Chapter 8
Evolving Goals, Pedagogies, and Identities as an Elementary Science Teacher Educator: Prioritizing Practice

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Introduction

In this chapter, I explore the evolution of the work I have done as an elementary science teacher educator at the University of Michigan, focusing on my work in my science methods class for undergraduate preservice elementary teachers. I focus my analysis on three elements: (a) the *goals* I have set for my elementary methods class, (b) the *pedagogies* I have used and privileged, and finally (c) my own changing *identities* as a science educator, teacher educator, and science teacher educator. I draw on my syllabi and assignment descriptions over 17 years and my published scholarship generated in the context of the course (e.g., Davis, 2004; Davis & Smithey, 2009; Forbes & Davis, 2010). I engage in qualitative content analysis to discern themes and shifts in goals, emphasis, and expectations over time. I draw on my publications to complement these analyses as well as to characterize my own development as a teacher education scholar. These analyses show ways my work has reflected broader changes in the field.

I have conducted studies in my own teacher education classrooms with the goal of improving my own teacher education practice (Hamilton & Pinnegar, 2000) as well as that of others, and this body of work contributes to the literature base in the field (Zeichner, 2007). The individual studies I have published, however, lean closer to "formal research" than "practical inquiry" or "self-study research" (Loughran, 2007; Richardson, 1994). My work does not always reflect some of the key characteristics of self-study, such as the reflectiveness on the part of the practitioner (i.e., me) about how the research is affecting their *own* practice—in my writing I have emphasized implications for the field more distally—or fully bringing in the voices of the teacher education students. That said, in this chapter, I examine this

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body of work, side-by-side with the artifacts of my work as a teacher educator. In essence, then, the chapter provides a meta-self-study, examining a science teacher educator's work and identity as evidenced both by instrumental artifacts of that work and scholarly products resulting from it. I use vignettes to provide a quasi-narrative window into the evolution of the work (and myself) over time.

Theoretical Framework

Changes in the theoretical stances I use have involved adding layers of complexity—not replacing one perspective with another. In my early work, I prioritized teacher knowledge, reflecting a cognitive and sociocognitive stance (Bransford, Brown, & Cocking, 1999). I used (and continue to use) knowledge integration as a frame, considering how ideas are added to one's repertoire, connected to other ideas, and distinguished from others (Linn, Eylon, & Davis, 2004). As I came to focus more attention as a scholar and as a teacher educator on curriculum materials, I saw these as conceptual tools in a sociocultural sense (Grossman & Thompson, 2008; Remillard, 2005), and I conceptualized these tools as being inherently situated in teachers' daily work (Ball & Cohen, 1996; Putnam & Borko, 2000). Now, focusing more on practice-based science teacher education, I explore multiple roles of "practice" in learning to teach science—both scientific practices (NRC, 2012) and teaching practice (Ball & Forzani, 2009; Lampert, 2010), and the interplay between the two.

Indeed, my development as a scholar has reflected key developments in the fields in which I situate my work: science education and teacher education. Both fields have shifted from valuing mainly conceptual knowledge and its application, toward an application of knowledge in the service of practice, and toward the meaningful integration of knowledge and practice.

In science education, since the 1990s, the field has moved increasingly toward an orientation toward scientific practice (e.g., Berland & Reiser, 2009; Gilbert & Boulter, 1998; McNeill & Krajcik, 2008; Zembal-Saul, 2009) and, currently in the US, toward "three-dimensional learning" that involves the integration of disciplinary core ideas such as biodiversity, scientific and engineering practices such as argumentation, and crosscutting concepts such as energy or size and scale (NGSS Lead States, 2013; NRC, 2012). The integration of content and practice, particularly, has driven much of my research and teaching.

At the same time, the field of teacher education has moved away from emphasizing mainly teachers' knowledge development and analytic skills—which was itself a reaction to the older process-product orientation of the teacher education field (Grossman & McDonald, 2008)—and toward what is increasingly referred to as practice-based teacher education (Ball & Forzani, 2009; Grossman, Hammerness, & McDonald, 2009). In practice-based teacher education, the goal is to support novices in becoming teachers who can engage with a threshold level of proficiency in a set of key teaching practices. In my own elementary teacher education program, we refer to this as aiming toward the development of "well-started beginners" who can effectively employ a set of high-leverage teaching practices, who have strong content knowledge for teaching and thus take subject matter seriously and teach content with integrity, and who meet a set of ethical obligations of teaching (Davis & Boerst, 2014). Again here, we see the importance of integrating knowledge and practice.

Because of the centrality of the construct of "practice" in this chapter, delineating its many meanings is key. Arias' (2015) analysis of how Lampert (2010) uses the term can help explicate how I use "practice" in reference to both science education and teacher education. Lampert refers to four meanings, and Arias explores three vis-à-vis teaching and science:

1. *A collection of practices*: In learning to teach, we refer to a set of high-leverage or core teaching practices. These can include planning practices (such as using curriculum materials for lesson planning) and interactional practices (such as eliciting students' ideas, meeting with a parent, or leading a whole-class discussion). In learning science, we refer to the scientific practices used to learn about natural phenomena; a canonical set (including, e.g., constructing evidence-based claims or using scientific models) is articulated in the *Framework for K-12 Science Education* (NRC, 2012).
2. *To practice*; *to rehearse*, *to do something repeatedly to study it*: In learning to teach, a beginning teacher may rehearse a lesson with her peers before teaching it to children. In learning science, a fifth-grader may work repeatedly on supporting claims with evidence.
3. *Practice as in a profession*: In learning to teach, the profession is teaching; in learning science, it would be a discipline of science, such as biology or geochemistry.

In the meta-self-study, I show the ways in which these different meanings of "practice" come to play increasingly prominent roles in my work as a science teacher educator.

Methods for the Meta-Self-Study

Instructional Context and Participants

I have taught elementary science methods since 1998, when I arrived as a new faculty member at the University of Michigan. Of the 17 years of the study, I have data associated with 16 instantiations of the class.[1] Throughout that time period, I have been the "lead faculty" for the class. Generally, this means I teach one

[1] I do not include the Fall 2007 version of the class in my analyses here. Two graduate student instructors taught the class that semester and I did not save a version of the syllabus or assignments.

