



# Learning to Teach: A Mixed-Methods Study of Interns Learning the Skills of Teaching

## Citation

Mascio, Bryan Dennis. 2018. Learning to Teach: A Mixed-Methods Study of Interns Learning the Skills of Teaching. Doctoral dissertation, Harvard Graduate School of Education.

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Learning To Teach:  
A Mixed-Methods Study Of Interns Learning The Skills of Teaching

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A Thesis Presented to the Faculty  
of the Graduate School of Education of Harvard University  
in Partial Fulfillment of the Requirements  
for the Degree of Doctor of Education

2018

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To my teachers, inside and outside of the classroom...

Those who gave me a hug when I needed it,

Gave me a pat on the back when I earned it,

And gave me a push when I didn't ask for it.

Those who gave me a hand when I taught with them,

Gave me their time when I learned from them,

And gave me their trust when I studied them.

... I hope that my work can continue to give back to you all.

## Acknowledgements

I am incredibly grateful for the support and guidance offered by countless teachers, students, mentors, colleagues, family members, and friends leading up to and sustaining me through my doctoral work. This is an accomplishment that I barely dared to dream of, and its fulfillment has been supported by far more than those I can name here.

I thank my dissertation committee—Sara Lawrence-Lightfoot, Tina Grotzer, Hunter Gehlbach, and Pasi Sahlberg. They have each, in their own unique ways, shared their wisdom and helped me find my own. I have benefitted greatly from my work with them, and look forward to opportunities to continue to do so. Before beginning this dissertation work, other faculty welcomed me to HGSE; I am particularly grateful to Jenny Thomson and Gigi Luk for thoughtfully shepherding my entry into the world of research. And I would have never considered coming into this foreign world if not for the work of Kurt Fischer. His theories have changed how I see human development, and he has changed how I see the world.

While at HGSE, I have also greatly benefitted from colleagues and classmates that have pushed my thinking. This began during the MBE program with cherished friends John, Daisy, Elisabeth, Maria, Susan, and April. And it continued in the doctoral program with Pei Pei and Megan who have helped shape my research and my writing. I have had many lunches, coffees, casual chats, and debates with fellow doctoral students and master's students, all of which have

added to my understanding and appreciation of education, but even summed together they are dwarfed by the amount of time spent in discussion with Vanessa Rodriguez—I can not thank her enough for her time and energy, and because of our friendship I know that I don't need to.

This study would not have been possible if not for the willing participation of many teachers and interns. Thank you Katie, Amanda, Hanna, Katie, Kat, Sara, Kristen, Krista, Kate, Kerstin, Kris, and Kim. Teaching is an incredibly personal endeavor, heavily imbued with moral and ethical implications; their willingness to be vulnerable is every bit as inspiring as the teaching they do every day. I also thank Tom Schram who has been willing to delicately balance roles of participant and mentor, as only an expert teacher and researcher could do.

Lastly—and certainly most importantly—I thank my wife, Carmela. She has provided all of the loving support I could hope for in a life partner, and she has also provided inspiration and insights as an invaluable thought partner. The differences in our areas of expertise have never stopped our engagement and participation in each other's study designs, data analysis, interpretations, and presentations. All that I do, personally or professionally, is better because of her.

## Table of Contents

Introduction Chapter: Following Fischer’s Lead .....	1
Paper 1: Can You Just Tell Me?! A Portrait Of Learning To Be A Teacher .....	18
Paper 2: Teaching In The Mirror – Autobiographical Portraits Of Interns Learning To Teach.....	51
Paper 3: Nothing Exists Alone: A Tool And Technique To Dynamically Capture The Complexity Of Interns Learning To Problem-Solve.....	98
Concluding Chapter: Seeing Interns “Big” .....	160
Appendix.....	180
Bibliography.....	184

## Abstract

Our understanding of learning has improved dramatically throughout the last century; cognitivists built upon behaviorists, and in turn provided the foundation for increasingly advanced insights into the learning process. Dynamic Skill Theory is a neo-Piagetian conception with important implications for how we understand student learning, teaching, and research. It surfaces key elements of learning such as: variability, multiple learning pathways, complex and dynamic systems, and the importance of context.

This dissertation, grounded in Dynamic Skill Theory, takes a mixed methods approach to investigate the process of how teacher interns—in the culminating phase of a comprehensive university-based teacher preparation program—learn the skills of teaching.

The first article, *Can't You Just Tell Me?!*, is a portrait whose narrative takes place on a single day in the fall of Katie's year-long internship, examining the complexities of learning, teaching, and learning to teach – while revealing the parallels between these processes. Katie's identity as a learner, based in her traditional K-12 background, threatens to stymie her progress as a teacher, which requires active engagement in constructing her teacher knowledge.



The second article, *Teaching In The Mirror*, is a group portrait of three interns whose learning to teach is shaped by their autobiographical journeys. Their narratives reflect on the influence of their personal histories on their developing practice.

The third article, *Nothing Exists Alone*, offers a tool and technique that can be used by either researchers or teacher educators to better understand the learning of interns or teachers. Three interns report their thinking while problem-solving in the classroom, multiple times through the year. By using a dynamic analysis technique, I am able to examine the dynamic nature of multiple skills each intern is developing.

In combination, these three articles call for changes in how teachers (and student teachers) are regarded in preparation, policy, and research. Namely, teachers must be considered as (continuous) learners, and learning must be understood in far more complex terms than is commonly encountered.

**Following Fischer's Lead –****Introduction To A Mixed-Methods Study Of Interns Learning The Skills of Teaching**

*Far from being a problem, patterns of developmental variability are the key to understanding the organization of these dynamic systems and the constructive processes by which human agents create new interrelations and thus new structures. The complexity of these systems is not something to be controlled for but to be described and understood.*

(Fischer & Bidell, 2006)

When I was designing my dissertation study, I wanted to investigate the development of teaching skills—in particular how interns, at the final stage of their comprehensive university-based teacher preparation program, learn to teach. This purpose was largely grounded in my practitioner roots. As a teacher, the better I understand how my students are developing in their learning, the better I can support them in their continued learning—and with each successive student I do this with, the better I am positioned to understand and support the next. As an aspiring teacher educator, I believed the same would be true—the better I understand how interns develop in their learning to teach, the better I can support their continued development as a teacher, and the more prepared I will be to educate future prospective teachers.

