do. The principal, the vice-principal, people from the county, they pop in often. . . . I think they like what they see. I hate to say that, but I think they do. I don’t know what this really means, but I was asked by the principal to join some leadership team, a three-person leadership team. There’s a couple things we have to do throughout the school year. I think that
he sees what I’m doing has really good value. I think that he would like to see more teachers get involved. I actually know he would. (Chris 3:371)

Well, the pacing guide that was kind of an issue, not major. I got around that by developing. They want a pacing guide. Okay, fine, if you want a pacing guide, [then] here’s a better pacing guide than what you had before. I went and did that on my own and they liked it. . . . The tests, but I figured out a way to get around that. I did have a major say in the multiple-choice tests that the county’s giving. I’ve actually developed probably about 85% of those tests as well. Even the multiple-choice tests are a little bit—well, they’re more effective than they used to be. Basically, when I find conflict then I try to resolve it. That’s really what I’ve been trying to do. . . . [My strategies for resolving conflicts are] just using my research base. . . . What do students really need to know and how can I actually put them in the best position to actually learn this idea or concept. . . . I think about how they learn. . . . The school is very, very much a learning style school but when I speak to the administrators I speak of learning theory. They know that I don’t buy into the whole learning style. . . . They want a rationale for why I group kids the way I do. A big thing in the school is you want to group your kids together according to the data on their past quizzes or tests and also their learning styles. Well, I don’t put them together based on their learning styles; I mix their ability group. I usually have a higher achieving student, two average students, and a lower achieving student. The idea why I have those four students ideally sitting together is . . . social learning theory, that kids are going to speak their language, they’re going to learn from each other, try and help those troubled kids in that way. The other teachers don’t really do that. I don’t really know what they do. I don’t really focus too much on what goes on in their rooms. The vice principal, one time after an observation, was asking me what data I use. I said, “Well, I use the student actions . . . I use this social learning theory.” She asked me more about the social learning theory and what it was. I’m sure she heard it before, I’m sure she just wanted to know if I knew. No, they’re very much a learning style school. When I speak with administrators I speak in learning theory to support the things I’m doing in the classroom. I’m okay with that. (Chris 3:639)

This year I actually had a huge influence in creating [the curriculum] guide itself. It’s supposed to come from the teachers. . . . [Other teachers] didn’t really help me. I just did it myself, and I sent them all a copy for some feedback. Nobody responded back [because] they didn’t care as much as me. I didn’t get major push back from the other teachers, or the instructional coaches, or the county. They pretty much just said if this is what you want to do, you can do it. The instructional coaches said, “This is a collaborative effort between the teachers and if all of you guys agree on this, you can do it.” . . . They didn’t really have any constructive criticism, or anything, or really critique it. I feel they were just, “Okay. Yeah, we’ll do this. Put [the] density unit first. We’ll see how it works.” . . . I don’t think many people want to put in the time or put in a major effort to try to think things through. I think there might kind of be, I don’t want to say, “Just put something in front of me and I will teach it. Just let me get through it.” I think it’s more like a job. I don’t know. I’m not really sure. (Chris, 3:148)

I might not necessarily be doing the thinking maps and the bulletin boards in the classroom, but they see the value in what the students are doing in the classroom. (Chris, 3:389)

I talked with a couple people from the program, but nowhere near as much as this last year. It’s kind of concerning. . . . As far as planning—I don’t know, I guess maybe the first year was planning. I had more people around me, so it helped me to have that foundation to go off of.
At least a strong foundation. I talked to Andrea a couple times. I talked to Liam once or twice. That was pretty much it (Chris 3:244).

Kids are getting involved and putting their ideas out there. It makes me feel good when a student puts forth an idea and then another student asks, “What evidence do you have to support your idea?” Even if the kid’s idea, the initial idea is kind of far-fetched, if they appear support it with evidence, okay, that’s great. That dialogue between students, that was very evident this year. That was pretty cool to see. (Chris 3:406)

[Classroom management is] fun. That’s just a lot of routines and being consistent with my expectations. Letting them know clearly what I wanted them to do. I started that off early, it was amazing how that really does carry throughout the whole year. It’s little things like you don’t put your head down in my classroom. In the classroom, we talk about rationales for why we don’t do it. Three or four months, before Thanksgiving, and I was noticing a student lay his head down on the desk and if they don’t immediately pick it back up because they realize what they’re doing, all I had to do was kind of stop and look, and they realize. (Chris 3:258)

This year I proposed kind of a mini-unit. Kind of set the foundation for the whole of our science, talking about phases in particle nature and density. So, when we’re developing these skills for the understanding and the skills that are associated with understanding. What I’m going to do is when a student needs to figure out the mass of a mineral, what I’m going to plan on doing is very carefully thinking about what minerals I want students to determine the mass on and just label them mystery mineral one through ten, whatever it is. Then when I get to talking about minerals itself they’ll have that density data already in their notebook, so that I can just pop right back in, “Well, density is one way we can figure out a characteristic or property of a mineral, but here’s another one.” Then introduce the rest of them. Kind of thinking ahead, and being a little more proactive and, “How can I maximize this activity more than once?” Kind of piggy back off that idea, off that activity. . . . I draw from [my entire research base]. A mixture. It’s all on the foundation of [how] they learn . . . concrete to abstract. You work through this progression of understanding. How you build knowledge off of old knowledge. That comes into building knowledge off of previous knowledge. That’s the minerals [example] I was talking about before. You just have to work through how those people best learn and help put those students in that position so they can learn. But do SATIC code and being able to record myself often. I do actually do more video recording than audio recording. It’s kind of neat. I never had classroom management issues, but the kids when they see the camera’s up, they kind of, they’re always a little bit more obedient, a bit more engaged. I definitely do a lot of video recording. Making sure that I’m doing what I need to be doing. Doing that this past year I realized that my wait time II was not good at the beginning of the year, but I was working on that and I think I got better at the end of the year. (Chris 3:115)

I just feel very fortunate to go through this program, and I will never look at education the same. It’s ruined me, in that sense, because now I know what I have to do. Now I don’t have an excuse. . . . I know what I need to do. It’s just a matter of getting in there and doing it. And hopefully, not hitting too many road blocks along the way. (Chris, 3:910)

I’m older . . . I was in the military. I think those previous experiences, I think I did defense for part of it, where I didn’t want to participate a lot at the beginning because then I’d just be trying to show off how smart I was or something. That’s how I kind of feel people do, and
that’s just probably because of my prior experiences in past, in high school. I wasn’t smart enough to go to college so I didn’t go to college at that time. The togetherness I felt during the program, [I was] probably standoffish and a little skeptical so I wasn’t really meshing too well. Then towards the end, I think, we all built pretty good relationships where we all felt comfortable participating in the class and calling people up and collaborating towards the end, for sure. But I think there was a transitional period where I wasn’t ready to commit myself, and almost like having a wall up with your companion or something. You don’t want to give your whole self until you get to know them and feel comfortable and safe. . . . I think, towards the end of the Fall semester when I realized, “Man, I’m suffering.” And with all the reading, I had to reach out for some help, otherwise I was going to drown completely . . . that’s when I was, like, I need to start networking, otherwise I’m going to drown, I can’t do this on my own . . . so in order for me to succeed I had to suck it up and ask for help. (Ethan, 1:45)

49I just think their expectations were super high and that caused stress for me. Because you’re going in, you don’t know what you’re doing, you’re living up to them and they’re giving you this feedback, and sometimes this feedback is not easy to take. For me it was kind of difficult because it feels like you’re being attacked all the time. But once you start implementing what they’re doing and what they recommend, don’t take it so personal. . . . It’s tough to hear some of the things, a lot of the time, to me; it felt like all I was doing was wrong. But it makes you want to work. . . . [My cooperating teacher] made a great impact [on my understanding of effective science instruction]. He was always there to help me think about the act of teaching, my reflecting in the act of teaching. . . . It’s a tough relationship, I don’t know how you describe it, it’s basically he’s your mentor, almost. (Ethan, 1:119)

50I’m teaching at [a] Middle school which is a low socio-economic status school, so what I’m concerned with is parent involvement. I don’t know the research on it but I know at [the school I student taught at], you’d need a parent, you call a parent, they’d be on their kid like that. I don’t even know if you’ll be able to get a hold of parents down there. How involved are they in their [children’s] lives? (Ethan, 1:633)

51My goals are super important. I tell the administration that my goals are almost more important than the content, because . . . the percentage of kids that even go to college, the percentage of kids that even go into science, it’s not important to me, technically. I’m more interested in making them positive, educated players in society, based on my goals, whether it’s making sure they’re critically thinking, problem solving, collaborating—those are more important to me. To me, I have a bachelor’s degree in science, that’s my vehicle to help kids. (Ethan, 1:240)

52I’ve got tons of audio recordings myself, a few video. The effect of just sitting down, yourself, and saying, “Man, that was a crappy question, or I shut him down too soon, I shut her down too soon.” I think the big concept for me was self-reflection. (Ethan, 1:417)

53The logic flow seemed like it helped me to tackle this content, this topic of the unit . . . having to sit down and logically think through what order am I going to cover things, what makes more sense, what’s concrete, abstract, whatever learning cycle strategy I’m going to follow . . . a better understanding of how to plan what I want to cover. What are the big ideas and what direction do I want to take? What are the pros and cons of going one way versus the other way? (Ethan, 1:433)
I knew that there were certain programs or strategies that they wanted to see used in the district called, “writing to learn strategies,” which we learned in [professional development]. . . . Other reading strategies, the Cornell notes stuff. I still did it, but, what dominated my planning was the way I knew how to teach, and then I sprinkle those in when I could, just to play this game. So I know what they wanted us to do. They wanted us to have awesome District benchmark test scores. I already knew that. Use the textbook, do a bunch of readings, do a bunch of gimmicky “writing to learn” stuff. That’s what they wanted every period. So, I did that because we had to turn stuff in [as] little homework assignments. Did that. I had veteran teachers who were not turning stuff in. I was, because I was usually gung ho about stuff, and the Golden Child. I’m usually doing the right thing. So, I did do it. I balanced it out. I did what they asked, yet, doing the same thing I did. (Ethan, 2:302)

Everyone should’ve been doing this gradual release model in some book we read that told you how to structure your lesson plan . . . and it didn’t jive with me, because, remember, I just got done going through a really difficult transformation in my brain, accepting how to do things [as promoted by the TEP]. . . . So, I was expected to do the cookie-cutter, this gradual release thing [and] writing-to-learn. Supposedly, they had figured out that a certain amount of time spent doing discussion, then switch over to reading, then switch over to direct instruction. . . . They wanted to see times on your lesson plans . . . which I don’t do, because a) it’s really, really rigorous to try to plan out, b) I just use my own decision-making, judgment, and say, “Are these kids getting it this way?” If not, I try re-engaging them using some other strategy. I’m a big boy. I make big boy decisions. I don’t need a book to tell me how to, like a robot, “If you do them like this, then it’s going to work.” That’s what they wanted, because then everyone’s teaching that way, then everyone in the school will increase the scores. (Ethan, 2:400)

[Guided Group Interaction is] just an activity that we’re supposed to be doing with kids because it supposed to allow kids to hold each other accountable and air things out in a safe manner. So, supposedly, because it works for sixth-graders, we’ll do it with the adults, and it was just a set up for us to air things out. It was supposed to be a time to talk about all the stuff that he could tell we were talking about. (Ethan, 2:510)

I recorded most of [the meeting] . . . I spoke up in the middle and I was just like, “I don’t feel like I have any academic freedom to do what I went to school to learn how to do.” . . . I know how I talk. I’ve listened to myself a million times before. People that don’t know me find the way I talk, or the way I pause, my intonation, they find it offensive or abrasive. . . . When it comes to that, that’s not on my top priority list to change how I talk to an administrator. What I worry about is how I interact and ask questions of my students. I want to make sure I’m being positive and interactive with them in a way that makes them comfortable and want to participate, but that’s the flipside. When I’m sitting in with my administrators and other teachers, I mean business and I’m more to the point professional or, in their eyes, maybe less professional. I don’t know. . . . I listen to the audio tapes once in a while, but I just a member saying, “I don’t feel like I have the opportunity to do what I’m supposed to do and everyone’s telling you how to teach” something along those lines. This other girl, though, finally spoke up and said, “You guys are just the only ones who had the balls to speak up and say what needs to be said.” That’s the thing, it’s like we were meant to take the heat, but nothing changes. (Ethan, 2:579)

[This other member of the sixth grade team] had already put eight years in, and then she was even starting to get just uncomfortable. She really liked working at [this school],
specifically, with those types of kids that come from that type of socioeconomic background, or whatever. So, it was even so much BS this year, she transferred out said, “See you later.” . . . She’s math, but she was there to help me play the other side, basically to almost be like a mentor, but not my official mentor, too. (Ethan 2:826)

50If I didn’t work with [Andrea and Chris] . . . I don’t think I probably would have reached out to [Chris], because I didn’t know him that well, Andrea maybe, because we were on Facebook support for the program. So, if I didn’t have them [in the building] period, let’s say, I don’t know, maybe I would’ve reached out more through the Internet, maybe. I just don’t know . . . I like to just do things on my own until I struggle or fail, because I think it means more and it will stick more with me if I struggle with it. So, if I was sitting there asking people every turn “Okay. How did you do this? How did you do that?” I don’t know what the value is of that. Is it my idea anymore or is it just someone else’s? (Ethan, 2: 887)