(occasionally two) sections of the class (which historically has had two or three sections), and collaborate with the graduate student instructor(s) involved in the class, apprenticing them into the work of teacher education.[2]

The four-semester undergraduate program has had a consistently strong orientation toward content-area teaching and learning at the elementary level. It includes a field component, with preservice teachers having purposefully-designed clinical experiences for 6–9 h per week during the first three semesters of the program and a full-time student teaching experience in the final semester. The science methods class occurs in the third semester of the program.

The teacher education program underwent a significant redesign in the early 2010s (Davis & Boerst, 2014). The program became more purposefully oriented around three pillars: a set of high-leverage teaching practices, content knowledge for teaching academic subjects in elementary school, and a set of ethical obligations for teaching. While the redesign was in the planning stages for several years, it affected the science methods course starting in Fall 2011, at which time the class changed from being a full semester long to being 9 weeks long. Some of the substantive work of previous iterations of the class became central parts of other coursework, and thus could be removed from or reduced—yet reinforced—in the science methods course.

As a college student I majored in engineering and then worked as an industrial engineer before graduate school, where I was trained as a science educator and learning scientist. Unlike many teacher educators, my career trajectory did not involve a traditional classroom teaching job. During my graduate work, where I focused on middle school student learning, I did not have opportunities to apprentice in the role of teacher educator. I became interested in how new elementary teachers learn to teach science in part because I realized that as a new teacher educator and professor, I faced challenges that were similar to those my students were facing. I came to teacher education scholarship through my work as a teacher education practitioner.

Typically, there are 25–30 preservice teachers in a section of my science methods class. Most years, almost all of the preservice teachers are female, and most self-identify as white. In these ways, the participating preservice teachers are typical of the elementary teaching force in the US. Preservice teachers select a teaching major in this program; typically, approximately 15–25 % concentrate in science within their education degree.

The graduate students working with the class are typically working toward a doctorate in science education or, occasionally, teacher education. Most have science teaching experience at the elementary, middle school, or high school level.

[2] While still lead faculty, I did not teach the class in 2007, 2011, 2013, or 2014, due to sabbatical or administrative responsibilities. Note that because of the collaborative nature of the design and enactment of this course, when referring to our collaborative work on the course, I use first-person plural pronouns. When referring to my own work as a teacher educator or my work on the analyses for this meta-self-study, I use first-person singular pronouns.

These graduate students' progression as teacher educators follows a path similar to that described by Abell and her colleagues (2009).

Data Sources

Data sources for this study include my course syllabi (1998–2014), class assignment descriptions (1998–2014), and published scholarship focused on the class or my students. Here, I review each.

The structure of my syllabus has remained roughly similar over the 17 years of the study. Syllabus sections typically have included logistics about the class, course objectives, reading materials, requirements and grading, summary or overview of due dates, and tentative course schedule and assignments. In this study, I draw most heavily on the sections outlining course objectives and course requirements and grading. Reviewed holistically, all elements of the syllabus became more elaborated over the time period of the study.

The main categories of assignments or class requirements identified through open coding of syllabi include: (a) participation, (b) reflective journals, (c) versions of "reflective teaching" assignments (in which a science lesson is designed, enacted, and reflected upon), (d) unit or investigation plan (i.e., curriculum design), (e) science content interview with a child, (f) critique of lesson plan, (g) peer teaching (in which preservice teachers teach a small group of their peers), and (h) small science teaching experience (in which a portion of a science lesson is designed, enacted, and reflected upon; sometimes called "experience in the field" or EITF).

I turn to my published papers as a way of addressing questions about the evolution of goals, pedagogies, and identities—in particular, identities—over the time period of the study. Seventeen relevant published papers are used in this analysis. These were selected based on the following criteria: (a) published in a peer-reviewed journal, (b) focused on research questions related to the elementary science methods class or recent graduates, and (c) presented empirical research (i.e., not design approaches or research syntheses).

Coding and Analysis to Characterize the Evolution of Goals, Pedagogies, and Identities

I analyze the *learning goals* made explicit in my syllabi and assignment descriptions over time. I use open coding to develop a set of emergent codes. Within the first category, "curriculum", I coded for mention of standards, curriculum materials, unit planning, and critiquing lesson plans. Within the second category, "scientific practice", I coded for inquiry and investigation, explanation and sensemaking, scientific practices or scientific modeling, and the "four strands" of science proficiency (NRC, 2007) or "three dimensions" (NRC, 2012) of science learning. Within the

Table 8.1 Coding scheme for pedagogies of teacher education

Code	Instances of assignments
Pedagogies of investigation	Unit (or investigation) plan, Content interview with elementary child, Lesson plan critique
Pedagogies of reflection	Reflective journal entries, Reflective teaching
Pedagogies of practice	Reflective teaching, Unit (or investigation) plan, Lesson plan critique, Peer teaching, Experience in the field
Representation	Peer teaching
Decomposition	Unit (or investigation) plan, Lesson plan critique
Approximation	Reflective teaching, Peer teaching, Experience in the field
For *planning* practices	Reflective teaching, Unit (or investigation) plan, Lesson plan critique
For *interactional* practices	Reflective teaching, Peer teaching, Experience in the field

third category of "students", I coded for student ideas and equity. Within the fourth category of "teaching practice" I coded for high-leverage teaching practices and the idea of planning, teaching, and reflecting on lessons. Within the final category, I coded for identity. Through content analysis, I trace changes over time, using a matrix derived from the coded data (Miles & Huberman, 1994).

A similar approach is taken for the next set of analyses, but the focus is on the *teacher education pedagogies* used in the class. A taxonomy of teacher education pedagogies includes pedagogies of investigation, reflection, and practice (Grossman, Hammerness, et al., 2009; Grossman & McDonald, 2008). Pedagogies of investigation privilege analytic work (e.g., analyzing a case depicting a teacher's decision-making) and pedagogies of reflection privilege reflection on one's own or others' teaching. Grossman and colleagues' pedagogies of practice include decomposition (i.e., breaking teaching into its elements), representation (i.e., depicting teaching such as through videos or cases), and approximation (i.e., engaging in smaller or lower-stakes aspects of teaching; Grossman et al., 2009). In characterizing the teacher education pedagogies used in my classes, emergent coding highlighted the importance of one further breakdown, between pedagogies of practice supporting planning practices (e.g., lesson or unit planning) and those supporting interactional practices (e.g., eliciting students' ideas). Table 8.1 summarizes how the assignments from the class reflect the coding scheme. Assignments are coded because this shows what teacher education pedagogies were used to hold preservice teachers accountable. The syllabi are used holistically to add richness; while pedagogies are not necessarily explicit in syllabi, review at a gross level, using these codes as guides, provides further insight into the nature of the course.