The purpose of this introductory chapter is threefold. First, I will provide an overview of the study design; as is also the case for the following purpose, a more full account can be found in each individual article. Secondly, I wish to briefly place my dissertation articles within the context of the existing research and literature. Lastly, I want to extend that conversation by specifically focusing on the importance of Kurt Fischer's (1980) Dynamic Skill Theory and proposing important implications for teacher research; this explanation marks the beginning of my process in creating my researcher identity, and is an attempt to link the varied research worlds that I wish to continue traveling in.

### **A Teacher Researching Teaching**

In order to investigate interns learning to teach, I spent two years at an elementary school that is part of the University of New Hampshire's school-university-collaborative. This is where interns spend their final year of a five-year integrated program, co-teaching with a master teacher, and ultimately earning their master's degree and a certification in elementary education. Each year I focused on three interns, spending a great deal of time observing in their classroom, attending their weekly seminar class, having informal conversations and formal interviews, and continuously probing their thinking; for the second cohort, this probing included multiple administrations of an online survey where they reported on a recent classroom problem they solved. I also had discussions and interviews

with their mentoring teachers, their university supervisors, as well as the principal, superintendent, other teachers, and additional interns at the school.

This resulted in the collection of hundreds of hours of qualitative field notes and interviews, as well as a series of survey responses used for coding and quantitative analysis. The qualitative data were used to create two portraits: the first, *Can You Just Tell Me*, offers a narrative of a single intern during a single day to explore how her identity as a learner impacts her development as a teacher; the second, *Teaching In The Mirror*, includes three interns' data from throughout the internship year as well as reflections on their personal histories, and is a portrait of how autobiography impacts the development of interns' teaching. The third article, *Nothing Exists Alone*, uses dynamic analysis to create quantitative profiles of each intern's problem solving for real incidents at three time points during the year, thus investigating how they develop as teachers in the complex and dynamic system of their classroom.

I believe that my dissertation study and resulting articles do fulfill their original intended purpose. They illuminate these interns' development as they learn to teach. I am already using insights gleaned from my study as I currently supervise teaching interns, and I hope that other teacher educators will find similar value when they read the articles. However, after the original planning of my study—while collecting data, creating coding schemas, conducting analyses, synthesizing findings, and writing (and rewriting)—I have come to realize an additional purpose, beyond the particular findings with my participants. I hope

that my study can also present a different way to think about teacher learning and how to do research on the development of that learning. This will be further explored in the following section—first as part of the larger evolving conversation regarding our understanding of learning and teaching, and then in my extending that conversation to include implications for teacher research.

### **Learning, Teaching, And Researching**

Over the last century, our understanding of human learning has changed dramatically (C. D. Lee, 2016). The early behaviorist notion of learning, solely focused on inputs and outputs, explicitly shunned investigation of the thinking process (Pearce & Hall, 1980; Watson, 1913); behaviorism directly connects changes of antecedents with resulting outcomes, but leaves the process of learning concealed (Skinner, 1950). As cognitivists and constructivists came to the forefront of the field they illuminated this “black box” of learning; they investigated the thinking and feeling that drove the learning process, appropriately relocating the crux of learning to students’ minds (Piaget, 2013a; Vygotsky, 1978). More recently, neo-Piagetian theories of learning have built upon cognitivist approaches and incorporated dynamic systems thinking to provide a more sophisticated understanding of the learning process (Fischer & Bidell, 2006; Morra, Gobbo, Marini, & Sheese, 2012). This latest advance has three important implications for education: it reframes how we understand student learning, it calls

for different approaches that teachers must learn and utilize, and it changes how we should conduct research on teachers who are (continuously) learning to teach.

### **The Complex Dynamic System Of Student Learning**

Fischer's (1980) Dynamic Skill Theory (DST) reveals learning to be a complex and dynamic system, reframing the conception of student learning in three important ways:

1. The process and rate of learning any skill is unique to that skill, and there are multiple pathways to develop that skill (Fischer, Rose, & Rose, 2007; L. T. Rose & Fischer, 2009). For example, even though science and math are related, understanding how a student learns math is not the same as understanding how that student learns science. The student's progression in math does not necessarily mirror his progression in science, and the student's pathway to developing his math skills may be different than another student's pathway.
2. The learning of any skill is dynamic and context-dependent (Fischer & Bidell, 2006; Rappolt-Schlichtmann, Tenenbaum, Koepke, & Fischer, 2007). Thus, a student's learning of math both impacts and is impacted by, his learning of science and other subjects, as well as his history with math concepts, his current learning environment, his emotional state, and personal context.

3. Learning any skill is fundamentally about the learner increasing the complexity of his/her understanding, therefore rather than measuring an accumulation of facts, learning is measured by how a student connects and understands those facts (S. P. Rose & Fischer, 1998; Stein, Dawson, & Fischer, 2010). For example, instead of just assessing whether a student can correctly convert quantities from fractions to decimals or percentages, a deeper understanding of his learning can come from assessing his comprehension of the relationship between these three representations of a value.

### **Teaching In The Complex And Dynamic System Of Student Learning**

This enhanced understanding of how students learn has contributed to developments in the conception of teaching; as students were no longer seen as the black box in-between the inputs and outputs, the view of teacher shifted from supplier of information to shepherd of the learning process (Cochran-Smith, 2016). Teachers had to understand their students' learning needs, and make decisions accordingly, thus reframing the conceptualization of teaching as an intellectual skill (Feiman-Nemser, 2001). The knowledge of student learning informed by DST—that skills have multiple unique learning pathways, learning a skill is dynamic and context-dependent, and learning is about building complexity—calls for different approaches for teachers to use in their practice.