60Strengths, I would say, based on last year, just being creative and coming up with concrete activities for kids to do before introducing content-type stuff. I think my other strengths might be asking the questions that I ask and having kids elaborate their ideas more, and using their ideas to further investigate their understanding. (Ethan, 2:9)

61When introducing the nervous system, I had an activity . . . I left this as open as I could with little direction, just so I wouldn’t inhibit their problem-solving and teamwork capabilities, but they had a cardboard box with an object in it that only one student could have their hand in at one time, and in that was a location. Then, I had another location at the front where students could ask questions and try to determine what was in the box, but they had to figure out a way how they could get that message or that question down to the other end and then back up to the first person who created the question, but there’s limitations. . . . So, they had to use other students in some other way, and “How do you do that? That’s up to you guys to figure out.” That’s . . . probably what I said. So, in the end, it turned out to be where the person with their hand in the box, their job was to sense what it felt like, and then their job was just to simply pass it through the other messengers who called them, back to the person making the decisions. So, it essentially represented just the brain, spinal cord and then nerves. (Ethan, 2:85)

62I tried to extensively monitor every little question I asked and listen to every little response and comment. Even if it’s three comments at one time, I tried to stop and hold up and have these kids go back and not talk over each other because I need to hear what they’re saying, and I know learning is taking place when conversation is sparked from one simple question or from another simple answer, and they elaborate. I evaluate it. I ask them to read it and elaborate, because maybe they’re not where I want them to be, without me telling them the answer, but, yet, they’re not guessing. I don’t know. I guess, just seeing work at the beginning of the unit, compared to the end of the unit. That could be oral or written. But it all depends on what we think learning is . . . I worry that the other teachers going to say, because of a worksheet or a test. You know what I mean? And I don’t think that’s accurate. I think it’s just me saying, “Okay. You guys are giving me these answers at the beginning of the day or the beginning of the week or the month, but now you guys are talking about this accurately, like it’s breathing. You’re just doing it.” (Ethan, 2:954)

63This year, again, I just haven’t really kept in touch with [faculty or cohort members from TEP]. Partially because I don’t feel I had [anything] significant come up or needed anyone
else with advice until that job opportunity came up. I actually put myself out there [by e-mailing my cohort members]. I think I might have mentioned this before [but] I don’t like asking for help a lot. Maybe it’s because I think it makes someone look weak or at least I think it makes me look weak—I love it when people ask me for help, it makes me feel wanted. But I don’t think I’ve ever reached out for anyone this year. (Ethan, 3:516)

64 All year long, I don’t know if I should put this on record, but my administrator was supposed to come in and observe me. But it didn’t happen until May. So, I was out of sight, out of mind. Again, if I needed any help, if I had any questions about teaching or anything, I would just rely on some colleagues in my building here. (Ethan, 3:365)

65 I have learned that I need to maybe take a backseat sometimes, when in discussions with other colleagues, and note that they may not have the substantial background that I have in reading literature and discussing at an intellectual level, science education. (Ethan, 3:18)

66 Asking advice from colleagues. That’s a big one, I confide in colleagues all the time for advice and telling them the scenarios. What would they do? Then, I can bounce it off of what I would do or what I did. That’s growing on the weakness of working with other colleagues with different backgrounds. (Ethan, 3:74)

67 I just knew that I don’t know who talks to who around here. So, I knew that I had to be careful about what I thought about [professional development], and this, and that. Based on previous experiences, I just knew I had to lay low and keep some of my philosophies to myself—and my beliefs. . . . Even if I think something is silly, just keep to yourself. Because otherwise, I’m going to be the Negative Bickering Guy or something. . . . But I just knew that I wasn’t going to start calling people out, or policy out, or asking questions about [professional development]. Just because of the prior experiences I had. (Ethan, 3:329)

68 This position isn’t science. However, my teacher behaviors and strategies are still influenced by my research base. Really, the only difference is content and other roles I play besides teaching (Personal E-mail, 8/29).

69 The framework I’ve developed, I still stick to it. Even though no one is watching me, really, down here, I’m out of sight, out of mind. I still do what I know is supposed to be the most effective way to interact with kids, the most positive way. You get the most deep understanding out of kids no matter what the content is. . . . I know it’s the most beneficial thing. It matches up with what I’ve read and discussed. But also, students prefer this sort of interaction in an engaging classroom I try to create. They’ve explicitly told me, sitting and taking notes off a board and listening to someone lecture isn’t engaging to them. That’s why they don’t go to classes. However, they will say that because they’re adolescents, they will say that that’s all I do, but that’s not what I do. They don’t have an accurate view of what goes on in my head and they don’t understand what I am doing and how it benefits the class and them. I do it because that’s what I’m supposed to do. Based on my current understanding of how people learn. [I know my students are learning] based on whatever work they give me—oral answer discussions, oral elaborations, elaborating in writing, whiteboards, presenting. I’m able to just monitor what they’re doing through different ways. Whether it’s writing or through the discussion format. . . . I think what they’re doing; they’re mixing up me giving directions or information that has to be kind of just given for not busywork, but housekeeping-type stuff. I think they view that as lecturing. Because I talk a lot by asking questions, I think they interpret that as lecturing just
because I’m talking. . . . They think just because my mouth is moving, if something is coming out, then that’s just a lecture. But it’s not. I have to ask the questions, otherwise who’s going to be guiding or scaffolding the class? . . . because of that relationship building, I can push people to try to promote and engage more. And then monitor for all the negatives that doesn’t equate to our expectations and quickly correct those behaviors. And so, therefore that helps, in the end, create that classroom environment that you want that lets people feel safe to participate. I’ve seen a lot of kids that are outgoing this year. I’ve seen a lot that are very shy. Some of them, that may be because they’re immigrants and English is a second language to them. So, of course they’re standoffish but that doesn’t mean I wouldn’t allow them. I would still come over there, squat down next to them, work with them, ask them to come up with their ideas they wrote down on the whiteboard on a sheet or whatever. You don’t get a free pass not to participate just because of anything. So, it just comes back to engaging kids and trying to get them to participate one way or another. Because in the end, if they feel confident to do it, they’ll engage. (Ethan, 3:102)

That’s what it is, it’s mentally taxing. You’re restructuring what you think teaching is, what it looks like, and then, for me personally, I’m coming in to a program that maybe if I had known it was so heavily involved with all those readings, I might not have done it, I might have been scared away. But now looking back, obviously, I’m proud. I have accomplished something great coming from where I come from. People are going to say that a degree is nothing, it’s just debts, it’s something you struggle with. Is it really worth it? . . . I know who I am today is just different from who I was in May alone, just from the program. It has shaped me in different ways. It has added . . . and rearrange[d] who I am . . . I told [TEP faculty], “You changed my life.” (Ethan, 1:701)

I’ve got headaches and sick to my stomach-type feelings because that’s how I felt when I first went to a graduate program. I relied on the whole fact that I’m not supposed to be there; I’m not smart enough. And so, that creeps back in after getting treated like crap for two years, basically. Then, it’s going to be different, 180, going somewhere else. Maybe they’re going to expect too much out of me. I don’t know if I can do that. But I think at the end of next year, I’ll know whether or not I’ll stick with this or not. Because I don’t have much more energy to keep fighting the way I had to fight these first few years, I’m too old. It sounds pathetic saying that. . . . And so, these first two years were unsettling. With the severe decision to quit a job, to go to school, spend more money, go through a rigorous program that was mentally and physically challenging. Just to come out and say “Man, I still don’t know if I did the right thing.” That’s why I had to take this opportunity, because I know it’s going to be more rigorous, but it should be highly supportive, I hope. But this will be the last opportunity. I’ll be able to say “All right. One of the best schools I could probably work in. Is this what I want to do? Or is there too much other BS that I just can’t take in the teaching profession?” Because I love working with people. Science is cool. But can I take all the other crap that comes with it? . . . There’s too much pressure. (Ethan, 3: 717)

I was a lot more resistant than I know a lot of my fellow cohort members were to a lot of the things [one of the science education faculty members] was talking about. Mostly because I was like, “I got through the system fine.” Like, I don’t understand why it doesn’t work. All this stuff is just unnecessary fluff. And so I rejected a lot of the stuff then. Even though I saw it being implemented and working, I don’t know why I rejected it, but I did. (Emma, 1:1016)
[During the fall semester, my practicum teacher] was really supportive. He was willing to step back and say, “Okay. That’s your idea, let’s see how it works.” You know? And, “Okay, it didn’t work. Why didn’t it work?” Or, “It did work. So, what made it work? How can we do this again?” kind of thing. He was very supportive, and he let me do a lot of different things. And that was such a nice environment. And then, there was [my student teaching cooperating teacher in the spring semester]. And that was awful. He was anti-supportive. He was pretty much anti everything that this program stands for. He was very much, I mean, he’d be a great drill sergeant. He stood up and he yelled at the kids, and he told them exactly what to do. Like, feet on the ground, straight back, pencils down unless I tell you to write with it. Not an exaggeration. . . . As much as I hated going to [the] Middle School everyday, I do realize that because of that experience, I know that [effective teaching] needs to get done. And I also know that there are highly ineffective teachers out there. . . . Because the kids that I worked with, it was rote memorization to pass the test. And as long as they did that, they were fine. And they had no understanding of the content at all. I mean none. And so it brought it all to light. That everything needs to, all those little things we talked about have to happen, for people to learn… [In the fall semester with my practicum] teacher, I got to see what happens when you do start implementing the stuff that we talked about. (Emma, 1:103)

And then in the spring semester, when I saw what really happens when you teach traditionally, and how hard it was for me to deal with, I called [my professor] many a night and was like, “I don’t know if I can do this.” Like, “I don’t even know how to deal with this situation.” And he would just calm me down, and talk me through it, and give me some ideas, and just be there. (Emma, 1:100)

I remember a year ago, a little bit over a year ago, when we took our first course—I didn’t really feel a part of the group. I mean, obviously because we were still getting to know each other. But we have some very outspoken people in our group. And when there are outspoken people in the group, I tend to hold back a lot. And so, I just specifically remember talking about our goals. You know, very first I was like, “Oh, man. These people are intense.” I just didn’t feel like I fit in until, again, later in the fall semester when we were working on our RBF, and we’re getting together, and we’re talking about this stuff outside of class. And even a little bit in the summer semester we started hanging out . . . getting coffee, and studying and stuff, I started to feel a little bit more involved. And then, this past spring semester, when I had my terrible experience everybody was rallying around me, and they were really helpful, and really supportive. And so, that’s when it was really like, “Okay. This is my family.” (Emma, 1:59)

[In my oral defense at the end of the fall semester I was asked a question] about if a fellow teacher, or administrator, or parent came up to me and asked me a question about my teaching—it was a lot more specific than this—how would I respond? And so it set us up for, “you need to be politically savvy, and not just go spouting off research on your high horse.” And so, that’s something that I hadn’t thought about. Of course [I thought] everybody knows this is how it is, and how it should be. (Emma, 1:794)

Effective teaching, behaviors and strategies, and all the stuff that we’ve talked about. You know, planning the curriculum in a developmentally appropriate way, all of that stuff needs to happen in order for meaningful learning to take place. (Emma, 1:154)
My picture that I drew, originally, was still me with students outside. And then, the one I drew this year was me with students outside—but for completely different reasons. So the picture didn’t change too much, but what we’re doing in the picture, and how I would go about, as I’m drawing, I’m like, “How am I going to get my students out here? How am I going to get rid of the novelty effect? What’s going to go on? How am I going to keep them at the stream, but not falling into the stream.” So a lot more stuff was going through my head than “I want to take my kids to mountains and be outside.” You know? So it was a similar picture, but a lot different thought process. (Emma, 1:634)

There are very few teachers who are resistant to change. We have a very young staff, and so a lot of the staff is very much open to . . . the higher-order thinking questions and how we develop critical thinking. Our professional development is called AIW, which is Authentic Intellectual Work and it’s all about asking questions that require higher-order thinking. So we bring in lessons that are supposed to be our lessons—to help us . . . and as a group we go over the lesson and figure out how we can improve it to make it more of a higher-order thinking, critical thinking activity or lesson. . . . So there’s good support there from that, and then the professional development that I did this summer is . . . Science [Writing Heuristic], which is all about big ideas and concept maps and how we can use our big ideas and concept maps to help students come to an understanding of big ideas and not all of the small, factual understanding that is kind of traditionally what we’ve been doing in science education. And they do that through what they call a dialogue, which is basically the questioning, the scaffolding questioning, that we learn so there is a lot of [support]. (Emma, 2a:29)

The teacher that works right next to me, the other science teacher, she is a great resource. She’s been working for about six years and she started in the middle school so she had a lot of the students that I currently was having and she could kind of help me with their personalities and what they were taught when she was teaching them. (Emma, 2a:60)

Mason . . . lives like half an hour drive, so he could kind of “pop on over,” I can go over there [to lesson plan]. So other than that, there are probably just people that responded most when we send out those [online] emails, you know like “Hey, I’m having this problem. You know what’s going on there . . .” Noah was the one to initiate it. Like “I had a really bad day [or] what exams do you have.” (Emma, 2b:52)