Some assignments are superficially similar but enacted differently. One example is an assignment we now call "peer teaching."[3] Based on Grossman and colleagues'

[3] As noted in Davis (under review), we typically call these "peer-teaching" experiences, rather than "rehearsals" (see, e.g., Kazemi, Franke, & Lampert, 2009; Lampert & Graziani, 2009). While similar, in peer teaching, preservice teachers do not necessarily have the later opportunity to enact

notion of approximations of practice, peer teaching entails having preservice teachers teach segments of a carefully selected lesson intended to highlight common problems of practice in teaching science, such as working with data gathered by children. They teach these lesson segments to a group of peers and a teacher educator, who provides very specific, focused feedback. The focus is on one or a handful of specific teaching practices. Preservice teachers have the opportunity to rehearse these practices in ways that "quiet the background noise" (Grossman, Compton, et al., 2009; p. 2083) and lower the stakes. Early iterations of the class similarly involved preservice teachers teaching to one another. However, in those early years, I simply asked preservice teachers to select a lesson and teach it to their peers. The lessons ran a gamut (and often were more like art activities than science lessons), there were no focal science teaching practices, and participants (including the single teacher educator) did not provide specific types of feedback. As a result, while both versions are technically approximations of practice, only the later instantiation truly supports preservice teachers in deliberate practice (Ericsson, Krampe, & Tesch-Romer, 1993), in light of all three of Lampert's (2010) definitions of "practice."

The third set of analyses focuses on shifts in my own *identity* as a scholar, teacher educator, and science educator. Drawing directly on the publications that have emerged from my study of my methods course, I characterize the research questions of each of the relevant studies as focusing on knowledge, beliefs, practice, and/or other characteristics (such as identity or confidence). This serves as a proxy representation of "who I am" as a science teacher educator and scholar.

Because of the nature of this meta-self-study, I did not engage in traditional reliability and validity checks. However, issues of trustworthiness of the data and the claims about the data are important. I asked two graduate students who have taught this class with me multiple times and who are well-versed in the literature in science education and teacher education to read draft versions of this manuscript. Through conversation, we developed ways of addressing their recommendations. In general, they found the descriptions of the course, and my claims about it, to align with their senses of it. In this sense they served as critical friends in this analysis. More generally, they and the other graduate students with whom I work form the cadre of colleagues who have supported my own growth as an elementary science teacher educator, even as I have worked to support theirs.

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with children the lesson they were working on in the peer teaching. Like rehearsal, peer teaching grows out of the microteaching movement of the 1960s and 1970s and it has some similarities with that approach, as well. Both are intended to reduce complexity, allow for correction, and focus on decompositions of practice (Allen, 1967). The main difference between peer teaching and microteaching is in the nature of the decomposition of the task. Microteaching tended to focus on teacher behaviors deemed important in process-product studies (Zeichner, 1999), such as asking higher-order questions. Ball and Forzani (2009) note that a critique of microteaching has been its representation of teaching as "a set of decontextualized and atomized practices" (p. 508). In contrast, peer teaching focuses on meaningful lesson chunks.

The Evolution of Goals Over Time

Table 8.2 summarizes the characterization of the objectives articulated in the syllabi over the 17-year period of the study. This is complemented by a similar coding of assignments, because the assignments should reflect not just the explicit goals, but also perhaps any implicit goals of the course. Given that the plan/teach/reflect code indicates a more holistic goal, the analysis is consistent with an earlier description of the course goals as oriented around inquiry, curriculum materials, and student ideas (Davis & Smithey, 2009).[4]

Looking at the analyses of goals and assignments together, a few major trends can be identified. First, the focus on *planning*, *teaching*, *and reflecting* on science lessons—that is, putting the pieces of science teaching together—was consistent throughout the period of the study.

Second, the focus on *curriculum and curriculum materials* is most prominent prior to 2008, and drops off almost entirely starting in 2011, except for continued work on standards. This shift is explained by the program redesign, which affected the science methods class beginning in Fall 2011. In that redesign, we developed a course called Teaching with Curriculum Materials, which drew directly on much of the instructional work around lesson plan critique, adaptation, and use from the science methods course—yet was broadened to incorporate this focus for all academic

Table 8.2 Analysis of explicit course objectives over time

	F 98	F 99	F 00	F 01	F 02	F 03	F 04	F 05	F 06	F 08	F 09	F 10	F 11	F 12	F 13	F 14
CURR: standards	✓	✓	✓	✓	✓	✓	✓	✓	✓						✓	✓
CURR: curriculum	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓				
CURR: unit plan	✓	✓	✓	✓	✓	✓	✓	✓								
CURR: critique					✓	✓	✓	✓	✓		✓	✓				
INQ: inquiry, invest., EEE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
INQ: explanation / sensemaking								✓	✓		✓	✓				
INQ: sci. practices / modeling										✓	✓					
INQ: 4 strands / 3 dimensions												✓	✓	✓	✓	✓
Ss: student ideas	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	✓	✓	✓	✓	✓	✓				
Ss: equity											✓	✓	✓	✓	✓	✓
TCHG PRAC: HLPs														✓	✓	✓
TCHG PRAC: P/T/R	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OTHER: identity								✓	✓							

(✓) indicates goal was reflected in a main course assignment, but not in syllabus course objectives.

[4] The reflective teaching assignment, peer teaching, and experience-in-the-field assignments each relate to the capacity to plan, teach, and reflect on science lessons. The unit plan (or, later, investigation plan) and critique assignments all relate to the focus on curriculum. The content interview relates to the student ideas focus.

subject areas. Thus, the science methods course no longer focused on the use of science curriculum materials, because this was addressed in depth in the first year of the program.

Third, although the syllabus only listed a focus on *student ideas* as an explicit goal starting in 2004, the assignment analysis makes clear that there was a focus on student ideas (via the content interview) since the beginning of the class. In the program redesign, a new course sequence titled Children as Sensemakers took up in depth the ideas of how children make sense of scientific (and mathematical) phenomena, so this focus, also, was eliminated from the science methods class starting in 2011.