**Different skills and pathways.** Knowing that students' various skills and sub-skills may develop in different ways, at different rates, and differently for

different students, changes how a teacher must view the classroom assignments, individualized expectations, and students' personalized needs. For example, teachers must take into account the varied skill-sets that contribute to a student's ability to complete a task: undertaking a project requires a) executive functioning to organize and plan the parts of the project, b) reading skills when taking in the information, c) processing skills to synthesize that information, d) time management skills to stay on track, e) social-emotional skills to navigate work in groups and handling frustration, and f) a myriad of other skills that may be easily overlooked. This requires teachers to take into account a large number of factors when making decisions in their classroom.

Likewise, teachers must not expect that the pathway for one student to learn any given skill is identical to the pathway of another student learning that same skill. For example, research on early literacy shows that in contrast to prevalent theories, there are multiple pathways to children learning single-word reading (Knight & Fischer, 1992). Typically, researchers and practitioners believed that there is a singular pathway to learning and integrating letters and sounds; this belief in a singular pathway meant that students who are not progressing along that pathway were categorized as deficient in their learning to read. Using a dynamic systems approach, Knight and Fischer (1992) found that there are actually three distinct pathways: the conventionally understood pathway that results in skilled reading, a second distinct pathway that also results in skilled reading, and a third pathway that results in reading difficulties.<sup>1</sup> Teachers who recognize the



existence of, and appreciate the importance of, multiple pathways will be able to appropriately guide and/or remediate their individual students' development.

**Learning is dynamic and context-dependent.** Knowing that those different skills interact with each other as well as a student's context—past and present—means that teachers must learn to broaden what information they use in their classroom decision-making. For example, teachers must reject of the false-dichotomy of students' academic versus social-emotional learning; these are not only both very important, but they are also interwoven psychologically and neurologically (Immordino-Yang & Damasio, 2007).

The dynamic nature of learning also necessitates inclusion of information and factors that may not seem central to the classroom tasks at hand—it may be math time, but that does not mean that a student's activities at recess, or what happened last night at home, the pedagogy of last year's teacher, or his current reading level, are not contributing to the difficulties with the assigned math problems. This requires teachers to know their students in new and deeper ways in order to support their learning.

**Learning is building complexity.** Rather than viewing learning as the simple accumulation of knowledge, or even as stacking new knowledge upon old knowledge, DST and other advances in the learning sciences reveals learning as the building of complexity (Fischer & Kennedy, 1997). A helpful analogy may be learning to read. Beginning readers think about individual sounds and separately about individual letters. As they learn, they connect individual letters with the

sound it makes (through one of three pathways) and transform that pairing into a single concept. When those are combined, words are read—initially by sounding out individual letters and then eventually seen as a single entity. Words combine to become full sentences, paragraphs, and eventually full books. Books are then conceived of, not as a collection of words or paragraphs, but as the ideas they represent. Those ideas may then be combined with related ideas from other areas of life. For example, *To Kill A Mockingbird* may be united with the injustices currently seen in society. Each level described is not simply the amount of knowledge, but rather a higher level of complexity.

An accumulation of knowledge is fairly easy to assess, and a non-complexity concept of learning may only require teachers to provide additional knowledge if any is flawed or missing. But understanding learning as the building of complexity requires teachers to probe students' understanding—to look beyond whether they produced an incorrect fact, and investigate where that misunderstanding came from and why the student believed it was correct. This requires cognitive work. Using the above analogy, teachers cannot simply assess the number of correct letter sounds or even the number of vocabulary words a student knows, and then just reteach those that are wrong. Instead, a teacher must ask the student to use and apply his knowledge in new ways that demonstrate the complex connections between the books read and the human experiences they relate to; and if a student misunderstands, the teacher must explore the nuances of

the student's perspective in order to help him disentangle, repair, and rebuild his schema.

### **Researching The Complex And Dynamic System Of Teacher Learning**

The simplest and most straightforward way for teacher research to reflect the advanced understanding of learning provided by DST is to assess whether teachers are utilizing the different approaches that DST suggests are necessary to support student learning. Some of those important approaches are described in the preceding section: a) taking into account the varied skills a student is using for each task; b) recognizing that each student may develop those skills along different pathways; c) understanding how each of those skills may be developed at different levels and at different rates, yet impact one another; d) realizing the importance of students' context; e) considering factors that are outside of the "here" and "now"; f) appreciating the role of social-emotional learning in academic learning; g) acknowledging learning as the building of complexity rather than an accumulation of facts; and h) probing for students' cognition and emotions in order to support them.

In order to investigate whether teachers are indeed supporting their student's complex and dynamic learning, researchers must focus their data collection on teachers' use of these associated approaches. One such example is Eilam and Poyas (2006; 2009) who identify the skills central to classroom problem-solving, including requiring those who are learning to teach to: 1) increase their awareness of the complexity in the classroom, and 2) use a cognitive

lens to look for the thinking that underlies observable behavior. These teaching skills are clearly aligned with those required by DST, and I explicitly utilize them when quantitatively assessing interns' problem solving.

If research on teachers and teaching begins to collect these kinds of data, it will greatly improve our understanding of how teachers support student learning. However, this shift is not nearly enough. While it acknowledges the dynamic complexity of *student learning*, and calls for teachers to upgrade their practices accordingly, just collecting those new forms of data does not necessarily mean that the researchers have equivalently upgraded their understanding of *teacher learning* to incorporate the insights of DST. Still using the three core acumens of DST—there are different skills with multiple pathways, learning is dynamic and context-dependent, and learning is about building complexity—I propose further implications for researching teacher development, and describe how my dissertation work incorporates those proposed processes.