For my first year, I feel very comfortable with what I covered in my physical science and my chemistry class. I feel like what I covered, I did fairly well. I mean I know there are things that I can improve on. The content I covered and the depth that I went in with that content, I feel good. The questioning, I mean, I know I can do better there, too as well, but I feel that I’m beginning to understand where my students are coming from more and then how I can question them to lead them to an answer, scaffold them, I should say, the understanding that I want them to get out of it. I feel more developed than I was, but not as much as I much I need to be if that makes any sense. (Emma, 2a:5)

A lot of [deciding when to move on to a new topic] comes from summative assessments. . . . And then again, a lot of the questions the students ask. You can kind of tell if they’re really understanding, if they ask an in-depth question. Or, if it is really a kind of surface question, you know we need to delve more into it. . . . And then time, of course, which is always limited, you know. Towards the end of the year it’s one of those things like, “OK, we have about
three weeks left, and I really have to cover [this] other stuff.” [I decide what other stuff we have to cover by looking at the state standards]. For me, it was with the freshmen...and the properties of atom. So I was like, I haven’t gone over the structure yet...it was a really quick thing. I just asked them what the structure of the atom was and they already knew, they had memorized it...they spit it back to me, I wrote on the board, I’m like “What are the protons?” “Well, it’s a positively charged thing,” so, perfect, you know. It’s how we did that for one class period. And then I was like, “Alright, we’re good to go.”...If they take Chemistry we could get into more depth. (Emma, 2a:146)

84[When deciding how to teach] I’ve kind of just been following the general outline of the learning cycle where we do the activities and you can talk about it and then you do a reading...and then I think this year I want to do a lot more concept mapping with my students. So have them do a concept map first, kind of get where their current understanding is on the ideas, then do activities that would help further their understanding and then maybe re-address the concept map, then do discussion. But a lot of it really comes from following the learning cycle, having that really general lab discussion. “Here’s what it meant,” kind of a thing and then do the readings over it. (Emma, 2a:118)

85There is a particular teacher in the Special Ed Department that I have had run-ins with. I don’t know how to say this without really sounding awful. She doesn’t think that I was making the modifications that I should have been, but I didn’t have her kids’ IEPs, so I was doing what I thought worked with them, and none of her kids were failing, so I didn’t think I was doing anything wrong, but it wasn’t good enough, and she was just kind of constantly picking on me. And so I started talking with some of the other special ed teachers, just to kind of see where this was coming from, and stuff like that. A lot of them did say that they thought she was picking on me as well, but she was saying she was going directly to the principal, and saying that I wasn’t making modifications at all and that I was way above freshman level, that I was teaching to seniors, that I was not teaching appropriately to freshman. And I, obviously, vehemently disagreed with that, and that’s where I think this is coming from. [To handle the situation] I kind of stopped talking to that particular teacher and started working more with the Special Ed person that I’m supposed to work with. So for some reason, I don’t know how it really happened, it kind of seemed like miscommunication in the Special Ed Department. I was supposed to work with a lady named [X], and she’s only here part time, so she’s only here in the mornings. We kind of had an off schedule, so that’s when this other lady, [Y], stepped in...I didn’t realize that wasn’t even the person I was supposed to work with. So for some reason, I don’t know how it really happened, it kind of got better. I feel like I know what I’m doing, and I haven’t heard anything negative from the Special Ed Department since that time. (Emma, 3:20)

86[My principal] pulled out an assignment [at my end-of-the-year evaluation]. She had a file that I didn’t know she had for me... And she had the first version of [the assignment], and not the modified version that I gave to the Special Ed people. It went through five revisions before I actually gave it out to the kids, and she had the very first one, so it was like my
language. It was my understanding. It had all of the big words in there and it was full paragraphs. It wasn’t the bullet points or anything like that, and so she pulled that out and she was using that as an example. I tried to mention that that wasn’t the final version, that . . . I don’t just give these notes, and then that’s it. I tried to tell her before we even get those notes, we played the game where we were . . . part of the nitrogen cycle. And then we through the nitrogen cycle, and then we diagrammed them, and then we did some small group discussion, and then we analyzed our diagram, and then we went into the notes. I felt like it wasn’t very well-received because she kept saying other things, like other standards as well, and said, “Well, I think you just need to consult the book and see the language that they’re using in the book,” and that kind of stuff. So then I did. I went to the book and I went through the book, and I said, “So I went to the book, and I wrote down all of the chapter titles, the section headers, and what the sections included, and then I went back and highlighted what I covered, and then I don’t even cover like half of what that book covers just because they cover organic chemistry.” I mean who would do organic chemistry with freshmen? That doesn’t make any sense . . . I went back in to her to try to kind of, like, to let her know that I was taking her critiques and trying to work with it . . . and said that I went through the book, and that I looked at what I was teaching and how I was teaching it and what the book teaches, and I felt like it aligned pretty good. And she said, “Well, I think you should just take a closer look at the book.” So from that point, I don’t know what that really means. So I don’t know if that means just being a more traditional teacher, have more tests, so I really don’t know what I’m going to do next year. . . . I always thought that my biggest issue was classroom management, and when we had this meeting, she made it sound like the biggest issue was not teaching appropriately, or teaching appropriate expectations, or whatever. (Emma, 3:76)

87She helps me with grades, grading decisions, or rubrics, or you know, stuff like that. I feel like we go back and forth a lot. If I’m not sure about something, I’ll bring it over to her and say, “Hey, what do you think about this assignment?” And she does the same to me. Or if I’m writing an email to a parent that needs to be rephrased, I’ll bring that over there, and she does the same. So I think it does go back and forth a lot. (Emma, 3:278)

88I ask [my] mentor/friend . . . I always go over to her when I have questions. So when [my end-of-the-year evaluation happened], I was talking to her about it, and she thought that I shouldn’t lower my expectations, but that maybe I should do it more traditionally if that is what will appease them. But I shouldn’t lower my expectations, so I feel supported from other teachers. (Emma, 3:250)

89I do a good job at planning, and coming up with good lessons that have big ideas that are connected, and then coming up with labs first that gives everybody that thing to tie into and then the discussion part of it. (Emma, 3:225)

90I am going to have a very clear list of expectations that are not just like respect yourself or respect me, because I feel like that is too vague. So I’m going to have very clear like, we’re going to clean up the room before we leave. We are going to be in our seats when the bell rings and if you’re not, you’re going to be counted tardy. So clear expectations with clear consequences . . . which means this summer, I am going to spend a lot of time just thinking about what are my biggest pet peeves from this year and how can I address them. So I hated that kids were milling around when the bell rang, and they were coming in like 30 seconds late and stuff like that. So you’re going to be in your seats when the bell rings. If you’re not in your seat when the bell rings, you will be counted tardy. That’s my example for that. (Emma, 3:233)
Because the kids that I worked with, it was rote memorization to pass the test. And as long as they did that, they were fine. And they had no understanding of the content at all... Not everybody’s a good teacher. There are bad teachers out there. And they stay because of seniority. At least, that’s how I understand it... he was only there because he has been there for a long time. And that’s unfortunate. . . . [His classroom management strategy was to] yell at the kinds until they stop, or start crying. That was always fun. (Emma, 1:159)

It took me awhile, and you will probably find this throughout your questions to be a resounding theme, but I definitely did not jump on board right away. For lack of a better term I didn’t buy in right away. (Hannah, 1:19)

In the beginning I was turned off to it because I thought, “Ugh, [my cooperating teacher is] just like all the rest of them in the program. He’s totally into this, a little bit unrealistic, and okay, I will just deal with it.” (Hannah, 1:245)

I know that personally I had to allow [the members of my cohort] to care about me. That’s true with [the TEP faculty]. That’s true as you guys, as the PhD students with us, true with my cooperating teacher—if I didn’t allow people to care about me, which I didn’t for a really long time, I wasn’t getting anything out of it. But as soon as that clicked and I started to allow that in the spring, things just sort of shifted and I just really understood a lot more about everything that was going on. (Hannah, 1:152)

Our cohort is what I would say is very good at discussion with each other. In talking with my classmates, because we communicated a lot, I realized that I was behind. I couldn’t keep up with their conversations. I didn’t know where they were coming from, and I knew that I was missing something. So a lot of it had to do with the conversations my classmates were having in class, and even times we would meet outside of class. I could listen, and I could learn by listening, but I wasn’t able to give into the conversation that much. That was a pretty big thing. The other couple of things was—there was one point at the fall semester [one of the TEP faculty] called me into his office. We just chatted and he just said, “I noticed that some of your body language in class, and some of the comments, I appreciate them and I can tell you have a lot of passion and a lot of feeling behind what you are saying in class. I’m just wondering how you are doing.” It just struck me that he’s not coming down on me for things that I say, he’s just more interested in what I have to say and why am I saying it. I had never been asked a question like that before. So just the fact that he took the time to ask me to come in, and it wasn’t a scary thing. I was like, okay, there’s something more here. But even that didn’t just hit (Hannah, 1:53).

I was always really uncomfortable when [my cooperating teacher] was asking his questions about certain things. When [my group] prepared for our lesson plan in the fall I struggled with my group, just to mesh with them. That was a difficult situation for me to work on that lesson plan together, and when [my cooperating teacher] would ask questions about it or try to help out I just didn’t want to disappoint him, so therefore I held back and didn’t want to talk about it. Moving on through and into the spring . . . we clicked really well, eventually. We actually had conversations kind of like this where he was like, “What changed?” He even told me, “I was dreading having to do this.” Not because he didn’t want to help, but because he wasn’t sure how he could. It was more, “I can tell she is turned off. I can tell she has walls up. I don’t know how to fix that or have her bring those down so we can move forward with this.” So we did have conversations about, “When did you decide that this was going to be different?
What happened?” And we talked about how I needed to let people care for me. So all throughout the spring, gosh, I don’t even know where to start with that. We just started to click really well. Something that I very much value about my time at [my student teaching school] is it wasn’t just about the instruction and the classroom and the content. We talked so much about just things that were going on [at the TEP] and how to relate that all back. It was so beneficial just to have somebody straight out of the program, and somebody who has kept in contact with the program to be my cooperating teacher. I’m so lucky to have that because bringing those two together, in a way, saved what I needed to get done here. We were able to have serious conversations about that. We were able to have funny conversations. We clicked well on matters about school and matters that had nothing to do with school when we talked about things. It was a really good relationship between us. (Hanna, 1:253)

97 Having more understanding of how people learn, and then the teacher behaviors—those two pieces were the most profound for me. They reflected on most of what I learned, things that I had never thought of before and didn’t realize what an impact they could have on your teaching. (Hannah, 1:1465)

98 Lesson planning concerns me the most. . . . We talked about this in student teaching so much, but I have all these pieces. I understand how to ask questions. I understand that you need to do concrete to abstract. I understand all these little pieces that we have learned about, but I struggle to pull it all together and I struggle how to pick out big ideas. (Hannah, 1:482)

99 In comments that [other teachers] say to me, “Well you’ve done it pretty different than the person before you did.” Or, “You mean you didn’t cover that tiny little detail?” I would say, “No,” and in my head, I don’t share why, but I know why I didn’t. [Other teachers] saying certain things to me is a trigger of really having inside to decide, okay don’t take that personally in negative terms. . . . But for me that’s affirmation toward [I] might be doing something different, which perhaps is more of how I learned how to teach. (Hannah, 2a:130)

100 How do I say this? . . . I go to him when I have issues with particular students, things that are more administrative. He’s very good at that stuff. He sees the whole building as a whole and he also sees . . . like he knows the troublesome students because of the time he’s had to spend in the office, so he knows that type of situation, which has been really nice. Like it’s just little stuff . . . like attendance issues . . . I don’t talk him really about how to teach something. I don’t talk to him about how we should go about this, or classroom management or that type of stuff. [When we co-teach] I allow him to do things, like, it’s not allowing him, like I have control over him, but I have him help out with things like putting [students] in groups because he knows the students well enough and he knows how to separate out rowdy [students]. But in terms of how to teach and what to teach and that kind of stuff he has just kind of said “That’s your thing,” which part maybe isn’t the best in a co-teaching relationship and we both are the first to admit that. (Hannah, 2b:191)

101 Being in a really big school and not knowing anybody, and then realizing that the people that know you best and that you know best are your students, rather than your colleagues. That was something . . . I didn’t realize was hard for me until probably about third term… I think I didn’t realize without extra effort, how lonely of a job it can be, even though you’re with people all the time. It’s a very solitary thing . . . I think the sense of having a community, whatever that looks like, I lacked a lot. (Hannah, 2a:332)
Planning for the next year all the time this year, it never held me back in my teaching, but it forced me to really rely upon what I knew already and the foundation that I got from doing the MAT program and doing my student teaching and the cohort colleagues that I had…. I had to rely upon people that knew me already and knew how to teach and share these same ideas with me. I would say that eventually, when . . . I know that I’m going to be there for a while, I’ll be able to start incorporating new ideas with the staff around me rather than going back to what I knew before. (Hannah, 2a:359)