These changes due to program redesign should be considered in light of the intention to develop a more coherent and practice-oriented program. While the effect on the science methods course was to eliminate these explicit goals, the ideas were introduced earlier in the program and then reinforced through the science methods course and other subsequent learning experiences.

Fourth, each semester had a focus on *scientific inquiry or scientific investigation*. Over time, this became a much sharper focus on *scientific practice* (including, for a few years, scientific modeling), the *four strands of science proficiency* from *Taking Science to School* (NRC, 2007), and most recently the *three dimensions of science learning* from the Framework (NRC, 2012) and the Next Generation Science Standards (NGSS Lead States, 2013).

Fifth, in 2009, the course focus on issues of *equity* was made explicit as a goal and was addressed much more purposefully. Finally, in 2012, the course objectives began articulating specific *high-leverage science teaching practices* of focus, in keeping with the program's orientation as a practice-based teacher education program.

I identify four "eras" through analysis of these goals.[5] While most changes to a course are evolutionary, rather than revolutionary, such "eras" can be a helpful shorthand for depicting major thrusts. As such, we can refer to the early period (1998–2002) as the most *traditional*, with a focus on unit planning as the ultimate goal. This was followed (2003–2006) by the *curriculum materials and student ideas* era; here, I spent instructional time helping preservice teachers develop their capacities to (a) anticipate, elicit, interpret, and respond to students' ideas and (b) use science curriculum materials effectively. The period from 2008 to 2010 focused on *scientific modeling*; the emphases on student ideas and curriculum materials continued, but through the prism of modeling. This period also was the time when we introduced *peer teaching*; drawing on Grossman, Compton, and colleagues' (2009) ideas about approximations of practice, we began to focus on teaching portions of lessons as a way of developing high-leverage science teaching practices. The more *practice-oriented* era began in 2011, and was precipitated by the program redesign. At this point, the course became shorter, lost its explicit focus on curriculum materials and student ideas as indicated above, and developed a stronger focus on a specific set of high-leverage science teaching practices. This period also coincided with

[5] These "eras" are demarked in relevant tables using wiggly lines.

the release of the Framework and the NGSS, so the course continued its focus on scientific practice, but using language from the new reform documents. In this period, we also sharpened our focus on equity, developing a set of equity science teaching practices to use as touchpoints.

In selecting vignettes to depict some of these changes, I draw on one semester, Fall 1998, from the "traditional" era; one, Fall 2005, from the "curriculum and student ideas" era, to depict the focus on curriculum materials; and one from the most recent "practice-oriented" era, Fall 2012, to depict the focus on teaching practice.[6] For each vignette, I use a composite, fictional preservice teacher ("Jenny" in 1998, "Ashley" in 2005, and "Emily" in 2012) as a rhetorical device to contextualize novices' experiences in the class. Each vignette includes excerpts from the syllabus' course objectives and class requirements, gives a sense of how a week would be described on the syllabus, and describes my sense of the overarching flavor of the class.

Fall 1998: A Traditional Elementary Science Methods Class

Jenny read the following about the **course objectives** in her syllabus when she came to class in September 1998:

> ED421 will actively engage you in scientific phenomena, much in the way we hope you will actively engage your students. We will discuss the strategies you'll need to support learners in understanding fundamental science concepts, learning about vital scientific processes, and understanding the nature of science. … You will apply your growing understanding of science teaching by developing, enacting, and refining science curricula. [O]ne emphasis of this course will be on the idea of *preparing* to teach and *analytically reflecting* on your own and others' teaching. …

During this course, you will:

- become familiar with current resource materials like AAAS Benchmarks, state and district objectives, and numerous science curriculum programs,
- prepare to carry on inquiry-oriented activities by engaging in investigations involving exploration and discovery,
- gain experience in preparing, teaching, and analytically reflecting on elementary school science lessons while working with young students in local schools, and
- develop long-range teaching skills by preparing an in-depth science curriculum project.

As Jenny read on, she saw that the **class requirements** included participation, journal writing and "other analytic reflection assignments", an assignment that asked her to plan and teach two science lessons (including to her colleagues), and a final project that involved developing a unit plan.

(continued)

[6] These focal semesters are demarked in relevant tables using solid lines.

Skimming through the **description** of what they would do each week, she saw that 1 week, for example, they would explore how kids think about science, and she would do something called a "Draw-A-Scientist" interview with a child from her placement classroom. It looked like there would be a lot of readings and a lot of writing—but things seemed overall pretty manageable.

Overall, at the end of the semester, Jenny thought that a statement she had highlighted in the objectives in the syllabus captured the **overarching flavor** of the class: "one emphasis of this course will be on the idea of *preparing* to teach and *analytically reflecting* on your own and others' teaching." Jenny and her colleagues developed numerous science teaching plans, spent a lot of their time responding to journal prompts, and were essentially unsupported in learning to engage in specific science teaching practices.

Fall 2005: Analyzing Science Curriculum Materials and Working with Students' Ideas

Ashley walked into the science methods room in September 2005 and picked up a syllabus. In it, she read about the **course objectives**:

In ED421, our four main goals are:

- develop an understanding of scientific inquiry and inquiry-oriented science teaching… We will emphasize explaining using evidence …
- learn to anticipate and deal with students' ideas, including their prior knowledge and alternative (non-scientific) ideas
- develop your ability to critique and adapt curriculum materials so they're more inquiry-oriented and more appropriate for your classroom and your students
- help you start to think of yourself as a teacher and develop your abilities as a teacher

The objectives went on to describe that Ashley and her colleagues would become familiar with resources like the national and state standards; learn to teach "inquiry-oriented lessons… involving asking questions, making predictions, conducting experiments, collecting data, making observations, developing explanations, and communicating findings"; and prepare an "in-depth science investigation plan, building on existing curriculum materials."

Reading on, she saw the **class requirements**. Besides class attendance, participation, and various written assignments, the class requirements also included two "reflective teaching assignments", about which the syllabus said, "[Y]ou will develop a lesson plan by revising an existing lesson, teach it to children, reflect on your teaching, and analyze some student work." The last

(continued)

requirement was to develop a unit plan. She was used to doing big final projects in her classes, and she would also get to teach two science lessons, which sounded fun, if scary.

When Ashley looked at what would be happening **week-by-week**, she saw that the goals for each week were pretty extensive. For week 4, for example, she saw that the goals were to:

> Start to be able to anticipate kids' ideas about a specific science topic. Develop strategies for finding out about kids' ideas about a specific science topic. Consider how alternative ideas may be different for different students, for example, by gender, cultural background, etc.