**Different skills and pathways.** Research must be designed in such a way to discover the multiple pathways within teacher learning just as dynamic systems research has shown multiple pathways to student learning (as described above in regards to children's literacy). In order to allow this progress, one major issue that must be addressed is how research handles variability in data. Conventional experimental research is purposefully designed to guard against allowing natural variation in data to create misleading findings, and current calls for reform are meant to prevent questionable research practices from undermining

that purpose (e.g. Baker, 2016; Cumming, 2014; Gehlbach & Robinson, 2017; Ioannidis, 2012; Simmons, Nelson, & Simonsohn, 2011).<sup>2</sup> After all, data are “noisy”, and it is important to prevent that noise from overshadowing the “true” findings.

However, DST introduces a different way to explain and respond to variation in data. While data are undeniably noisy, DST offers a similar sounding but vastly different interpretation of that natural variation—the noise is the data. Instead of seeing individual variants as being potentially misleading and something to filter out, a dynamic analysis approach encourages researchers to focus on the variation and embrace a “science of the individual” (L. T. Rose, Rouhani, & Fischer, 2013); it is only through doing so, that researchers can create the possibility of finding additional learning pathways.

The importance of deliberating on, rather than discarding, discrepant data is central to qualitative research. Maxwell (2012) warns that failing to consider incongruent information can lead to overlooking alternative explanations of the studied phenomena, thus risking the legitimacy of the findings. Portraiture is particularly concerned with finding both patterns and exceptions to those patterns in order to fully represent the subject of the study; the researcher, “gathers, organizes, and scrutinizes the data, searching for convergent threads, illuminating metaphors, and overarching symbols, and often constructing a coherence out of themes that the actors might experience as unrelated or incoherent.” (Lawrence-Lightfoot & Davis, 1997, p.185)

While qualitative research has promoted attention to the outlying data, a similar shift is still necessary in quantitative research that typically aspires to filter out the “noise”. One key way for quantitative research to better incorporate the outlying data is to analyze individual participant’s data before aggregating, rather than aggregate before analyzing (L. T. Rose et al., 2013). By doing this, intra-participant patterns of development can then be compared and inter-participant groups can thus reveal a pathway for development (Hollenstein, 2013). The related underlying premise in DST is that all data are “true” for that individual, at that time, with that task at hand, and in that context. Essentially, to understand the researched phenomena requires investigating that data rather than guarding against its incorporation in the findings. This paradigm is what my third article attempts to model.

**Learning is dynamic and context-dependent.** The skills required to teach are vast; when research isolates and focuses on a singular skill—to the exclusion of other skills that dynamically interact with the development of that skill—it does so at the risk of no longer actually researching the phenomena of teaching. This is where qualitative research, and in particular narrative inquiry, has a clear advantage (Clandinin & Rosiek, 2007). My use of portraiture allows me to investigate each intern as an individual, and, “capture the richness, complexity and dimensionality of human experience in social and cultural context...” (Lawrence-Lightfoot & Davis, 1997, p.3). Without the limitations of a post-positivist paradigm, I am able to explore the teaching that is taking place

rather than restrain the interpretations with a pre-conceived hypothesis (Mishler, 1990).

Additionally, incorporation of a learner's context is incredibly important. Learning never takes place in a vacuum, and no learner is a blank slate—this is just as true for teacher learning as it is for anyone else's. It is well recognized that teachers' backgrounds inform how they teach, through an “apprenticeship of observation” during their years as a student (Darling-Hammond, 2012; Lortie, 1975). But my portraits go beyond this, incorporating interns' personal biographies beyond schooling, and illuminating how those life experiences inform and complicate their learning to teach.

Lastly, while it is important to analyze different skills separately from one another—rather than combine them into a composite that obscures their individual development—it is equally important to analyze the dynamic relationship among those skills. This requires the use of dynamic analysis tools and techniques, such as the State Space Grids (Hollenstein, 2013) used in my third article. Using this approach further allows me to investigate each individual intern's development over time.

**Learning is building complexity.** Research on teacher education should assess changes in pre-service teachers' complexity of thinking, and investigate the processes involved in those changes. Just as a teacher who understands DST must probe the complex relationships within her student's thinking rather than merely catalog facts that are known, researchers must probe the complex system of pre-

service teachers' thinking. This has been particularly lacking with regards to the study of internships, an especially important time for teacher development. Most studies of the intern experience primarily look at factors that are believed to impact the intern's development (e.g. demographics, characteristics of the internship site) and/or at outcomes of that development (e.g. intern self-efficacy, commitment to the profession), but not the development process itself (Cochran-Smith et al., 2015).

In the most recent handbook of research on teaching, Russ and colleagues (2016) introduce a new research approach to teacher learning. They propose that researchers should not focus on teachers' skills as unique or specialized, but rather as a modification of their "everyday skills" developed throughout their lives. These skills may start out as reading non-verbal communication or making inferences from statements (which most people use on a daily basis), but the skills are then transformed into the advanced skills needed to monitor a classroom of students or assess a struggling reader.

Their proposed research paradigm resonates in all three articles of my dissertation. In my first portrait, *Can You Just Tell Me?!*, I view the intern's development through an "everyday skill" lens—she is learning the skills of teaching just as anyone learns a complex skill. My second portrait, *Teaching In The Mirror*, is premised on the idea that teaching is at its core, a human interaction and about human relationship, thus the interns' personal autobiographies are part of who they each are as teachers. In *Nothing Exists Alone*, I ask the interns to



report their classroom problem solving in a similar manner as any incident of everyday problem solving—what options did they consider, what factors did they take into account, and how did they use those factors to choose between their options—and I analyze their descriptions using the same techniques as other research investigating how everyday people solve problems involving complex systems.

### **Conclusion**

Learning is not simple or straightforward. DST (Fischer & Bidell, 2006; Fischer, 1980) reveals that learning occurs through multiple pathways, is dynamic and context-dependent, and relies on the building of complexity of thinking. Because this is true for students in school, teachers must use approaches that truly support the complex and dynamic system of student learning. Because it is equally true for teachers as they learn those approaches, researchers must shift their practices to authentically and rigorously study the complex and dynamic system of teacher learning. Each of the following three dissertation articles embrace this understanding of learning as a complex and dynamic system, and investigates interns as they learn the skills of teaching.