I just find comfort talking to [Andrea] and she helps me just kind of like diffuse situations and tell me everything’s going to be okay—and same for her, too. So we bonded a lot over a lot of things. Chris I talk to a lot because him and I share content area. So him and I would kind of share activities, talk through things, “How did that work for you? Why’d you choose to do that? When did you put that in your sequence?” (Hannah, 2a:540)

I talk to [my cooperating teacher] a lot simply because I grew so much during student teaching and I trust him, and he knows me from the beginning until now. I know he’ll pretty much tell me what I need to hear. Either that’s a good thing or a bad thing. And he understands a lot of the content stuff that I’m trying to do because I brought a lot of it with me and tried it in a different class here. (Hannah, 2a:573)

A strength I have would definitely be, I would say, is questioning, but I don’t say that in that I’m great at it. I think that I see the value in good questioning and I’m very aware of when I’m on the spiral of very simple questions or yes or no questions. So I think the awareness of it is something that I have a strength in. Perhaps the weakness of it would be how get out of that spiral or how to come up with something that doesn’t seem out of the blue, but mixes right in with what you’re trying to talk about that is a deeper question. (Hannah, 2a:19)

My assessments are different from those that I see my peers give, but there are some of us, especially in the department, that are trying different things with that. So, I’ll talk to [my students] about two things: About why are the assessments in the way that they are in terms of writing out your facts more, and then I’ll ask them, “Well, how is this different from other assessments you’ve taken in other science classes, perhaps?” They will tell me differences and then we’ll talk about, how are you able to show the teacher what you know on this type of assessment versus the other type of assessment. And it’s really fun to talk to them about how they feel about the certain types of assessments because they’re so wound up in getting the grade, getting the grade, getting the grade, that it’s interesting to take them back to how are you getting that grade. (Hannah, 2a:67)

[My co-teacher and I] do a lot of just little conversations like we did with questions 1 and 2 during the lesson today where we come around and we listen to them and ask them question, so I’m looking for their understanding, at that point, whether it’s kind of a pre thing, during the lesson, or after the lesson. I’ve also done things where they have to write a summary about whatever it is we were talking about. For example, I did a pressure, volume and temperature [unit] and we were just kind of getting into that, and at the end of about 3 or 4 days I had them write a little summary and then I read that, that night, so then you’re better able to plan for your lessons the next day just to make sure their understanding is where I need it to be. White boarding has a lot to do with that. It’s another formative assessment . . . just conversing with the
students, whether it’s written or verbally helps me immensely in knowing if they understand, or not, or where their understanding is. (Hannah: 2b, 288)

I look for the big ideas. Sometimes I won’t realize the big ideas until I’ve taught it, unfortunately. But that’s just growing pains. I look for ways that are going to be not building blocks, but rather, cyclical to the students. Where they see it again and again but they don’t realize that it’s there until it’s kind of in their face and they get it because they’ve seen it again and again and it makes sense to them. . . . With, in my oceanography/meteorology class, we spend probably five or six weeks in the beginning working through a lot about particles. So we do a probably three or four week density unit and they’re learning how and what is density and we’re doing a lot with spacing of particles. And how can that spacing of particles be altered or not altered? So we talk a ton about how density can change, why it doesn’t change, how does temperature change it? We get into how heat is energy. And those ideas come back again, and again, throughout the rest of the class because we go into pressure after that, which has a lot to do with spacing of particles and how that’s affected by pressure being added or taken away. And then that’ll, after that course that we go into after we apply it into weather and then oceanography. So they have a really, really sound understanding of how particles change their spacing because of different factors that are applied to it, so, therefore, they can better understand and pretty much explain just about any weather phenomena and then as well as the oceans that we get into. . . . One of the standards they had to do was they had to be able to apply atom movement, temperature, pressure, and density. How that helps explain why this phenomena is happening. So I think that’s a really fruitful project because they recognize, hey we know this stuff really, really well and even if I struggle to understand the phenomena, like the little details of it, the really expertise type of information on this phenomena, I can do this and because I can explain the atom movement, temperature, pressure, density I know a lot about this phenomenon. (Hannah, 2a:221)

My administration is phenomenal, absolutely phenomenal. And she, my principal, all the way up to my superintendent, just wants the best for the kids, 100 percent. It is all about the kids, all the time; and I just never really see them doing things we know administrators have to do, because I see them in classrooms all the time. I have conversations about kids—you know that is just incredible. So how that translates to me, the teacher, I want to work hard for that person, because I know how much it matters to them, makes me want to work harder for the same goals that they have for the students that we have [in the TEP]. So that translates right back into the classroom and how much [I] will work outside the classroom. So the administration has been incredibly supportive of effective teaching. (Hannah, 3:139)

[My mentor] was in the middle school position and through all this curriculum shift she [moved] into the high school. She is in the same position as me right now where we are . . . teaching something that we have not taught before and we know we are not teaching [the same subject] next year. So she has been incredibly busy with curriculum stuff too. We talk, but I think she recognized right away, again I do not want to sound conceited, but she recognized right away that I could be self-sufficient and that I was not a first year teacher per se. We have bonded somewhat over the fact we are both struggling over this curriculum, but it has been on a very, “Hey, hi.” basis. I like her, but she is not somebody that I talk about teaching all the time. . . . It has been very hard to keep up though, some of the tasks that we do need to do for mentoring, just this spring because I think it has gotten really busy for both (Hannah, 3:194).
There are a couple of teachers on the team who are so different and so traditional in their teaching, and it is exactly what we [in the TEP] always talk about. . . . This year you have to meet with those people . . . one time a day you listen to what they are talking about and then a lot of it is the negativity about particular kids. It is so hard to not become that negative person, not towards the kids (some of them are) but more towards them. How do you cope with that? How do you? You cannot share ideas, you cannot talk the way it should be a collaborative team time. So you end up having to waste that time. Then what you really want to talk about with colleagues who really want to talk about it with you, [happens] later. So it just takes more time…. [I work with one colleague] which they are bitter about and I guess we are kind of bitter against them, too. That is hard to admit. But they are bitter about it and it has been some really nasty (probably not as bad as I am making this out) but there has been some tears shed between discussion[s]. We have just been talking about, “We are sorry. We did not want to make you look bad. We did not want to do something without you, but we had invited you to collaborate on a project. . . . We wanted you on this. It is going to make it so much better for the kids.” But they are worried about getting through the content; they are worried about, “I have to get to this point by the time the 31st hits.” So those are difficult goals to deal with because they are so much different than [ours]. . . . It all started when we knew we were at a point in planning that collaborative project, that we needed to go talk to the administrator—who was incredibly supportive, loves it, thinks it is amazing, wants more of this, told us we need to go to the school board to present it because she wanted to school board to see that this type of stuff is happening in the school; which was a great opportunity—but we said, “Hey we need to run down and meet with, our principal . . .” So we took our team time to do that, which is what you should use the team time for and then we realized that they were really upset with us, because they thought we were making them look bad by going to the principal and talking through some details of the project that we needed to get ironed out and it wasn’t inclusive of everybody, even though it had been clearly communicated to them . . . “Do you want to work with us?” “No.” “Okay, we are moving on.” It was kind of a lose-lose situation. We tried, and then we met some very big, “No I do not want to do this.” So we moved on, and it has not been the same since. At surface level, we can laugh about stuff, we will talk about stuff, but it is very surface level. [They said to the writing teacher], “We are a team, and you need to start treating this like a team.” . . . It is very much the idea of, we have been doing this forever we know what we are doing. You have not been doing this forever, you do not know what you are doing, and how dare you come in here and try to be brown-nosers and try to make us look bad by doing this project . . . and by the time we got to the end of that project, we were going to [the county] hospital, we had fancy clipboards that had their names it and ribbons on it for all the team people. We had pages on there, here [are] the things we need you helping assessing on their presentations, here are the lunch groups, here is the schedule for the day, color coded stuff, incredibly organized. All in the effort of them looking at this as you do not know what you are doing, you forgot this huge detail or not communicating to them at all, and then them not being in on what was going on, because we did not want them feeling that way anymore. [In the end] they were cordial about it, because we had asked for it and we had said we know that we are asking for a day away from a typical planning. I think that they just knew that, okay we need to be cordial about this; and they did, and they helped, and they were great, and they did what they had to do . . . luckily, I learned the lesson with people who necessarily cannot hurt me, rather than with an administration that could have been way worse. If you push and do something that you know is right, but you push on the
wrong people, it could have been bad. But I think that is why I knew that it was okay to kind of push in ways. I do not know if I like the word push. But we knew we had the support, where we needed the support. We had the support from administration, we had the support from parents, and we had the support from the kids. . . . So we had the support that we needed to get through it, and a couple of people along the way . . . bumps in the road. (Hannah, 3:502)

I did not take into account that these students are all in the same class, they all know each other very well, they have known each other since kindergarten or before, and they are at a younger age where they want to talk to the person next to them regardless of who it is. So I have been trying to think about how I am going to fix this and come in, starting next year, creating that environment where they are not intimidated to talk, they want to share their ideas, because that is good right now, it’s very good . . . but eliminate the very distracting side conversations that happen all the time. . . . I have worked a lot on my questioning this year, and I was not planning on doing that. I know that is important, that is something that was just ingrained in me during student teaching in particular, because that was expected. But this year I had to work so hard at it because of [my] lack of content knowledge. That required me to think through, basically teaching myself the topics, teaching myself the content only a couple of days or so before the kids; and having to think you are okay, having that a-ha moment yourself and how am I going to get them to that a-ha moment through questioning. So it was kind of a good thing in a very tough situation. . . . [I know learning is occurring by] listening to students. That is one of the reasons why I struggle so much with having to shut down some of that communication, because then I do not know. In particular the position that I am in and will be in . . . next year I will not have taught that content that I have taught that age group of kids. . . . So I have to allow them to communicate in class, and I tell them that all the time. Every once in a while, we will have little pedagogy conversations in class. . . . That is something that I learned how to do in student teaching, and learned when it is effective and when it is not. But, just asking them, why do you think we are doing something this way, why do you think we talk about it this, or why do you think I give you time to think and then you talk to your neighbor and then you talk about it in a group, and then we talk about it as a class? How do you think we make lists this way, using your ideas? . . . I do not know how you teach without talking to your students. How do you do that? (Hannah, 3:55)

I get stuck on, you know it has to be this perfect little learning cycle within every one day. When really it is okay that it makes in a day or two, it makes in a week or two, it makes in weeks. That is an okay thing. And sometimes, like you said, there [are] big ones but then there [are] smaller ones, (Hannah, 3:306)

Overall, I found that the experience was pretty much ideal. . . . I really got to know how stuff worked in that classroom. I got to know a set of kids for a whole year. . . . So, on the one hand, I had a lot of opportunities to work with these kids. I had a lot of freedom as to what I was going to be doing with them. I was following the curriculum that he used, but basically I could do whatever I wanted with these kids and just sort of work with it that way . . . I had a lot of opportunity to just play around with stuff, see what works, and see what didn’t. . . . So, it wasn’t just, “Go to a student teaching practice and get some tools.” We also had a lot of discussions about the theory of teaching, and philosophy of teaching, and getting into all these other things. And all that was really reinforcing a sort of approach that was being used [at the TEP] when I was taking classes. (Jack, 1:111)
I was doing student teaching, I drove . . . with these two guys for two hours . . . and I was in the same school as these guys. We had this serious bonding going on there. . . . It was a positive experience . . . because I have a group of people going into teaching that I can just talk to about my experiences and get their insight. (Jack, 1:62)

I guess the biggest concern for me is, am I going to be able to follow what I’m “supposed to be doing” in a convincing manner? . . . How I’m going to follow the curriculum, but then also not follow the curriculum in a subtle way, covert way. (Jack, 1:852)

[With my administration, we] worked out plans that also incorporated . . . getting their parents involved on that front. . . . It was almost akin to striking deals with these kids in terms of all right, this is what you need to do in terms of behavior and if you do this then this will happen; and they basically kind of make it sort of “if, then” scenarios with these kids as best we could. (Jack, 2:109)

I had support from colleagues for all sorts of things that were useful: they helped me find equipment; they helped me, “Here are things you can do with kids,” . . . but my colleagues are not necessarily in tune to the sorts of instruction that I am . . . so I couldn’t get much support from them on that front. However . . . they certainly are supportive with what I am trying to do in the classroom. So I mean, when I tell them this is what I’m trying to do and for these reasons they usually say, “Okay, that seems good; you should do that.” So they may not be doing what I’m doing but they’re not feeling like that’s a problem. (Jack, 2:233)

The way it kind of works is . . . you have to use the same assessments; that is not necessarily checked very often, but it is a stated policy. . . . We have to use similar materials; we have to cover the same stuff, and the same timeframe. Now, I’m part of the decision making process there, so it’s not simply that somebody dictates to me this is what you have to do at this time. . . . For example, in physics we had to cover a lot of content, a ton of content in fact, which really was a non-negotiable element there. What that means is that although the way I instructed that content could be however I wanted. . . . I was fairly limited in that there are only so many things you can do if you want to just get that quantity of content out on the table. . . . I think I’ve navigated it fairly successfully so far. There have been times when I’ve said this doesn’t quite make sense here. . . . Most of the time it’s just, “All right, I’ll go along with this, I’ll do this, I’ll try this.” . . . I didn’t try to raise hell or anything the first year. (Jack, 2:258)