She would do readings and written assignments most weeks (like the "Anticipating Kids' Ideas" homework mentioned for week 4 and assignments that would require analyzing and critiquing lesson plans other weeks). It sounded like there would be an emphasis on "scientific inquiry."

At the end of the semester, when Ashley thought back on the **overall flavor** of the class, she recognized that the class had focused on critiquing and adapting curriculum materials, working with students' ideas, and engaging students in scientific inquiry. Her professor thought that she and her colleagues had developed some skill in all of these areas (see Davis & Smithey, 2009). Compared to Jenny, who took the class in 1998, she did a lot less abstract reflection on teaching. Compared to Emily, who would take the class in 2012, Ashley and her colleagues worked in a less focused manner on teaching children to engage in scientific practices (though they did work on how to help kids construct scientific explanations).

Fall 2012: Increasing the Focus on High-Leverage Science Teaching Practices

Emily walked into the science methods classroom in September 2012, having made it through the first year of what her professors called her "practice-based" teacher ed program. She saw some familiar language about teaching practices and equity in the **course objectives** in the syllabus:

Our main goals are for you to:

- Describe the four strands of science learning—understanding scientific explanations…, generating scientific evidence …, reflecting on scientific knowledge …, and participating productively in science
- Incorporate the four strands of science learning into effective elementary science teaching …. Specifically, you will work on science teaching practices such as:
  - Appraising and modifying science lesson plans … to address a specific learning goal …

(continued)

  - Establishing norms and routines for classroom discourse and work that are central to science …
  - Choosing and using representations, examples, and models of science content
  - Supporting students in constructing scientific explanations …

- Identify and enact instructional practices that make science accessible to *all* students …
- Learn how to prepare, teach, and analytically reflect on elementary school science investigation lessons

When she looked at the **class requirements**, she saw that this class, like her others, would emphasize practicing lessons with her peers. Class requirements listed included:

> *Peer Teaching in ED421* (*three times*) …
>
> Each peer teacher will have a chance to lead their peer "students" through each of the following three elements of a science lesson: *engage with an investigation question*, *experience the scientific phenomenon* associated with the investigation, and *explain the phenomenon with evidence* to his/her peer teaching team. …
>
> *Experience Element in the Field* …
>
> Teaching the *Experience* element of a lesson will involve co-teaching a science lesson with your mentor teacher in your field placement classroom. The goal is to … practice small elements of science teaching, sometimes in low-stakes environments ….
>
> *Reflective Teaching Assignment* …
>
> … [Y]ou will analyze a science lesson plan using the lesson design considerations framework, develop your version of the science lesson plan using the instructional planning template, teach the lesson to children, reflect on your teaching using your video record, and analyze some student work.

She and her colleagues didn't always love rehearsing together—sometimes it felt awkward and embarrassing—but they usually felt it was helpful for improving their teaching. She also thought it sounded good that she'd be able to teach just a portion of a science lesson before teaching a full one.

When she looked at **each week's description**, she laughed about the length. Her professor had a lot to say! She saw each week's goals and how she could connect back to other classes, the syllabus listed out exactly what science teaching practices she'd work on each week, and it highlighted equity practices she would use.

By December, Emily realized that the **overall flavor** of the science methods class had involved deliberately practicing science teaching (through rehearsals and with kids). Her professor felt that she and her colleagues had learned about a range of scientific practices, gained expertise in science teaching practices, and developed ways to use language to support all students in engaging in rigorous and consequential science. Emily built on what she'd learned earlier in the program about lesson and unit planning and about students' specific ideas in science. Compared with Jenny and Ashley, Emily focused on these topics less within the science methods course itself, but more on actual teaching practice.

In sum, the early version of the class emphasized developing knowledge about and reflecting on teaching. A later class emphasized using student ideas and curriculum materials to support science inquiry. A more recent class emphasized the development of not just content knowledge for teaching, but also of teaching practices, supporting ambitious science teaching. Indeed, the course requirements demonstrate this shift; in 1998, the assignments showed a roughly equal emphasis on planning, enactment, and reflection; in 2005, the emphasis on reflection had fallen off; and in 2012, the main focus of the class requirements was on enactment, or practice. Due to these quite different goals, participating preservice teachers likely developed very different knowledge bases, skill sets, and even value systems. The goals themselves also became more transparent to preservice teachers, as rationales were included for assignments. Emily was more likely than Jenny or Ashley to recognize specific science teaching practices she could use (such as establishing norms for classroom discourse that emphasize science evidence), and she was more likely to have at least beginning levels of skill with these practices.

The Evolution of Pedagogies Over Time

My pedagogies as a teacher educator shifted over time, as well. Table 8.3 characterizes how each of the main assignments for the class reflect a range of teacher education pedagogies over time. This analysis shows a rough evolution from emphasis on pedagogies of reflection and investigation toward pedagogies of practice (Grossman, Hammerness, et al., 2009), and similarly from a focus mainly on practices related to planning to a greater focus on practices related to interactional work of teaching. This is in part because of the program shifts described earlier, meaning there was less need for the science methods course to fully address students' ideas (pedagogies of investigation) or lesson planning (pedagogies of practice for planning); instead, the course simply continued work preservice teachers had begun earlier in the program.

Table 8.3 Analysis of pedagogies reflected in main course assignments over time

	F 98	F 99	F 00	F 01	F 02	F 03	F 04	F 05	F 06	F 08	F 09	F 10	F 11	F 12	F 13	F 14
Pedagogies of reflection: Journals	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
Pedagogies of investigation: Content interview	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓				
Pedagogies of practice – planning: Unit/inv. plan	✓	✓	✓	✓	✓	✓	✓	✓								
Pedagogies of practice – planning: LP critique*						✓	✓	✓	✓		✓	✓				
Pedagogies of practice – interaction: Peer teaching[a]										✓	✓	✓	✓	✓	✓	✓
Pedagogies of practice – interaction: EITF											✓	✓	✓	✓	✓	✓
Multiple pedagogies (reflection, practice): RT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

[a]Early versions of critique and peer teaching were originally incorporated into reflective teaching assignments and are omitted from this analysis for clarity, until they became explicit assignments

Choosing the same focal semesters—Fall 1998, Fall 2005, and Fall 2012—and using the same representative composite preservice teachers for a suite of vignettes allows illustration of this evolution. The third vignette, for example, depicts the approximations of practice (Grossman, Compton, et al., 2009) employed to engage novices in investigation-based science teaching through practice-based teacher education (Zeichner, 2012).