### **Notes**

<sup>1</sup> A full explanation of the three pathways can be found in the original text (Knight & Fischer, 1992). In short, the traditional pathway for learning to read is

represented as starting with 1) word definition, followed by parallel development of 2a) letter recognition and 2b) rhyme recognition, which then converge in development of 3) reading recognition, followed by 4) rhyme production and finally 5) reading production. The alternative pathways have separate branches that did not ultimately unite to jointly lead to reading production. For example, one alternative includes three separate branches from 1) word definition—one branch is 2a) reading recognition directly followed by 3a) reading production, a second branch is 2b) letter identification, while the third branch is 2c) rhyme recognition followed by 3c) rhyme production.

<sup>2</sup> Some examples of these calls for research reform include: preregistering hypotheses and proposed analysis technique so that post-hoc analyses and p-hacking are not represented as predicted findings; use of confidence intervals rather than p-values, both because they are more stable and because they are a more authentic representation of whether findings are to be trusted, and; inclusion of effect sizes to better represent whether a finding is “significant” in the way that the word is meant in the English language rather than in statistics.

**Can You Just Tell Me?!**  
**A Portrait Of Learning To Be A Teacher**

Twenty energetic fifth-graders stream into Kristen's<sup>3</sup> classroom, sweaty and out of breath from their PE class. Without any noticeable direction from her, they grab their chairs and make semi-circle rows around the easel in preparation for the next lesson. This is a familiar routine, whose effortless appearance hides the years that Kristen has spent developing in her classroom. On the chart paper is a list of work that has been, and needs to be, handed in this week. It starts off with a packet on fables, and includes revising the memos on their independent reading books, finishing the stories they've been writing, preparing for their spelling tests, a list of math work, and several other tasks.

Kristen reviews the list, making sure everyone understands each assignment. She has everyone turn and talk to a friend about what assignments they have left to do. An excited buzz fills the room as children share their progress with each other. When they're done she tells them that their friend is also who they should check in with at the end of the day to support them in getting their work done. Kristen explains that throughout the week everyone will do an individual reading assessment – and while she's conducting these, the rest of the class will work on their list of assignments. I remember how difficult it can be to

create a situation where the whole class will be productive and engaged so that I could work intensely with an individual – and I’m struck with how Kristen has fostered a culture where it seems so natural.

Before having the students return to their regular seats, Kristen hands out a stapled packet of reading and worksheets on fables. This is the start of a larger unit that also includes fairytales, and while most of the students are excited about the topic, that sentiment is not unanimous. One little boy begrudgingly looks over the packet of “stupid stories”. What he does not yet know is that Kristen’s guidance will help him develop a deep knowledge and appreciation for this literature. Two months from now he’ll excitedly share with me a sophisticated explanation of the difference between the original Grimm version of Cinderella and the one we commonly tell children.

Kristen tells the students that the word “moral” appears in the packet seven times; when they get back to their seats the first thing they should do is circle all seven. This could easily be dismissed as a trivial instruction, but it has two very different—but equally valuable—outcomes. First, it allows Kristen to scan the room to easily identify the students who jumped right into reading the packet, and thus were not fully listening. Beyond needing a repeat of this instruction, these students will also need to be monitored and coached for the important learning strategy of paying attention to directions. Secondly, once students do circle the word “moral”—either on their own accord, or after a gentle redirection from Kristen—their attention is drawn to an important element of the assignment. The

packet includes multiple short fables, with comprehension questions that include finding the moral to each story. This one simple instruction provided important support for potentially struggling students, and improved performance for everyone.

I have seen Kristen effortlessly use these powerful teaching techniques countless times as I observe her classroom, and know that they have been developed and honed throughout almost two decades of her teaching. No profession expects those initially entering the field to be as skillful as those with many years of experience; however it is crucial that we prepare first-year teachers to both be adequate in their abilities, and to be primed for ongoing development. This is the purpose of teacher preparation programs. What learning is necessary in that preparation?

### **Teaching Intern Skills**

Over the last century, our understanding of student learning has changed dramatically, evolving from behaviorist views of rote learning to more sophisticated constructivist views of how students co-create their knowledge (review in C. D. Lee, 2016). This advancement has also driven forward the conception of teaching (Cochran-Smith, 2016). As students were conceived of less as acquirers of static knowledge, and more as ever-changing learning entities, the role of teacher shifted from provider of information to shepherd of this

process. This reframed the conceptualization of teaching as an intellectual skill (Feiman-Nemser, 2001). But how do teachers acquire their skills of teaching?

While teacher preparation coursework certainly contributes to prospective teachers' learning, and good teachers will continue to grow throughout their career, I am particularly interested in the learning and growth that occur during a teacher candidate's clinical experience—the internship. The internship is a critical time because it challenges interns to bring together their pre-internship coursework with the realities of teaching practice (Cochran-Smith et al., 2015). This is the bridging of the much-talked-about divide between theory and practice. Additionally, an intern's experience has a large impact on her sense of preparation and commitment to her teaching career (Ronfeldt & Reinger, 2012). Recognizing the importance of the internship experience, this portrait takes place in a classroom that is partnered with University of New Hampshire's (UNH) teacher preparation program. UNH has a long history of advancing teacher preparation, and in recent years has been nationally recognized for its innovation and excellence (Andrew & Jelmberg, 2010; Morrissey, 2015); while no program is perfect, examining the learning that their interns experience is a glimpse of what learning to teach can be.

In the newest edition of the *Handbook of Research on Teaching*, Russ and colleagues (2016) propose a novel approach to research teacher learning; researchers should not focus on teachers' skills as unique or specialized, but rather as a modification of their “everyday skills” that they have developed throughout

their lives. These skills may start out as reading non-verbal communication or making inferences from statements (which most people use on a daily basis), but the skills are then transformed into the advanced skills needed to monitor a classroom of students or assess a struggling reader.