[To maximize student learning I have students work in small groups] so that I can come around and give specific guidance where it is needed. In both of my classes [there is] a tremendous range of ability with a lot of these concepts—some kids get these things immediately and don’t need any extra help from me, and there are kids who need a great deal of guidance with most everything. It’s a matter of getting us into a situation where, first of all, they’re in groups so they can get support from their peers, but also they can get support from me as much as humanly possible. (Jack, 2:725)

We don’t really know [who is making the decisions about who is getting cut, or how they are making them]. It comes down to [the] building principal and assistant principal and . . . a list of criteria that was drawn up by staff and administration. But I don’t think anybody has a ton of confidence in what actually goes into making these decisions. (Jack, 3:450)
[There was] total uncertainty and madness associated with cutting staff and not knowing who’s going to be cut in staff. And none of the teachers, myself included, really wanted to go out on a limb and try to do anything crazy and different in a year where literally anybody could lose their job. And we knew that that was going to happen pretty much day one. We knew that we were going to lose staff, and so that has . . . I mean, that’s shaped my decision[s]. It’s shaped other people’s decisions in what we’re doing, trying to keep our heads low. (Jack, 3: 433)

Basically I was asked the question [by my assistant principal], “Am I following the curriculum map for our unit?” I had rearranged some things and I don’t know how this got brought our administrator’s attention . . . [but] it became apparent to somebody that I wasn’t doing the exact same thing in the exact same way. Then I was told, “You need to follow the curriculum map.” Clearly, we get told pretty much from the higher ups they expect us to be in the same place at the same time throughout the year. I haven’t tried to rock the boat on that. . . . I will follow this map and I will do everything that we need to do, and all this. Honestly, I have taken things out of various places, various units. I have done things differently than other teachers. Usually, it’s not something that anybody would notice, but I get the very strong sense that if I decided not to do a unit that another teacher did, that would be a serious problem. It hasn’t been really communicated specifically like, “You will get fired if you do that,” but the expectation is pretty clear. . . . I didn’t really discuss it with my colleagues. . . . It’s not that I don’t trust my colleagues, but at the same time, I don’t feel like I want to. . . . I haven’t changed things very often, but I’m not trying to rock the boat too much. I make small changes where I can and just go from there. I modified labs, I have modified the way certain things are done. I’ve worked with people to remove certain things from the curriculum or change things around, but, you know, I don’t want to be a rogue teacher here. That is not a good place to be in a lot of different levels. (Jack, 3:184)

I am usually going to ask one of the better teachers here, someone who has been here a long time. They usually have pretty good insight for things I need help with, which are usually more about behavioral concerns like, “My kid is doing this, what in God’s name do I do about it?” They have usually been through it before so they usually have some guidance to provide. (Jack, 3:110)

My greatest influence [on my decision-making is what] I have built up from the work I did in the MAT program. From the work I did student teaching I have an idealized picture of “This is what should be going on in a physics classroom. This is what a physics lab should look like. This is what students should be doing.” And I try to basically do that as much as I possibly can, within the constraint that I have to cover a lot more content than is possible, [and not] doing everything the way I want to. So, I work that in when possible, but a lot of times there’s just going to be a lot of giving of information to students, because we just got to get through it. (Jack, 3:298)

I think more than anything else, [my cohort] gives me [a] sense that other people are out there trying to do what I’m trying to do. People are having oftentimes the same problems that I’m having, or different problems that I’m very thankful that I don’t have. . . . It just sort of kind of grounds me in that this is what we’re all trying to do; it’s worth doing. It keeps me away from just trying to take the easy road out. (Jack, 2:659)
But the nature of science class, that experience was good. It is when I noticed what
good teaching looks like, and how very different it was from anything I had ever had in my life. (Liam, 1:537)

My internship and my student teaching was with the same teacher. . . . It was beneficial
with the exception of some things that she did that didn’t mesh well with what we were learning
in class. . . . But aside from that she was wonderful to work with and I enjoyed it. The kids were
great. I learned a lot. . . . I think if you accused her of doing activity-mania she would be guilty,
and that’s the main thing. I learned a lot of great activities from her that I think could be really
effective, but the way that she taught them was always, “here’s the activity, we’ll move on to
another activity,” and there wasn’t really any discussion about the activity or building, at least in
my opinion, a deep conceptual understanding of what they were doing. . . . I feel like the
majority of what I’ve learned about effective science teaching came from the program, not from
my cooperating teacher. But like I said, I did get a lot of activities. I mean, her questionning
wasn’t the type of questioning that we push for in this program. It was dichotomous a lot of the
time. There were a lot of elements of traditional teaching. (Liam, 1:67)

The cohort model is probably the most effective learning experience that I have been
in, it’s very effective to keep that sense of collegiality and build that right away. We did have a
lot of leaning on each other, and that was fantastic. [Having a cohort] benefited learning in really
noticeable ways, at least in my opinion. I felt like I was accepted in the cohort. . . . There’s a lot
of collaboration. . . . Chris, he’s also an earth science guy, and even now we’re collaborating a
lot. We became good friends, but we didn’t really talk to each other much until we worked
together on the ten day lesson plan, and after that we started working together on a lot of things.
We read each other’s RBF’s and stuff like that. (Liam, 1:33)

There are people who think about differentiation in ways that actually go against what
we’ve learned and the research. There are people who think differentiation requires testing
multiple intelligences and all this kind of stuff, and that’s already happening. I know it’s
happening at the school I’m going to work, and there’s probably going to be a push for me to do
that kind of stuff too. So institutional constraints, and also being politically savvy about
differentiation, which is a big issue in today’s schools. A big concern . . . [is] classroom
management, am I going to be respected? But I think with my experience as student teaching
stuff I should gain students’ respect. I’ll probably be a little stricter than I was in student
teaching, and should have a well-run classroom that’s effective. So my concerns aren’t that great.
I’m actually really excited. (Liam, 1:141)

I’m actually kind of even offended by some of the suggestions I’ve heard because I
feel it’s very much devaluing what I’m trying to do and it may be that they don’t recognize the
value of what I’m trying to do. (Liam, 2a:325)

[My mentor and I are very different in] how we would define learning. I’m very much
against memorization of disconnected facts. There’s a quote I have my students reflect on the
first day of class, Henri Poincare, “Science is facts. Just as a house is built of stones, science is
built on facts. But, a collection of stones is no more a house than a collection of facts is
necessarily science.” So it’s the organizational scheme that I try to give students, a deep
understanding of fundamental ideas which, I think is almost the opposite of her stance. . . . I
think our passions lie in very different areas. Mine is teaching and I don’t believe that’s hers. For
example, one of the tasks is to memorize 40 of the most common elements on the periodic table, how to spell their names, what their symbols are. (Liam, 2b:269)

When it came to my teaching, we had very different approaches to it. I don’t think [my mentor] was very supportive of my teaching, because I think she was, you know, I don’t have direct evidence that confirms it, it’s just a lot of coincidences, but I think she was complaining about what I was doing to my first year principal, because I would hear some of the comments she would give me, would be echoed by my principal. (Liam, 2:803)

I actually heard some complaints about what I’m doing. There are some things that I can improve on. I know there’s some people who are upset with my lack of mathematics in some of my classes, at the beginning I thought this was that I need to teach, or have students plug and chug equations. I thought that’s what they’re pushing for, which maybe a certain part of it is, but apparently one of the complaints was I can teach, proportionality and density or something like that. That’s definitely something I can do more of, with more graphical representations of data and that kind of stuff. But they never came to my face I had to kind of hear through the third-party. And I had some colleagues comment on my, I guess, what I tolerate behavior-wise. Some people see that as inappropriate but I actually see some people’s strictness as inappropriate. (Liam, 2a:51)

Students do recognize [the value in what I’m trying to do]. Parents do recognize that and some administrators have recognize[d] that. (Liam 2b:327)

I’ve heard from several colleagues at the seventh grade level, and the advanced teacher who works with the advanced kids, that my inquiry environment would benefit a lot of kids that wouldn’t do well in a different environment, so I don’t feel as much pressure now. (Liam, 2a:199)

This week I’m cramming what should be a two-week unit into two days, because I know I have to cover this, because I’ve been told I need to cover this if I want to keep my job. People, strangely enough, are okay with me covering something even if students don’t understand it. (Liam, 2a:179)

I think when lesson planning, how people learn [dominates my decision-making], my knowledge of the learning cycle, it’s pretty consistent. In the act of teaching, I think some of this is self-imposed, but I feel uncomfortable, sometimes, not being in control of my classroom, but it’s something that I try to fight. For example I still, in the back of my mind somewhere, I have this view of the teacher as someone who dominates the environment, and teaches everything really quiet, and that’s pushed by a lot of teachers and it’s hard for me to overcome that I think because I am a product of a traditional education as well, so I’m still fighting my original understanding of what learning and teaching is. That was totally up-ended in the MAT program. . . . My knowledge of educational research is what I try to use [when determining how to teach]. [I] base those decisions off of, so how I interact with people depends on what I’m trying to do, so for example, I’ve made significant efforts in trying to have better nonverbal behaviors, something that conveys interest in student’s ideas, acknowledging their ideas without confirming or rejecting them, that kind of stuff—putting my fingers out, raising my eyebrows, being more active . . . because I know students need to feel engaged. . . . So how to teach is influenced in a great way by what I know students need to do in order to learn. So the level of engagement, and tying things back to their prior knowledge. I survey, and actually I use those
[misconception] probes extensively to get prior knowledge. I can find misconceptions, and I keep finding new ones I didn’t suspect, and I try to allow for flexibility, too, because I know learning is a lengthy process. (Liam, 2a:127)

139 How do I know if students have learned? This is really tough because, as you know, misconceptions are persistent. What I’ve found is I can assess students once, and they do very well. Assess them on a similar application of the same concept another time, and they can do poorly. . . . The types of assessments I use are always open ended questions. I haven’t done anything besides that really. . . . Applications of concepts to new situations that we haven’t covered in class but, very similar. . . . We did thermal expansion of matter. I asked them why bridge would have these expansion joints in the middle of the bridge. That not only assesses my goals, too, because that would be applying what they’ve learned to everyday life and also requires a deep understanding of the content. What I would expect them to be able to come away with is a particle nature of matter, at least in that case. They have to explain what’s happening at a molecular scale to expand the bridge. If they can do that, if they can apply their understanding to a novel situation and clearly communicate, explain why something acts the way it does, I see that as their having learned. . . . Another thing too . . . [is] not confirming or rejecting students’ responses. So if they are just voicing an idea, you don’t . . . confirm it. . . . I never let my students’ thinking end when they have the right answer. I pretty much try not to. [But] I think a lot of the things I do actually result in that, such as accepting the student’s responses, moving on with the lesson. Might as well just say, “Yep. He’s right. Let’s move on.” (Liam, 2b:338)

140 [The kind of support I have received for effective teaching has] varied over the last two years. I definitely feel much more supported this year than last. And that’s especially true when it comes to my administration . . . this year we have a new principal . . . and she made clear in her first observation that she was very supportive of my teaching and wanted people to do more of the things that I was doing. (Liam, 3:191)

141 I don’t have, someone telling me this is where I need to be, [and] this is what you need to be teaching. We do have our [Grade Level Expectations] that we’ve all kind of agreed on, and these are the concepts that eighth grade science should be learning, but they’re broad statements. There’s nothing about how to [teach]. . . . So I feel pretty free. (Liam, 3:278)

142 I’ve had private interactions with my principal. In fact, I even had emails exchanged where I had expressed some concern with the way that my mentor teacher has become, in teaching. And I’ve gotten replies that she was, in my corner, that she was a supportive principal. So I don’t think that, I’ve ever been criticized for my approach to teaching by my current principal. In fact, I’ve been praised for it. She seems to be on board with research-based education. So I haven’t gotten the same impression that there’s a lot of talk behind my back. . . . I think she was complaining about what I was doing to my first year principal, because I would hear some of the comments she would give me, would be echoed by my principal. (Liam, 3:875)

143 Kind of, we’ve established [my mentor] does things quite differently; we’ve established that I don’t go to her for help when it comes to how I should go about instruction. If it’s something like materials, or needing ideas for when I have to start, I will do that, but she has never once, I don’t think, come to me for help on instruction. So I think she viewed me initially as someone who didn’t have much to offer. (Liam, 3:898)
We’re not really colleagues. I mean, we don’t really work together. It’s really hard, considering we’re teaching the same subject and we’re right next door to each other, and have the same planning period. But I think the philosophical views are so different that we’ve just diverged and keep away now. . . Once in a while there’s some tension, but we’re cordial with each other. (Liam, 3:853)

I’ve definitely socialized more with [other teachers] trying to identify teachers who have similar approaches. Even if it’s not the same content, there are similar approaches to how to work with kids. There are two camps that I’ve identified: the control camp, and the working with kids camp. I like the working with the kids camp, and I’ve identified a handful of teachers in that [camp]. They always have good ideas to share and good stories to share. It’s always much more positive, too, that environment. So I like that. So instead of eating alone I eat with colleagues, so I actually have lunch with people, so I’m not as lonely as I used to be, which is just really good. One guy that came in, he’s a special [education] teacher and works with me. We have a lot of good things to say about each other, and our work, and it’s always positive, which I really like. (Liam, 3:215)