Fall 1998: Pedagogies of Reflection, Investigation, and Planning

Jenny looked at the handout delineating the many journal assignment options. Some required her to observe in her classroom; others just asked about her ideas about a topic. She read prompts like:

> Consider how you hope to use technology in teaching science. How would your plans differ given various technology set-ups (e.g., separate computer lab, … 2 computers in your classroom, 15 computers in your classroom, etc.)?
>
> Consider how your teacher tries to make science relevant to students' lives.
>
> Think about diversity in the context of your practicum classroom. What kinds of "diversity" do you see? Consider how your teacher deals with issues of diversity and equity in the classroom. How does your teacher's approach map on to what you consider the ideal?
>
> Reflect on the teaching of science, emphasizing how your ideas have changed over the course of the semester. … Look back at your original philosophy of teaching. Develop a new philosophy statement.

Jenny looked for more about the teaching assignment. In late October, she noticed that 1 week gave the following as an assignment: "*Turn in critique of an existing lesson plan. Enact in class*." The syllabus didn't say anything else about this, and there wasn't a separate assignment sheet for this, so she figured she had free rein for choosing a lesson plan and figuring out how she wanted to teach it. By late October, Jenny had worked with her cooperating teacher to identify a lesson to teach. It was from her first grade classroom's science curriculum and it involved having children (or, in this case, her peers) color pictures of the different life stages of a caterpillar (and butterfly) and then cut them out and paste them to a sheet of paper in the proper order of the life cycle. She had her colleagues do the activity. Her professor stopped by for a couple of minutes, but then had to rotate on to a different group. Talking with her professor afterward, she complained, "I didn't think this was worthwhile. My friends and I just chatted while we colored the pictures and cut them out." Her professor thought, "I agree. It wasn't very worthwhile!" But it would be a few years before she developed a better approach. In the meantime, preservice teachers weren't given guidance about what lesson to select, how to focus their enactment, or how to give one another feedback.

The Resulting Opportunities to Learn

The class emphasized reflective journals, unit planning, and the non-deliberate "peer teaching", demonstrating a mix of pedagogies of reflection, investigation, and practice. What the preservice teachers were able to get out

(continued)

of the pedagogies of practice, though, would have been almost entirely up to them. Furthermore, some of the pedagogies of reflection, too, were relatively dissociated from their own science teaching practice (see Davis, 2006a, for an analysis of one cohort's reflection on their own teaching). Thus, while Jenny and her colleagues undoubtedly learned some important knowledge related to science teaching, this class' foci were too diffuse to yield very effective learning outcomes for most participants. Participants had numerous opportunities for "studenting" but few that would prepare them for *teaching*.

Fall 2005: Pedagogies of Investigation Toward Planning Practices
Ashley saw that her syllabus mentioned a few "critique assignments." These built on one another over the semester, and in essence involved identifying key criteria along which to critique and adapt existing curriculum materials, analyzing the lesson plan to determine strengths and weaknesses along each criterion, and determining changes to make to address weaknesses.

For example, in early November, Ashley and her colleagues received Critique Assignment #2. On the assignment page, the criteria (which were developed as part of Critique Assignment #1 in early October and were elaborated in a class list) included:

1. *Questioning and predicting*
2. *Making explanations based on evidence*
3. *Communicating and justifying findings*
4. *Connecting to students' ideas*
5. *Promoting equity*
6. *Developing a sense of purpose*

The instructions provided to Ashley and her fellow preservice teachers stated:

1. Review the lesson plan you've received.
2. For today's critique, I'd like for you to focus on **making explanations based on evidence** as well as **one or two other criteria**. (Select your additional criteria based on what you think this lesson plan will allow you to go into depth on.)

For each criterion, they were asked to complete a chart with the following column headings:

- Aspect(s) of the lesson plan that **meet** the criterion
- Aspect(s) of the lesson plan that **do not meet** the criterion
- For the aspects that **don't meet** the criterion, how would you **change** this aspect of the lesson plan to better meet the criterion?

(continued)

The Resulting Opportunities to Learn

Ashley and her colleagues had the opportunity to explore science lesson plans as a result of engaging in these "critique" assignments, and developed skill in doing so (see Davis, 2006b, for an analysis of one cohort's experiences with these assignments). Using these critique assignments as a main thread running through the class supported a substantial emphasis on developing planning practices. These assignments also provided opportunities to work explicitly on planning for instruction around scientific practices—for example, in Critique #2, preservice teachers considered how the lesson could better support kids in constructing explanations. At the same time, the emphasis on lesson critique meant there was even less attention to the interactional practices of teaching than had been the case earlier.

Fall 2012: Pedagogies of Practice Toward Interactional Practices

Emily's professor had mentioned that one reason they would use rehearsals in science methods (in the "peer teaching" assignment) was because—as in most US classrooms—they were unlikely to get very many opportunities to teach or even see science being taught in their placement classrooms, which was definitely true for Emily. Emily read this about peer teaching:

> In the peer teaching assignments, you'll use either the *Stems* or the *Motion* Lesson (both from [the district's curriculum materials]) to teach a series of *Engage*, *Experience*, and *Explain with evidence* elements of lessons to your … peer teaching team over the course of the semester. When you are teaching, your colleagues will act as elementary students (intellectually, not behaviorally). The part of a science lesson that you'll teach (*engage*, *experience*, or *explain*) will correspond to the science teaching practices that we will model and discuss in class the previous week. … Immediately after you teach, we will "co-reflect" as a class…. This re-framing will let us all have a chance to talk about what went well and what could have gone better and work collaboratively on developing your science teaching skills.
>
> When you are not teaching your peers, you will fulfill the role of elementary students for your peer teacher colleague. … Your impressions and feedback for your peer teacher colleague will be invaluable for developing his/her teaching skills and will also help you think through your own science teaching. ….

The assignment also articulated expectations for peer teachers and peer students during enactment and collaborative reflection, including instructions such as "be responsive to your learners" (peer teacher), "think like an elementary student" (peer student), "be open to others' input" (peer teacher), and "refer to specific examples in offering constructive feedback" (peer student).