I embrace this concept of learning to teach; it accepts teaching as a natural human skill, yet also recognizes the significant enhancement required for high-level professionals (Rodriguez & Fitzpatrick, 2014). I want to understand how this process occurs as people become teachers, taking into account their thinking as well as their socio-cultural context. This is why I selected the qualitative research method of portraiture (Lawrence-Lightfoot & Davis, 1997), believing it is uniquely positioned for this kind of complex understanding. Portraiture combines ethnographic methods of naturalistic observation, interviews, and document analysis, with the self-identified perspective of the researcher. Considering the complex and dynamic nature of teacher learning, its process can best be captured from such a nuanced “inside view”.

I do not approach this study as a dispassionate researcher objectively analyzing the actions of foreign “others”. I am a teacher before being a researcher—both meaning that I worked as a teacher for more than a decade before becoming a researcher, and meaning that teaching remains central to my identity. I completed multiple teacher preparation programs—an undergraduate in adult education and a Master’s in special education—as well as a graduate program for leadership and administration. Most of my twelve years as a teacher

were spent in alternative school settings working with at-risk adolescents, but I also worked as a behavior specialist both directly with students with behavioral issues as well as with their teachers. As an experienced teacher conducting this research, I was able to capture details of teacher actions and student responses that may have otherwise gone unnoticed. Just as importantly, I was able to delve into the teacher's thinking that drove those actions.

Portraiture calls for data analysis both during and after data collection. At the end of each day in the research school I wrote reflections, impressions and questions. Rather than solely relying on my own interpretations, I was able to check any assumptions and concerns by following up with the participants. Those deep conversations and probing inquiries allowed me to test hypotheses and triangulate the data being collected. While the portrait presents events from a single day, the analysis and interpretation is based on three months of field observations and numerous formal and informal interviews.

Ultimately, the validity of a portrait is a measurement of its authenticity and whether it resonates as true for its three audiences: the portraitist, the subjects of the portrait, and the reader. The first comes as a lengthy and arduous process of data collection and analysis, but hearing from the portrait subjects can feel more like receiving a verdict. Teaching practice is intensely personal and laden with ethical implications, thus the two main subjects of this portrait allowed themselves to be open and vulnerable. When the final portrait was shared with Kristen and Katie they each strongly endorsed it, describing what Lawrence-Lightfoot (1997,



p.247) terms as evoking a “click of recognition” as well as a “yes, of course” response. As for the readers, each will determine individually whether the portrait rings true.

### **To Learn**

*When you teach a child something you take away forever his chance of discovering it for himself.*

~ Jean Piaget

Katie is moving between her two spelling groups, on opposite sides of the room. The one furthest from where I am sitting, comprised of three boys, is the highest group of spellers. Each of the four groups gets different lists of words, based on their abilities, and work for a week or more to understand the patterns and prepare for their spelling quiz. These three boys commonly work quite independently. Last week, having already quickly taken their quiz, they were allowed to administer the spelling quiz to two of the other groups.

As Katie crosses the room to her other spelling group, she is not surprised to hear them loudly discuss their list of new words. This group is focusing on words that start with either a hard or soft C or G, and each of the five girls has a pile of the same 23 words that they have cut out and are now organizing. They all have the word ‘CEASE’ laid out in front of them, and are discussing what it means—but they are pronouncing it as ‘SEIZE’, and are using examples of

“seizing the princess”, and “seize the throne”, with flails of their hands, brandishing imaginary swords as 10-year olds so enthusiastically do.

Katie picks up a dictionary on her way to their table. The five girls sit on blue hard-plastic chairs that are arranged around a five-foot wooden table, although one particularly fidgety girl shifts between kneeling on, and standing over hers. The whole classroom is set up with tables and chairs arranged in odd angles, rather than rows. There is an open area in one of the corners of the room, where there stands an easel and a giant flip-chart that is used for group lessons. There are also two individual desks—one set at the back of the room facing a back wall and the other right against and facing the front whiteboard—used for two students that have difficulty focusing. During this group work time, however, these students have each joined their respective spelling groups. Dictionary in hand, Katie approaches one of these students hovering over her blue seat.

Katie opens the dictionary to the ‘S’ section, starting to look up the word ‘SEIZE’, but turns it over to the fidgety girl when she announces herself as the “dictionary master”. When the girl points to the page exclaiming that she can’t find it, Katie asks “is it S-I-E, or S-E-I?” Understanding the implied redirection, the girl quickly flips to the right page and shares the definition with the rest of her group. After some discussion, everyone around the table agrees that this is clearly the word that they know from movies, meaning that they were incorrect when projecting its use onto CEASE earlier.

Before the student gets a chance to start looking up the actual spelling word, Katie points out to her ‘SĒZ’ on the page. The girl looks up at Katie, saying, “It’s a different language...” But when Katie does not give an approving reaction, she continues, “... or how to pronounce it.” When asked, “Which one is it?” the girl answers with authority, “It’s how to pronounce it.”

After letting the group look-up the definition and pronunciation for ‘CEASE’, Katie concludes that they have begun to understand the difference, and she brings them back to the main task at hand. The group is supposed to be identifying a rule for how to know which words have hard and soft C and G beginnings. One of the students excitedly remembers the “V-C-V rule”, that if two vowels are only separated by a single consonant, the first vowel says its name. This is an explanation of why the ‘A’ in ‘CAPPED’ sounds so different than when it’s in ‘CAPE’, but it doesn’t actually help with knowing the difference between hard and soft sounds at the beginning of words. Katie smiles at the girls and asks them to discuss it in their table group, so that she can circle back to the boys on the other side of the room.

Before she fully walks away, Katie pauses to listen in on their continued conversation. She stands comfortably in what would otherwise look like a stiff posture. Her right arm is laid across her abdomen, its hand firmly hooked into her bent left elbow. Her left hand alternates between resting at her throat and rising up so that her fingers cover her mouth. This is a common pose for Katie, covering

her slight frame, and it seems to allow her to melt into the background. She smiles again, before heading off to the boys.