I do go back to the MAT classes. I love going back there and talking with other cohorts and also seeing [the TEP science education faculty and] yourself. . . . I might not take the time to compose a message [in response to a Google Group e-mail], but I’ll read everything that’s written. It’s great hearing from people. . . . And from that usually there’s a lot of reflection on my part. . . . They’re really good reminders of what I want to be doing and what I don’t want to be doing. So there’s a lot of reflection, and then from those reflections it translates into doing things differently in the classroom. (Liam, 3:369)

I need to have student engagement in order to even assess [when learning is taking place], so that’s a really tricky thing. You never want to assume that learning has happened, even if it seems like it has. All my assessments are formative in nature, and even my summative assessments. If I need to I will go back and present additional experiences that I think the students might need to learn some concept that they didn’t learn before. For example, a lot of my assessments are always applications to a novel situation, so here’s something you’ve never seen in class before; can you apply your understanding to this different situation? . . . I do quizzes, tests, extended-responses always. Even my multiple choice ones always have the extended response to why did you choose that. But like today, I didn’t collect anything, but I walked around and read students’ notes, what they were writing in their notebooks. I ask questions, I get people to share from around the room, sometimes not as much as I’d like. . . . [Then I say,] “Okay, discuss it at your tables, and then pick someone from the table.” Then I went back and got four or five different people at different tables to talk, so that gives me a general sense of how well we’re progressing. I didn’t ask 25 students, but I get a sampling. . . . Whiteboards are good because I can see what they’re thinking, even the people who don’t talk, which is also why I go around and look at notebooks. I try not to directly challenge, I mean, evaluate the student responses when they provide them, but I’ll make mental notes of, okay, so that’s a key idea. I’ve got to go back and look at it, and I’ll try to adjust it maybe five minutes down the road, so it’s not like, “What you’re saying, John, is wrong.” (Liam, 3:452)

I’m really passionate about [students] learning this material at a very deep level, so I think I’m still pretty good at identifying what are the really big ideas students need to understand in order to make the most out of this content. So I limit my curriculum to fundamental ideas; for
example, running things this whole year has been particle theory, and I think my students at an eighth grade level can now use and actually understand saying something like I’m using particle theory to explain something along that nature. Which in itself communicates an understanding of what a theory is in science, and not only that, but really a fundamental idea that a scientist would identify as one of the most important in all science. There are still things I can tweak. What I’m doing next year is I want to have particle theory be even more so the theme of the class, so what other concepts I can tie into this over-arching theory. For example, I haven’t done much with pressure in years past, but I think that’s absolutely crucial in understanding the behavior of particles and how we develop this model of nature. So I’m going to do a lot more with pressure next year, and I’m going to figure it out over the summer—what kind of activities I can do so students learn about pressure. But at the same time it’s another piece for particle theory. And there are other things tied into a curriculum on forces and so forth. (Liam, 3:38)

149 Having joined the NSTA two semesters before I did the program was super good because I hung out with a previous cohort before I joined, so I was already being exposed to a lot of the new ideas before I [began the program]. Whether or not I understood them, I was going to say, “Okay, it’s way different. Nature of Science is way different.” I was prepared for the challenge of my own change ahead of time. I don’t think everyone in our cohort was prepared for that, or even believed it was going to happen. I think exposure to the previous cohort before I joined was valuable in orienting me to accept these changes that are required. (Martin, 1:8)

150 I loved [having a cohort]. . . . If I have an attitude about a course, I’m pretty confident that I’m not going to be alone with that attitude and I can talk to someone else about it. “Hey, you know, I’m uncomfortable about this. How do you feel about it?” Oftentimes, they’ll have very similar idea, and if they’re not, then they’re very comfortable sharing their different perspectives with me. It was absolutely wonderful. I felt like a great part of that cohort. Each of us played different roles in discussions and organizing activities and hanging out together. . . . I specifically tried to work with as many different people as possible. . . . I worked with Jack and Ethan a lot because we commuted to [school] every day together and we had conversation time to develop ideas. Then Andrea, Emma, Noah, Jack, and I had a regular study group. We didn’t meet every week to study, but when there were papers to write, we met, exchanged them with each other. . . It was super fun. I liked it a lot. (Martin, 1:36)

151 [My one cooperating teacher was] very friendly, very supportive, excellent modeling. She was willing to let me make mistakes. She knew which questions to ask to get me to reflect on those mistakes. She taught me the way we want to teach other people. I want to teach my students the way she taught her students. We had discussions and developed ideas, and she changed what she was doing in the classroom based on my input. Of course, everything I was doing in the classroom is a synthesis of what we were learning and what I saw her do—of course she’s influencing me heavily. It was very fantastic to be part of her classroom. We’ve continued to exchange emails over the summer. It was a wonderful, wonderful experience. (Martin, 1:131)

152 [My other cooperating teacher] was more of a traditional practice teacher. Her lectures were on PowerPoint. Students were given out worksheets that they fill out during the PowerPoint as slides pop up. They fill in a word on the worksheet. They just get through it, and then they memorize the worksheet and get all the questions right, and so they do great. She was very permissive in that she let me teach an entirely different way. She did not say, “You’re doing this wrong. You’re asking too many questions. I don’t know what’s going on.” If I wanted to do
white-boards, we’d do white-boards. She did not stand in my way of anything at all, and that was good. But because I was doing it a different way, she didn’t have very much support for me either. If things were getting off track... there was no helping things run smoothly in the other classroom. I definitely had greater classroom management issues in the second classroom than the first classroom. When things started to get out of hand there, she would step in and bring down the authority hammer and brings things back to the “be quiet and listen to the teacher thing.” Engagement was in question, but rowdiness was brought down... There was a time in the second classroom when I was having students have these discussions with each other. I had asked them questions, they were in groups discussing, and the cooperating teacher said, “You’ve got to stop because they have a lot of misconceptions that you need to fix right now.”... She wanted to fix misconceptions, but she didn’t know that letting them discuss these misconceptions and tackle these with each other was something that was actually good for the students. She let me try different methods, but she really was uncomfortable branching out with class discussions and group discussions and things like that. There was some pressure to, “Keep on the path here. Let’s make sure that they’re not doing crazy stuff.” It was a totally different experience, and it was good. (Martin, 1:153)

153 [Preservice teachers’] natural inclination is to go back and propagate that which we liked or we were good at. [Thinking.] “It worked for me. If it doesn’t work for you, there’s some problem with you.” [Our first methods course] was a tough course for a lot of people because [the science education faculty] don’t explicitly say, “You’re wrong,” but the underlying message that all the research that we read in this class, tells us that what we want to do is wrong. This is a reform program, and if you aren’t convinced that there needs to be change, then you will not get [the program] and the program will waste your time. This is an absolute necessary course to orient the students that there will be some major shifts in your thinking by the end of this program and it starts right here. (Martin, 1:686)

154 When [the second methods class started] shifting from how people learn to classroom management, you bring it back to the students as individuals. [Back to the idea] that we are here to help people and... sometimes what they want for themselves is not what is going to help them. In my classroom... [I] had this permissive degree of disengagement in the sense that... three students are carrying the class... They are fine with this. All of the students in the class are fine with how this is going, but is it really helping them? The class is managed. You don’t have rowdy problems, but are you answering the question of why you want to teach that we discussed in [our first methods class]? Is that what you’re doing here? Revisiting the summer questions [thinking about the ideas I developed in our summer class] in the second methods course [in the spring] was valuable. And then, how are you going to implement what you know about how students learn in a way that is productive? (Martin, 1:1026)

155 [The science education faculty are] asking us to do some very difficult things, very demanding things, and that change that is required is not emotionally comfortable. There has to be a purpose for why we have to [teach] the hard way. Why can’t we just do it the easy, systematic way that we want? Why must we challenge ourselves to such a high degree? If [the science education faulty] can’t answer those questions, then the whole program’s a big joke. But they can answer those questions, and they encourage you to challenge them on those questions. Why are we doing it this way? These are the things I thought about [while they were teaching us]. It’s not just big idea stuff, it’s little idea stuff like, “Why are you sitting on the table right
now?” Because one of the teachers got up on the table and sat down. She had an answer for that, “That posture was less threatening, and we were nervous about writing a paper. She wanted to change the dynamic of the classroom so that she appeared less threatening.” It all made sense and it worked, and the environment and the atmosphere changed. It changed to the point where we were comfortable asking the rationale questions. That transparent rationale was super important, and it wasn’t a lesson that was early learned. Some students didn’t latch on to “I can ask them rationale questions.” They just assumed the answer was going to be “Because I said so.” Those students struggled a little more in the fall because they weren’t ready to pursue that open door of rationale questioning. Those that did utilize that, I think they benefited from being able to ask those questions. (Martin, 1:863)

I recognized that [the program] is setting me up to have [that final task] be different. What was good about it is that that paper did have a lot of things that I fundamentally still believe. It’s just that all of the methods were totally wrong. Why that’s important is wrong . . . . I still believe [science education is important] and it’s still a guiding principle for me. All this other gobbledygook that I wrote to support this is just crap, so it was good that I am now more sophisticated regarding my rationale, my priorities. I am consistent within myself, I am consistent with the research base, I am equipped and prepared to actually coherently support those principles that I originally had. Reading then and now just builds confidence in my progress in the program. (Martin, 1:1354)

Though this article simply reminds us of what we already know about some faulty rationales for teaching, well written reminders can’t hurt. (Martin, 5/6/12)

I didn’t walk out of [the interview] feeling great, like I did for our [oral] defenses. The interview consisted of: me, the principle, and the head of the science department. Though nothing was directly said to this effect, I got the sense that they are going with someone else for the position they had advertised, and are trying to justify hiring me for something else. Hannah, your preparatory guidance was great. I did a ton of research, wrote some great questions, and then wrote thank you notes for the two of them afterward. (Martin, 3/26/12)

With [Mason’s] insight [shared in the previous e-mail], I recommend Re-reading the “Generative Learning Model” article assigned to us during our Fall Science methods course. I reached a similar epiphany through this article. I have attached the article for your convenience. As an update: I still don’t have a license, and I have been working construction repairing asphalt. Jackhammers, sledgehammers, asphalt and concrete. My back is killing me. Gotta pay the bills. (Martin, 11/15/11)

The following is an e-mail exchange that occurred via cohort’s Google Group. The exchange was given the subject “A rough first semester” and was initiated by Noah:

I was trying to keep my chin up for next semester. Hannah and [her cooperating teacher] helped me out so much by leaving me a very detailed lesson plan for the second semester. I knew what I was going to be teaching. I knew strongly concrete ways to convey it to students. I kept things together because I knew I could, and was, going to do better next semester. With a decent idea what I was going to teach, I could spend more time providing feedback to each student. And sleeping. I got an email today from my department head. He said that all science teachers would be going lock-step from this point out using his materials and activities. We start chemistry on Tuesday with copying definitions from the book. The first night’s homework is to read the
textbook. Day two is a vocabulary crossword puzzle. Eventually, students are to burn 10cm strips of magnesium and explain on the provided line why this is a chemical change. I could cry. Hell, I think I almost did when I read the email. There went my dream of better 2nd semester. . . . I’ve got three days to figure out how to play the game and no longer be disappointed by not being the teacher I thought I would be by now. (Noah, 1/12/12)

Noah, I empathize with your struggles this first semester. I have been fighting the rigidity of my curriculum for some time now, with very little progress. From the top down, all teachers are basically required to do the exact same thing each day. I think this lock-step approach is a growing trend in US education. I can say that this aspect is enough to make me want to seek employment elsewhere, and I am strongly considering that option at this point. (Jack, 1/12/12)

You guys are scaring me. (Martin, 1/12/12)

161 [My administrators] stay out of my hair. . . . If it’s not a classroom management thing, you’re on your own. . . . That’s a great problem to have, is an administration that makes you handle your classroom and do your own thing. That’s great. There’s never been any degree of judgment. . . . [My principal] relies heavily on department heads. He gives them a lot of authority and he trusts them and he redirects a lot of problems to them. . . . I think he recognizes that teachers are professionals, teachers are responsible for their own development, [and] teachers are the decision makers that change a classroom. . . . I think he does a degree of blocking for us from the district and from the state. I think he sees himself as a linebacker. Like his job isn’t to tell the quarterback what to do it’s just to make sure that they can do whatever it is they’re supposed to do. That’s kind of how I think he sees his job. . . . He doesn’t seem to be too involved [in what I’m doing in my classroom], he’s managing other problems for us. (Martin, 2:257)

162 My department head does not talk to me too much about classroom management, or biology concepts, or how to teach, or what to teach, or the order of content. [She talks to me about how to] interact with the administrators to get a positive result. When I come to her about concerns . . . She gives me the . . . the borders and boundaries between things—between me and the administrators, me and the parents, me and the students, she makes them very clear. That, it is okay this is within your authority . . . [or] you can’t do this, you have to go through these people. And she teaches me more about the political savvy. . . . How do you just get along with the people in the school? . . . So she, she is a model for how to navigate institutional constraints. . . which is a blessing because she herself could be an institutional constraint, she could be a problem for me but she’s the opposite of that. She says, okay how can do we dissolve this problem? How do we remove this obstacle? That is what she does. So she’s fantastic. (Martin, 2:361)