Because Emily was placed in a lower-elementary classroom, she was assigned the "Stems" lesson, which was intended for second grade. After co-planning for her "Engage" element of the lesson, the next week she taught it

(continued)

to three of her colleagues, as well as a science teacher educator, Maria, who had come to help her professor. (There was one teacher educator with each small group!) Emily knew that she was supposed to practice two main science teaching practices: eliciting students' ideas and setting up a question or problem for investigation. Emily's fellow preservice teachers and Maria gave her feedback specifically on those two practices. A couple of times, Maria asked Emily to pause her teaching, to try something again. Once Emily stumbled over how to word a question (her plan said "give scenario to ask about prior ideas" but she hadn't thought about how she would actually word this). Maria made a couple of suggestions and asked her to try it again, and it went much more smoothly the second time. Maria and her professor said this gave them a chance for what they called "deliberate practice."

The Resulting Opportunities to Learn

Through the peer teaching assignments, the class developed a more substantive focus on the interactional practices of teaching, not just the planning practices. In this way, the class also became less oriented toward (only) investigation or reflection. At the same time, the focus on *scientific* practice also increased, through the subsequent peer teaching lessons and other course experiences. The EEE framework helped link students' engagement in scientific practices with teachers' engagement in science teaching practices that support students in doing so.

Over time, the class shifted from emphasizing pedagogies of reflection and investigation, with the pedagogies of practice being largely idiosyncratic and unsupported, toward a more purposeful support for pedagogies of practice. Emily practiced her Stems lesson in a focused, meaningful way, whereas Jenny had "taught" her lesson on life cycles in a way that mainly entailed coloring and chatting.

The Evolution of Identities Over Time

I trace the character of my published teacher education scholarship through looking at whether the research questions explored emphasize knowledge, beliefs, and/or practice (or other elements such as identity or confidence, which were less prominent in my work). I illustrate these using time periods roughly parallel to those used for the vignettes, and draw on examples to show the thrust of the work. I use my publications' research questions as a window into my identity, as a reflection of how I represent myself as a scholar, recognizing the ways in which identity is constantly shifting and under development (Avraamidou, 2014). These identities reflect my values at given points in my career as well as my own skill sets and knowledge bases—which were developing in tandem. The identities also reflect shifts in emphasis in the fields in which I work as well as shifts in my own institutional and professional contexts.

My identity as a science teacher education scholar, then, has followed a similar path as the evolution of the class itself.

Early Work: Valuing Knowledge, Knowledge Integration, and Reflection

Sample Paper Titles and Research Questions

Example #1: "Knowledge integration in science teaching: Analyzing teachers' knowledge development" (Davis, 2004). The research questions included:

> First, in what ways is a prospective teacher's developing subject matter knowledge integrated with her developing pedagogical content knowledge (PCK)?
>
> Second, how do qualitative differences in her knowledge relate to the instruction—especially the instructional representations—she designs?
>
> Toward the goal of informing a larger question: In what ways is a knowledge integration perspective useful for analyzing a teacher's knowledge development?

Example #2: "Characterizing productive reflection among preservice elementary teachers: Seeing what matters" (Davis, 2006a). The research questions included:

> What aspects of teaching do preservice teachers consider, emphasize, and integrate when they reflect on their own teaching?
>
> What does their knowledge integration look like and how analytic are they when they reflect?

These papers thus address knowledge (including subject matter knowledge and pedagogical content knowledge), knowledge integration, reflection, and—to a limited extent—the planning practice of designing instructional representations.

What This Tells Us about Values and Identity as a Teacher Educator and Scholar

In these early instances of teacher education scholarship, I was building on my earlier work on middle school students' reflection and knowledge integration. I was interested in how the construct of knowledge integration (Linn et al., 2004) could help us identify a mechanism for the development of PCK, which seemed inherently to reflect "integrated knowledge." I was also interested in how reflection could promote knowledge integration among preservice teachers, given what I had explored with K-12 students. I took a mainly sociocognitive stance toward learning, and did not study these preservice teachers' actual teaching practice. The primary data sources in these papers were interviews and written artifacts from class.

Middle Work: Valuing Planning Practices and the Use of Curriculum Materials

Sample Paper Titles and Research Questions

Example #1: "Preservice elementary teachers' critique of instructional materials for science" (Davis, 2006b). The research questions included:

> What is the basis for preservice elementary teachers' critique of instructional materials in science?
>
> What criteria do preservice elementary teachers use for critiquing instructional materials when they develop the criteria themselves, and what criteria do they use when they are given a set of criteria from which to choose?

Example #2: "Curriculum design for inquiry: Preservice elementary teachers' mobilization and adaptation of science curriculum materials" (Forbes & Davis, 2010). Based on Forbes' dissertation work, the paper addresses research questions:

> How many and what types of curriculum materials do preservice elementary teachers use and what adaptations do they make?
>
> How inquiry-oriented are their lessons before and after adaptation?
>
> How do the preservice teachers' curriculum design decisions and inquiry orientations of the curriculum materials they use influence the inquiry orientations of their revised, post-adaptation planned science lessons?

Thus, these papers address knowledge and practice related to curriculum use and adaptation.

What This Tells Us about Values and Identity as a Teacher Educator and Scholar

In these pieces of scholarship, we see reflected the focus on curriculum materials identified in the early- to mid-2000s iterations of the class. I was focusing less explicitly on knowledge integration, though again, I was building on my earlier work through exploring the use of tools as scaffolding to support learning. I had begun to see curriculum materials as important tools for teachers, and I also was thinking about my own use of scaffolding as a teacher educator. The second piece also reflects another salient aspect of the identity shift I was experiencing as a teacher educator: I was working with graduate students whose work was expanding my own repertoire of ideas. In these pieces, while still adopting a largely sociocognitive stance toward learning, we were oriented more toward practice, though again, the focus was on planning practices rather than interactional practices.

Future Work: Valuing Interactional Practices as Well as Planning Practices

My interests are moving more toward exploring interactional science teaching practices as well as planning practices. I am interested in how teachers' knowledge and practice are intertwined as they develop capacities for supporting students in engaging in the kind of three-dimensional learning called for in the NGSS. Sample research questions might include:

1. How do preservice elementary teachers develop content knowledge for teaching science and a set of high-leverage science teaching practices through a series of university-based and elementary classroom-based approximations of practice?
2. What are the affordances and constraints of approximations of practice in an elementary science methods class for preservice teachers?
3. What science teaching practices are highest-leverage for supporting elementary students in learning disciplinary core ideas, scientific practices, and crosscutting concepts?
4. How can an elementary science methods class leverage the work on teaching practices conducted in the methods classes in other subject areas, given that elementary teachers teach each subject? What elements of teaching practice are straightforward to "transfer" or translate, and what elements are more challenging?