In their teacher's absence, the girls quickly shift away from the spelling words to what their plans are for the upcoming trick-or-treating. Among the laughter and descriptions of Halloween costumes, they do return to the question of how to tell whether the words start with a hard or soft sound, and the repeated response is that they'll "just know". Katie's return is met with the answer, "you sound it out both ways and see which sounds right."

I can see that, with the list of words they've been given, their proposed rule is unfortunately proving to be correct. All of the girls know how to pronounce "CIRCLE, CENT, and CELL" and wouldn't confuse the sounds with "CUB, CARD, or CALF". It would be hard for them to see the shortcomings of their strategy without being confronted with words that they don't know and wouldn't intuitively sense the pronunciation of. I wonder to myself what they would think if shown, "coulomb or cytosine".

Katie's expression must be enough for the students to realize that they have not found an acceptable answer. One girl again presents the "V-C-V" rule as being key to their dilemma, and Katie smiles as she reaches for the cutout words on the table. "Oh good, use these words to explain it." Katie's voice is characteristically soft and low – not hushed, but gentle in its tone. It is easy to imagine her while she teaches piano lessons in the afternoon, when her words of guidance would naturally mix into the drifting melody.

The girl, pleased with herself answers, “Okay, ‘CITY’ is a V-C-V, and ‘CODE’ is... a... oh... wait.” This quick use of cognitive dissonance is hugely successful. Instead of telling the students that their rule wouldn’t work—something that they would have invariably pushed back against—Katie creates a situation where they try it and experience it not working for themselves. This is an important part of students constructing their new knowledge. The expression on the girl’s face is unmistakable; after she finishes with “CITY” she *knows* that a V-C-V word must have a soft beginning sound, and then after naturally starting “CODE” with a hard sound, what she *knew* falls apart. The V-C-V rule will not be cited again in this way.

“It sounds like you guys are saying it’s all trial and error. Keep thinking about it and we’ll figure it out tomorrow.” It’s 9:30 and time for Phys Ed, so with that, Katie wraps up the spelling time allowing the girls to walk away without anything actually being wrapped up. I later ask Katie what rule she is hoping for the girls to come to. Admittedly, I had been wracking my brain for what rule could possibly exist—with English being based on so many different languages, I assumed that the pronunciation would be based on each word’s origin. As I started to worry that I was experiencing a terrible “Are You Smarter Than A 5<sup>th</sup> Grader” moment, Katie allays my fears. “They are almost there,” she answers, “there is no rule that will work, so they’ll just have to memorize them.”<sup>4</sup> I ponder whether they’ll be satisfied with this particular conclusion after so much work.

Over the past couple of weeks, I had seen Katie refer students to the dictionary, ask what they thought the answer was, and ask them a wide variety of questions rather than provide them with the answers. These kinds of teaching techniques run counter to many of our intuitive reactions when asked questions by students or children in our lives. These twenty fifth-graders pepper her with countless questions during the day, and it's natural to give an answer when a question is asked. Katie's ability to resist this inclination is noteworthy considering that she is only in her second month of a full-school-year teaching internship, and it is all the more impressive considering how different it is from how she herself had been taught.

While Katie grew up in the town where she is now doing her internship, she never attended the public school there. She tells me that if she had, she wouldn't have been allowed to use it as her internship site. However, when she first arrived one of the first grade teachers mistook her for her older sister who had attended there for a couple of years, giving her a big hug before Katie had a chance to correct her mistake. This mistaken identity has actually increased Katie's feeling of comfort in the school, she says, "I'm so welcome there and they always wave to me and say hello to me and that's something that the younger grades wouldn't necessarily have done if they didn't know my older siblings." The tone of Katie's voice conveys how strongly she needs this sense of safety and comfort, and the intensity of the doubt and fear that it keeps at bay.

Following her older sister's exodus from public school, all of Katie's schooling took place at a Catholic school 30 minutes from her hometown. She says this background has left her unprepared for the behaviors of her current students and the classroom management required when they don't necessarily sit quietly and follow directions. She also speaks of the huge differences in the curriculum and pedagogy that she experienced as a student in comparison to what she is expected to do now as a teacher. Her description is blurted out in a single breath:

We had so much homework every night, even in second grade. And we memorized, and we learned it, and we had a test, and we moved on. So we covered the entire book for every subject and we didn't have to know the meaning behind it as long as we knew the material. We knew the answers. We were good to go. The teacher stood in the front of the classroom and just lectured and we were all okay with it. It's all we knew.

She contrasts this with what she is now learning to do, "Here, it's all talking about integrating all these things and movements and activities. And they have to know the meaning – don't just tell them!"

While Katie has some hesitation about the slower pace that this new kind of pedagogy requires, and questions whether this puts more advanced kids at a disadvantage, she has clearly embraced the techniques. When working one-on-

one with a struggling student during reading time, she uses questions to help the boy analyze the differences between fables. “Is the lion and mouse different from the other one we read?” And when he says they’re the same, she responds, “...even the mouse?” When this doesn’t lead to concrete examples, she knows to shift away from questions, directing him with, “Let’s pick two differences.” But as soon as she has an opportunity to go back, she happily asks, “Is that important to include? Did the other story make you feel that way?”

The students in the classroom are clearly accustomed to interacting this way, and many embrace the process. During writing time last week, the students were busily working on their memoirs. Most were using Alphas, a simplistic word processor that avoids the distractions of formatting or access to online temptations. A few students had completed that phase, uploaded their work to an actual desktop, and were working to edit their writing and bring it closer to final form.

Katie had been circulating through the room and made her way over to the computers, grabbed a book off of a nearby shelf and crouched down next to one of the students working there. She opened the book to a random page and asked for the student to take a look at the paragraphs. “How can we tell where a paragraph starts? What does the author do?” When the student studied the page with no response, Katie pointed to the start of each paragraph on the page, asking, “Are there extra lines before each paragraph?” Realizing that the author had not used the same strategy he had been using in his work, the student answered, “No, they indented.” And he went back to his computer to correct his formatting.