163 That highly critical nature [of the TEP] really gets [graduates] ready to go. But I think it makes it harder for us to build positive relationships with other people that are teaching. Somewhat permanently. Early in the semester, I did not use other people’s things, out of a xenophobia kind of attitude. That was detrimental to things. We take a restructuring course for a reason. [Restructuring] should be a core theme, and not just that you do it. . . . [but also] the value of the work of other teachers . . . you have other colleagues that may not have gone through the same program that you have, but they’ve got experience and they’re doing things that are better than what you would do if you were just thrown in to the lions. . . . [Even if your colleagues are] not good at NOS, even if they’re not good at scaffolding, even if they’re not good
at what you think [are effective] classroom practices, or whatever. Even if they’re bad. Let’s say they’re bad. If they have activities that can be restructured, accepting those [and] restructur- 
ing them, endear you to them, get you on their team, saves you time. . . . I didn’t know that going in. . . . “We know better,” was kind of the attitude that I walked out with. (Martin, 2:1357)

164 There’s the classroom exchange program that I’ve been going to during my supervisory. Instead of wandering the halls or checking the bathrooms, I spend an hour a week, at least an hour a week in another teacher’s classroom and then he reciprocates that during his supervisory in my classroom. And that was really powerful at the beginning of the year because I could see, okay we both have these kinds of classroom management issues, he’s doing these things, I’m doing these things . . . it was really good. And we did a lot of exchange of activities and we have improved each other’s’ activities. . . . he was willing to be influenced, I was willing to be influenced, it was really an exchange. [I became a part of this program because this other Biology I teacher] asked me right after I got accepted if I would like to do this with him. He approached me and I said, “Okay” because I thought that saying okay was a way for me to avoid institutional constraints. . . . They ask you to be on a team, say, “Yes.” Be on the team. (Martin, 2:567)

165 [One of my colleagues was the state teacher of the year, the year before I started and when I would go to her for support] she would just say, “Oh Martin you’re doing fantastic, don’t worry about any of that, you’re doing great. No, it’s going to be so good. Things I hear about you from the students are great, [you] just need to stay in it, stick in there.” So very much “hang in there” kind of support. And she is, I’m going to be honest . . . my graduate student Martin would be highly critical of her science [teaching] approach. However, monk Martin would be super pleased with her investment in the welfare of her students. . . . [She] picks up students from home and brings them to school, and takes them back home and makes sure that they have enough food to eat. (Martin, 2:666)

166 You know, I’m a good listener. I like good advice. I am capable of judging advice. And I have made changes in my classroom when I hear good advice. Sometimes that means recognizing that, “Hey look this teacher is doing this job. You don’t have to write this lesson, you can just alter a few things and it’s going to work out.” The whole restructuring approach is good. . . . Steal from the department—that will save you time, it will endear you to them, will make them feel good for helping you, and you can make any changes that you need to improve the activity. It is such the right thing to do. (Martin, 2:115)

167 [My exchange program teacher] is very empirical. He’s reading the research and trying to see, “Okay, what change can I make for my students that will improve their retention on these tests?” And as such he has his classrooms in lock step with each other. . . . [He thinks] “I can give them all the same experiences and they will all go to the same place.” And I don’t agree. I know that’s not true. I haven’t fought him on it. But that doesn’t mean he isn’t doing good things in his classroom. But [the state teacher of the year is] the exact opposite. She [thinks], if she could provide an individual one on one experience, for each individual student, then that would be the best way. And she gets a lot of criticism for not covering a lot of materials, which is fine. But, there’s a division in the department and people, it’s not a black and white line, but there is his spectrum and her spectrum and I am falling right down in the middle and that has made everyone love me, which is great. So that’s sort of the department in a nutshell. That’s the rainbow of the department . . . [Teachers do not align themselves with either camp] too much. It
doesn’t take long to read the subtext that these two people and these two people aren’t the best of friends, but there has never been a time when I have seen anyone stop anyone else from doing their job. There’s never been a time where I’ve seen, like in a professional development meeting, there’s no loss of stability. . . . In fact, it’s very encouraging to go talk to other people in the department. . . . [When they say,] “That’s a problem that this person would be better suited to help you with.” [That is] their way of saying I don’t care about any of that. Their way of saying I don’t care about your current problems, and to direct you to someone who will care about your current problems. (Martin, 2:697)

168I haven’t really had many conflicts with colleagues. . . . My furniture is awful. The stools fall apart, they squeak, they hurt, students can’t wait to get out from here. . . . That’s a constraint that I have to navigate a classroom with this awful, awful furniture. (Martin, 2:1040)

169[My] use of manipulatives in class is a weakness. Not nearly enough manipulatives and that is just ludicrous considering the abstract nature of the content this third and fourth quarter. We’re talking about molecular motion, we’re talking about molecular structure, all these molecular processes and we used animations and videos, but we didn’t have any three dimensional representations for students to manipulate. . . . That is setting yourself up to be over their developmental capabilities, which of course leads to disengagement . . and that makes sense. Some of them cannot do it . . because they’re not there yet. So that needs to change. . . . What is influencing me in [the order I am teaching concepts]? I guess that’s my understanding of logic flow. That would be the Advanced Pedagogy class right there, going back to my teacher education program. I guess I would say that my well-developed understanding of science concepts influences my teaching practice. (Martin, 2:88)

170What I wrote [when I entered the TEP] . . . was almost perfect. When I read it [at the end of the TEP] I was like, that’s actually good ideas. (Mason, 1:768)

171Early in the program I was more the lone wolf I was still very much in the, “I’m here for myself” [mode] but . . . [people] were reaching out for me to join in and participate. (Mason, 1:89)

172[I started to become a member of the cohort at] the end of November, which was basically right when the first huge draft of the RBF was due. Once that pressure really started to get to me and I was just kind of lost, and I was like, “Well, they’re always working together” so I went to join them. . . . For me it was a, “Oh my goodness” moment, “I need help.” And that really pushed me to extend myself to join the group. (Mason, 1:100)

173[The oral defense was] beyond helpful. Inspirational. . . . I was still in that lone wolf mode a little bit and I was doing the RBF, just because. And without that oral defense I would not be where I am right now. It was the first time that I actually felt the true care from [the science education faculty of the TEP who conducted my oral defense] and that helped me a lot. And it also helped me come over the misconceptions of whatever I wrote then. (Mason, 1:942)

174I think requiring some type of reflective journals, whether it be weekly or bi-weekly, would also have been beneficial to me. I kept my own little journal, but it kind of faded off near the end once I was starting to write my RBF. If I truly had to write a deep reflection, maybe even with like a guided issue, I see the benefit in journaling and I get ticked off at myself for not having my own journal. If you told me to [keep a journal without the accountability of someone
reading it] at the beginning of the program it would not be done, because it’s just recently where I’ve really wanted to keep my own journal. So at least for me I would not have done it. (Mason, 1:1208)

175My principal seems very eager to work with me so I’m actually not worried about administrative constraints. (Mason, 1:359)

176I’m worried that, I’m now so used to having a mentor with me at every step of the way—my cooperating teacher, or coming back here with my cohort. I think it’s going to feel lonely at first, until I actually meet other people in the building. . . . I’m not going to have just anybody to just bounce off ideas because if I just go start shooting off ideas with some person that doesn’t know me at all they might think I’m a little weird. They should appreciate it because I want to better their students but it’d still be that awkward. I developed quite a bond with my cooperating teacher, and then the cohort, that I was just comfortable. And not having that is worry. . . . I’m also teaching at a small school. . . . I’m the only one teaching chemistry, physics, and physical science so I don’t have any other teachers to kind of argue with. (Mason, 1:342)

177The other thing that was hit on in [the spring] methods course was mostly reading, strategies, and assessment. And I just remember my students they were confused, they were kind of confused I kept throwing different reading strategies at them because I want[ed] to see how they worked. One con for that was the students got confused but that’s just going to happen for a student teacher anyways because you want them to experiment and test their own strategies, what works well for them and what doesn’t. (Mason, 1:268)

178Seeing some of those [NOS] activities really helped me because without being able to give some of those concrete experiences (to students), a lot of people could struggle with understanding the nature of science. (Mason, 1:589)

179My picture changed drastically. I loved seeing the change [to] the end product from my original picture. . . . What I wrote at the very beginning is exactly still, like everything is just was almost perfect. When I read it I was like, “[Those are] actually good ideas.” Behind it I think I just learned how to actually accomplish those ideas along the way. And I found that very surprising. Because I felt like I’d changed a lot, but my key ideas of how I wanted to teach were still there, . . . but now I actually have some tools available to accomplish them. So I felt like I grew in skill but my main ideas did not change. (Mason, 1:765)

180I do wish that that [I] would have been given [some of the content we covered in the spring semester] ahead of time; like classroom management. . . . Once I had each step, like classroom management was huge in that methods course—and assessment—I could really tell the changes in my teaching. You know what? That actually might be a pro, because I was actually being able to see what I was doing, what worked and what didn’t and then actually implement the research and was able actually to see the effectiveness of the research. I never actually thought about that. . . . Because I was able to actually witness my own growth, which I needed that morale boost midway through the student teaching because it was so stressful. So that was actually nice. It was frustrating during it though. . . . So, sadly, I think that’s just going to be happening anyway in student teaching. . . . I’m trying to weigh between if I didn’t have my concrete experiences with my own assessments and just have the students read and not have that work very well. If I didn’t have the failure, would I not have even thought, about implementing the research? . . . Because having that concrete experience and then seeing the benefits was
actually so good. . . . But sometimes, for the betterment of students I do think that it would have been better to have some of those reading strategies and assessments in my head prior to [student teaching]. (Mason, 1:236)

Going to the [ISTS] conference was probably the big highlight during my first semester. Being there and seeing all the cohort members again . . . that was big emotional support. . . . Emma and I started talking a lot more. So I had Emma helping me with lesson plans and just helping her a bit, or she helped me a bit, that type of support. Otherwise, you were a big aspect of communicating, sort of teaching me, and reminding me of why I was doing what I was doing. (Mason, 2:50)

I was also a little too lenient classroom management wise. But then, I was getting much better by the end of the year. [To improve, I] was just being aware of what was actually going on from an outside perspective. For me, it seemed OK until I had some observations [from my principal] or I actually started recording myself and saw the students off task and everything. To actually bring in a video recorder helped me a ton. And just also that observations from my principal, actually just brought it to the forefront. My principal and I [talked about classroom management and] . . . I had to take away the bathroom pass because some students were abusing that and roaming the hallways, so there were things like that. (Mason, 2:18)

My associate principal has been fantastic. She has come in three times because it’s required and I’ve asked her to come in [two more times] to just help me, [to] give me more advice on how can I get my students more involved. How do you reach out to the kids that, they will not put forth the effort, if they definitely see no reason to do it? Because grades don’t matter to them. . . . So how do you motivate them? How can you get them comfortable? That is something that . . . I am making progress in that. There are definitely some students’ attitudes [that have] changed even within the last three weeks. . . . The best thing about her feedback is, actually, just how positive she is, because I don’t know if it was just because I was in a low, so I was always constantly pulling out the negatives in my teaching. So then I would just put myself in this giant hole. She would come in and be like, “Oh but you’re doing this, you’re doing this, you’re doing this,” and she would build me back up. . . . Just a morale boost, is sometimes what I need. [She would notice the positives, like] . . . I have the standards posted, I’m walking around the students, I’m taking their ideas into consideration. It’s just the little things that I think by now comes a little naturally to me so I don’t notice them. Or maybe I don’t do it enough so I don’t notice it. (Martin, 3:44)

Compared to last year, the science department has been much more involved. Partly due to data teams, which I’m seeing more positives from that than what I originally thought—I thought it was just going to be another thing we had to do. But the science department, it’s just nice to talk about ideas, and we’re actually forced to talk about, which is actually good. Schedule in that time to have those discussions: How can we improve their graph interpretation? How can we improve their [ability to make logical inferences]? It’s nice to spend time actually talking about those issues . . . to have that [be] the highlight topic for a conversation to stem around. So data teams have been great. Then, the 7th grade science teacher, she has been my motivator. She took me under her wing. I went over there and observed one of her classes. It’s just nice to see how other people teach. She is the one that invited me to her classroom, so she’s very open and she wants me to do well. . . . It just seems like a friendlier staff, I would say, overall. (Mason, 3:87)
[When it comes to my greatest influences on my decision-making] I feel like for middle school that’s when you want to expose them, open their eyes to different [ideas. I covered] bigger issues. So I talked a lot about global warming, I hit on natural disasters with floods, and we did a little bit more engineering. How do you have fun with science? . . . Mostly it’s can you develop [student] interest? That was where I was struggling because right at the beginning of this semester . . . I was told what to teach and it made me miserable. So then once they kind of backed off, I was much more motivated and got to do more fun projects. I still made sure I was covered by the [state standards]. . . to defend myself. It’s mostly do I see an interest developing in my students? [That] was what was the big driving factor. [The factors impacting my instructional practices] were . . . honestly it was, some of it was stress. How stressful am I? I know there were some PowerPoint slides that I made really quick and that was, like I’m stressed. I’m out of time. I’m going to pick the easy route for this one. So stress definitely played a role. Usually it was after that that I would be like, “Okay how can I get them to be the ones thinking again?” So then it was like I was in the loop. It was always going back to what are best practices? So in the end it was the reflection. Was I happy with how I taught? . . . Then the other thing that actually helped me was the data teams because we actually talked about, we all had to teach very similarly for our data teams so we would do group sharing. . . . for the lessons pertaining to the data teams we wanted to all teach very similarly. We were given freedom like if during that week, we felt like it wasn’t working we were able to try different methods and bring those to the data team meeting. And be like, “Well, this is what I did once I realized that it wasn’t working.” Most of the time we didn’t have that issue. I know teacher modeling was almost every time. We would model what we wanted the students to do and then have the students do it. Monkey see, monkey do. There were a lot of times when I would just do that last minute. [First, I would] let the kids try to figure it out and by then [with] most of the students, I was able to question them through it. Then I would squeeze that in at the very end. That would actually help the [lowest performing kids on our assessments. They] were the ones that benefited the most from the monkey see, monkey do. (Mason, 3:128)