Conclusion: Tensions and Tradeoffs

In reflecting on these shifts in my own teaching and what it has privileged, I feel that the moves toward scientific practice and science teaching practice have been important for supporting novices in developing into elementary teachers who can engage their students in rigorous and consequential science learning. Practice-based teacher education can help novices be positioned to engage in ambitious science teaching (Windschitl, Thompson, & Braaten, 2008). Helping new elementary teachers be able to engage in the kind of teaching required by the NGSS will allow students to experience sophisticated science at even a young age (Lehrer, Carpenter, Schauble, & Putz, 2000; Metz, 2000). Table 8.4 summarizes the movement toward both science teaching practice and scientific practice in the course over time, as organized around Lampert's (2010) definitions of practice and Arias (2015) extension of those definitions to science teaching.

Table 8.4 Reflections of "practice" in course evolution

		Collection of practices	Rehearsal	Profession
F98	Teaching practice	Mainly planning practices	Some opportunity to rehearse interactional work of teaching, but unsupported	Mainly "studenting", not teaching
		Unspecified interaction practices		
	Scientific practice	"scientific processes"	No opportunity to rehearse scientific practices	No meaningful reflection of scientific profession
		Inquiry		
F05	Teaching practice	Critiquing lesson plans	No opportunity to rehearse interactional work of teaching	Stated goal of developing teacher identity
		Anticipating student ideas		
	Scientific practice	Inquiry	No opportunity to rehearse scientific practices	Investigation as reflection of scientific work
		Explanation		
F12	Teaching practice	Suite of high-leverage science teaching practices	Suite of approximations; scaffolded opportunities to rehearse interactional work of teaching	Elaborated syllabus using professional language
	Scientific practice	Range of scientific practices embedded in EEE framework	Multiple opportunities to practice explanation (and other scientific practices)	EEE framework and scientific practices as depictions of the work of scientists

The shift in the collection of teaching practices has been quite deliberate, as my own teacher education program moved to an orientation around a specific set of high-leverage teaching practices. Similarly, the shift in the focal scientific practices has moved away from mostly unspecified "scientific inquiry" toward (a subset of) the specific practices included in the Next Generation Science Standards and the Framework (NGSS Lead States, 2013; NRC, 2012). The move toward the purposeful use of approximations of teaching practice, along with multiple opportunities to work on the scientific practices, has been purposeful as well, and similarly driven by movements in the field (most notably, by Grossman and her colleagues' (2009) influential piece on approximations of practice and the Framework's articulation of the scientific practices). The evolution of practice-as-profession has been less influenced by changes in the field. In reflecting on how my materials show the profession of teaching, I have come to think that the shift (toward more elaborated and justified articulations) demonstrates my *own* growth as a professional who is increasingly aware of the need to portray teaching as a profession and who values supporting novice teachers in understanding the rationale behind instructional expectations and recommendations. The depiction of the science profession, in part, reflects our improved decomposition of the work of scientists. In sum, then, these shifts are mostly driven by growth in the field, but are at least in part driven by my own personal growth, as well.

I also, however, recognize tensions and tradeoffs in the moves I have made. Any science teacher educator faces challenges in determining what and how to teach. For example, which scientific practices are most crucial? What science content is highest leverage for a future elementary teacher? Which science teaching practices are highest leverage? In practice-based teacher education, how can we ensure that we provide high quality feedback to each novice teacher?

Beyond this, any teacher educator who studies the work happening in her or his own teacher education classroom faces certain challenges. Some of these include when and how to engage in data collection and data analysis, how to ask for permission to conduct research in a way that respects the instructor-student relationship, how to engage in data analysis that inherently cannot be anonymized, how to engage in member-checking, and many others. In my institution I have faced some additional challenges. For example, how to study one's elementary science teacher education when one's teacher education program is engaging in a major redesign? How to balance doctoral students' needs for teaching positions and dissertation contexts, with one's preservice teachers' needs as novice teachers, one's program's expectations, and one's own needs as a scholar? How to support doctoral students in learning to effectively support approximations of practice? While not unique to my context, these issues bear particular focus because of the important role that context must play in one's scholarship when the focus of that scholarship is one's own classroom.

Tradeoffs must be made in addressing some of these challenges. In my own work, for example, as a matter of principle I prioritize my preservice teachers' needs and my program's expectations before my doctoral students' interests—but those doctoral students' interests often in turn come before my own, as we collaboratively design teacher education experiences for our students. I have mostly privileged the scientific practices of scientific explanation and modeling—knowing well that, for example, scientific communication is also a critical scientific practice. I focus on science teaching practices I see as crucial (such as supporting students' explanations), but limit focus on others that I also see as crucial (such as responding to specific student ideas). The list of tradeoffs goes on. My intent here is not to prescribe solutions to these dilemmas for others, but rather, to acknowledge the issue of making such tradeoffs and to offer considerations for others' deliberation: one can conceptualize such choices in terms of one's own personal and professional situation, one's institutional context, *and* developments in the field that can push one's thinking forward.

In elementary science teacher education, I have found that focusing much more purposefully on scientific practices and science teaching practices helps me to support the development of what our program, as noted above, calls well-started beginners. I aim to help our graduates feel, and be, prepared to engage in science teaching that reflects the kinds of ambitious teaching called for in the field today. Elementary teaching is an incredibly challenging job; having deliberately practiced how one, for example, elicits children's scientific ideas, uses representations of science concepts and data, and supports students in constructing scientific explanations may make those challenges a little bit more manageable.

We should always endeavor to grow as educators not just based on our own experiences, but also through development in the larger field of scholarship. Elementary science teacher education will continue to benefit from ongoing studies that teacher educators conduct in their own teacher education classrooms, informed by and informing the larger field. Depicting the ways in which our classes change over time can help us gain perspective on the ways in which we, as scholars and practitioners, experience the changes happening in the field. This, in turn, helps to yield important professional knowledge about both novice teachers and teacher educators.

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