[Before NSTA meetings I would be] sitting out on the bench listening to [an TEP science education] class being like, “Oh, listen to them! This sounds great.” (Noah, 1:129)

I ended up doing a lot of collaboration talking with Martin and Jack. . . . we all ended up being in these very specific niches that we all filled within the group. . . you knew exactly what somebody else was going to bring to the table. (Noah, 1:129)

[The science education courses of the TEP] were very beneficial, not just in giving us an idea, but taking your original ideas and making you evaluate the original thoughts. . . . [To recognize that] you had some horrible misconceptions. You had some ideas for teaching that would not help, and would not further the current state of science education. Having four courses of methods . . . they broke down [your ideas about teaching] and built you back up. (Noah, 1:523)

[I knew I was] going to feel like a fool. Maybe it wasn’t on everything. . . . ”Yeah, see! I got them all outside!” Yeah, but you wrote about just wanting your students to understand, quote, “the scientific method.” How does that make you feel? (Noah, 1:1362)

I had three cooperating teachers . . . it was interesting to see three different ways of thinking. . . . three different programs for teacher education, three different schools, three
different classes, three different age ranges. It was interesting to see that dynamic. I got along
with [the cooperating teacher who is a graduate of the TEP] better than the other two. His ideas
and his thought process made more sense to me. . . . At that point I was really reaching for
understanding the rationale behind [their] decisions. Some of the teachers had very clear, “This is
why I’m doing it.” One of them had a very student centered [rationale] for their learning
approach. One of them had a very institutional, anecdotal approach. I found myself gravitating
towards the one that said, “I do this because this helps students learn in these ways with this
research.” Others are, “I do this because the special ed teachers tell me to do it this way because
students hate math.” That didn’t resonate with me. I understand why they had made that
decision, but it didn’t really resonate as being a good reason to make these changes. . . . I wanted
a rationale that was compelling for me to do this. Some people had one. Some people did not.
(Noah, 1:179)

191 “What’s wrong?” “It’s just that my kids aren’t excited.” “Okay, why do you think your
kids aren’t excited?” And you go back to fall, “Well, I’m walking around and I’m excited about
the content, and I’m monotone . . . Shoot!” Then you got kicked back out in the classroom and
recorded yourself to try to do better, and then the next week you came in and went, “But now
I’m walking around and I’m asking better questions, but no one wants to read. Why is that? The
reading is all right. I cut it and I made it better, but there’s just no reason for them to read it.” . . .
Okay, well here’s your before, during and after strategies to give them better frames. Now get
back out there and have them read something. (Noah, 1:1131)

192 I know I can always go to the MAT cohort and send out an email. And a lot of times
it’s kind of nice because I see someone will send out an email. I think [in] one instance Emma
was working on chemistry stuff and she’s like, “I don’t know how to do this and this and this.”
I’m doing that in three weeks, so I’m going to continue to read all the things that were sent out.
So sometimes it was nice because I got all that in advance. I don’t even have to send out an
email! Most of the time I didn’t because somebody else asked those questions. And that was
really nice [support for] highly effective [teaching]. (Noah, 2:135)

193 There are, as all schools, a lot of supportive measures. I’m not always sure how much
of them are towards that highly effective teaching. . . . I would get as much support as I wanted
to from a lot of people to help me improve direct instruction and how to get the best lecture. But
there’s some fundamental differences here that we disagree on. And I do have a lot of support
and collaboration time with my other science instructors within the building, which I really,
really like. But I’m not going to claim that that time is always A) used productively towards any
goal, and B) used towards what I would consider a highly effective education. So yeah, there’s
the support but you see it going different. (Noah, 2:160)

194 Mixed messages, right? . . . We go from saying nobody says anything about what’s
important and we’re all on totally different pages, to someone saying somewhere in the middle,
well, we should teach students about clouds. And then five different people interpret it five
different ways. To okay, well that’s not quite working. So here’s the worksheet you have to give
on Tuesday, and here’s the worksheet you have to give on, Wednesday and here’s what you have
to do on Thursday. We did that through the chemistry unit for a while, about four weeks. That
was no freedom. It wasn’t like here’s how I think you should present this, but . . . I have to make
sure this worksheet gets out. I have to make sure this particular one is in the grade book this
particular way. (Noah, 2:238)
We all agreed to something. We agreed to [the] administration. Everyone said this is what we’re going to do. When it came down to it, five people went back to their classroom to do five different things five separate ways. So I guess there is more freedom in there . . . [but] I do still feel a lot of that pressure. . . . When we say we’re going to do something, I feel that I should. So I still feel like that side of the department, the administration, what we said we were going to set out to do is still a pretty strong influence [on how and what I decide to teach]. But as it goes on, in some way that is kind of comforting, I’m trying to refocus in on the goal page of what do I want students to get out of K-12 education? Because as far as I can see from department-wise, administrationaly, the focus is so narrow on a deep and robust understanding of curricular content that we aren’t even getting a deep and robust understanding of curricular content. We’ve narrowed it down so much that we have totally forgot that there’s kind of other things going on, or we ignore them or something. (Noah, 2:373)

I’ll look at something and go. “What are we talking about here?” . . . So I still am going back to those fundamental ideas from the RBF of how students learn and going what do they have the most prior knowledge in? What was the most concrete? Which is why waves got cut out entirely, because I’m like I can’t teach something that abstract in two days and make it anything worthwhile. I’m sorry, it’s gone. It’s not worth their time. But yeah, it’s really kind of coming back to those fundamental learning theories and everything that is based from there is where my decisions are coming from. . . .[When determining how to teach] there was a lot of pressure department-wise to do more straight bookwork, book reading, under the guise of saying that we need to prepare students to go to the next building . . . everything we’ve been doing is way too abstract and nuclear stuff. I need something more concrete. I’m like do we have atom models here? No, we don’t have atom models here. Shoot, what else have we got? So again I’m going back to the RBF. . . . is where I’m sitting the most right now, of trying to find something either based on I guess strong, prior knowledge and something that is the most concrete ideas. And then oh yeah, now do this reading. [Students ask] “Why don’t we do the reading first?” Because you wouldn’t have understood the reading if you did it first. [Students reply] “Oh, okay.” And then they just keep reading. I’m like yes, that worked! And a lot of trying to cycle through ideas. . . . How I teach in the room is I want to be not doing a big PowerPoint. I would rather like to have people talking to each other and doing social learning. Just putting readings last if we’re going to do them. Trying to find a good movie; trying to find some sort of demo; trying to find something hands-on, to sort of explain these ideas. That being said, I think I’ve done a poor job . . . because I’m going I need resources! [I ask my colleagues] “What have we got?” . . . go online to Wikispaces and just pull whatever worksheet they have and give it out. (Noah, 2:400)

[My department is] a very poisonous group because our philosophies on the purpose of education, what is worth knowing, everything, the much bigger, deeper meaning questions we do not agree on. More importantly we differ so much that we don’t actually have a decent conversation about it. (Noah, 3:604)

The general idea of having a mentor is good. The idea of having new teacher meetings and trainings are good. I think if the support and the success of the classroom is based on how well the teacher executes, then the use of a mentorships depends on how the mentor executes. . . . So I’m not saying mentorship in general is a poor idea. I just think here, what I’ve experienced, has just been terrible because there is very little effort put into it and I would say that about our
new teacher meetings as well. They have been terrible. My mentor is the department chair. . . . I
never feel that [he’s] coming from a mentoring teacher. “Hey, how you doing? What can I check
up on?” . . . My impression [is] it pays a little bit to be a mentor so he picks that up. (Noah,
3:339)

199I’m the only one in the building doing anything on static because I can’t deal with the
junk that we’re supposed to. Now maybe I’m a little disappointed. It took me two years to get to
the point where I said screw you guys. I’m just going to do it. . . . I was thinking . . . students are
still struggling, fully so, with an atom. It’s still borderline for being abstract. So in terms of
different things, I thought static would be most appropriate because it would help reinforce [the
atom] if I can do static and static is all about moving electrons, then we’re thinking atoms. We’re
still thinking particles. (Noah, 3:67)

200From the administrational side, it’s not like they are walking in going, “Hey what
you’re doing is great! I am seeing this.” But in the way of not walking in, they are also not
saying you should be doing more of these multiple-choice tests. I [do] get that message that you
should be doing most of these multiple-choice tests, but most of those [messages] are coming
from the department. And I’ve come to just realize, as my predecessor came to realize, they’ve
got no teeth when it all comes to it. While there is a lot of talk [of] pressure for accountability but
the pressure for accountability is not accountable to anything because they are not doing
anything about it. [My colleagues] are saying “You should do this” and they don’t care. So, if my
principal is okay for sending me to a science conference, and is okay for sending me to this
physics workshop I’m doing over the summer, and is okay for letting me have two observation
students, [then] I think the administration is okay with doing things that could include good
teaching. But I’m not going to say there is the strongest support for highly effective teaching
because we don’t do it. (Noah, 3:148)

201I think I’m going to play things a little more. I’ve been rather conservative because I
would really like to have a job, and [I was] hiding within the system, but I’d like to do a little
more of what I know to be effective. I was told very directly last year no pet projects which
means if you have a lab and no one else is doing it than you can’t do that lab. We talked about . .
. . building something to do with Newton’s Laws. [And I was told by my department chair] no.
You can’t do that. That’s a pet project. You can’t have your students build things. . . . I think at
this point we kind of realized, we’re all so broken off that even if you tell me, no, Noah. You
can’t do a lab on chemistry, too bad. I’m going to figure out a way. I’ll take the time to set up
these mystery powders myself if I have to. To do something that is worth [students’] time. To
push them, thinking-wise about chemistry. I’ll have them build something. And, maybe [I] can
probably swing it [as] . . . here’s a way they can demonstrate performance in a laboratory setting
[for the Next Generation Science Standards]. I think I can find a way to word it. (Noah, 3:205)

202I certainly read everything [posted to the Google Group]. I do appreciate Martin
always finding interesting things and then emailing them to everyone. . . . I’m not being as
proactive as I should. . . . Maybe I’m just not the guy to try to initiate that stuff. I’m much better
at responding to someone else. (Noah, 3:654)

203Stoichiometry on the other hand, I just didn’t do it at all [this year]. I realize that’s why
the other [teachers] are two weeks behind me because they spend two weeks on stoichiometry. It
was two weeks of basically yelling at their students “Why don’t you get this? Why can’t you do
these conversions? Come on, it’s really simple. Here’s the packet. Today we’re going to work through these pages in this packet.” I know, I did that last year because I felt I had to. This year, I abandoned it completely because when it comes down to that final we don’t even write any stoichiometry questions on it because we think it’s so hard. So if I don’t do stoichiometry . . . their students aren’t going to remember it next year, my students aren’t going to remember it next year because they haven’t done it. So I can actually do static, I can reinforce things on the electrons. I’ll take that one. (Noah, 3:453)

204 [The greatest influences on my decision-making as a teacher are] going to be torn between three things. One is “Is this appropriate for students? Is this the best for them? Given my education, what we know about how students learn, is this the most appropriate?” . . . The second thing I deal with will be physically my own time, “Can I deal with it?” . . . Where am I going to spend my time? I spend a lot of time here. I still spend more time than all other teachers. . . . The third is just the institutional constraint side. . . what we consider our standards comes last to my decisions, but it kind of does. (Noah, 3:388)

205 I’m so nervous that I will be absorbed into the system as the status quo and like the teachers who go through an MAT program, get done, and then [you can’t tell they went through a research-based program]. Maybe it’s because they fought it there, or maybe it’s because they’ve gotten to a school and they got it beat out of them from their colleagues. I think there’s a little part of that when I went to the state practitioner conference this year. I’m watching everyone present and I’m like “Why didn’t I present? Why don’t I feel I have anything that is worth presenting?” . . . That’s part of the reason why I’m driven to take this physics workshop, to see [research-based teaching] more. I’ve had multiple [colleagues] ask me about [the summer workshop] and [no one ever asks if I’m going] “Because I want to be better.” [They ask if I’m trying to move up the pay scale.] I’m so worried about that mentality getting to me. (Noah, 3:745)