It is not uncommon to see students working with Katie conclude with an appreciative, “Oh yeah, I remember!” or a silent but wide-eyed smile as they find their own way to an answer. There are occasions, however, when someone loses patience or faith that they’ll get there. Since today is the last day for students to finish their memoirs, a few stragglers are feeling especially anxious about the ticking clock. I see Katie working at the back of the room with one little girl who cries, “Can you *just* tell me? This is so frustrating!”

### **To Teach**

*Tell me and I forget. Teach me and I remember. Involve me and I learn.*

~ Benjamin Franklin

As soon as Katie returns from leading the students to their PE class, Kristen asks, “Do you have any questions for coding the reading stuff today?” and Katie responds, “I’m shadowing you first, so no.” Kristen is Katie’s cooperating teacher, meaning that this classroom is actually her classroom and she is mentoring and supervising Katie this year during her internship. Kristen has been a teacher in this school for 15 years. Prior to that she had taught at a residential center for troubled kids, and had spent one year as a half-time para-professional and half-time case manager—a situation that essentially had her reporting to herself.

This is Kristen's third year with an intern in her classroom. The first had been from a different college, but last year the elementary school entered into a four-year relationship with UNH—a selective process that marks it as being particularly committed to the mentoring and development of their interns. Kristen's intern from last year is now teaching one of the other fifth grade classes right across the hall. When Kristen heard that I was interested in studying how teachers-in-training develop in thinking about teaching, or their '*teacher cognition*', she quickly agreed to have me join her classroom.

Despite Katie not having any questions about the upcoming reading assessments, Kristen goes over how the reading time will go. She points out what she finds difficult when managing the assessment, as well as what kids commonly struggle with. She also explains what these assessments mean and why she does this particular one (non-fiction) at this time of the year. Kristen retrieves a flipbook of giant index cards, an elaborate structure she has created over the weekend combining data from multiple sources for each student. She concludes by talking about the folly of teachers in lower grades having kids use books from the reading kit that are far above grade level. Kristen knows that Katie will have her hands full learning the nuts and bolts of how to conduct the assessment, but she can't pass up the opportunity to place it in context and give Katie a glimpse of the bigger picture.

Later, when Kristen is preparing the students for independent work so that she and Katie can conduct the assessments, Katie positions herself at the back of

the group of students. Katie listens intently to Kristen's instructions, and jots down phrases and terms that she will use later when working with students. Once everyone is working diligently on their fable packet and prepared to work independently for the rest of the period, Katie picks the first student to assess and Kristen asks the girl to join them at a table in the back corner of the room.

The two teachers are already sitting opposite one another, and when the girl calmly slips into the chair offered her at the end, they both easily turn to face her. The three are positioned as a cozy triangle, able to have their private conversations set apart from the quietly busy class. Kristen and Katie each have worksheets and pencils in front of them, and they slide a thin booklet on earthquakes to the student.

Kristen explains the assessment to the student, and asks her to start reading. Both Kristen and Katie are marking their papers as the girl quietly reads aloud. They log mistakes made, draw a curved arrow when a phrase is reread, and note where she has self-corrected. When the girl is done reading out loud, Kristen offers her time to reread "...as you normally would. When you are done reading, just close the book and we'll know you are done." When the silent reading starts, Kristen leans across the table to point out spaces on Katie's sheet to start doing calculations based on her markings. Kristen begins doing the same on her sheet.

Once the girl is done reading silently, Kristen asks what she learned, and jots down answers. Katie furiously writes on her sheet. After the initial answer listing off a few facts, Kristen begins asking follow-up questions. Her tone is

casual, and the girl seems at ease in their exchange. As the first inquiry leaves Kristen's lips, however, Katie looks wide-eyed down at her sheet and makes a funny face. When I ask her later how she feels about needing to do the assessment herself she answers, "It's actually really hard, harder than I thought because she made it seem like a conversation... I think I'd be a robot asking question by question, and she made it seem interesting, and I don't think I could do that yet."

When the girl answers Kristen's question about a specific diagram, she slides her hands back and forth, mimicking the motions of the tectonic plates. Kristen smiles, "I saw you using your hands when you were reading it. Was that diagram helpful?" and the conversation continues. "Tell me more about the seismograph... you've talked about it several times, can you tell me more?" "Let's talk about the book itself right now. Can you tell me about the sections?" "Is there anything the author did to help you know that you are going from section to section?" "What kind of descriptive words did the author use to help you understand?" "Is there anything else you learned that you want to tell us about?" When the girl references that earthquakes can sometimes be helpful, Kristen leans forward and, as though wishing to be let in on a secret, asks "Oooo, how?"

This pattern continues as Kristen and Katie bring additional children to the back table. The next little girl is offered a book on "Amazing Animal Adaptations", and asked whether she knows about the topic. Just as the first girl had answered about earthquakes, she doesn't know much about them. Kristen reassures her that not knowing about it may actually be better for this. I absently

nod, thinking that it would be hard to gauge comprehension if a child already knew the information—it's good that they have three books with different topics.

When a boy is brought back to the table and given the book on earthquakes, he enthusiastically replies that he knows lots about them. Kristen responds, “That’s great. Let’s see what else we can learn.” She later explains to me that they have specifically picked the book each student will use for the assessment. The flipbook she had shown Katie earlier includes data from an assessment that Katie had done with each student a few weeks ago, their STAR test scores, and their scores when assessed with this kit last year on both fiction and non-fiction (kids typically do better on fiction). She had spent her weekend triangulating this data for each student, to determine which book was most appropriate to use for each individual assessment.

When asked what he learned from the book, the boy only gives a single fact, and Kristen prods for more, “even if you already knew it.” He points to the picture on the cover of the book, elaborating on the destructive power of earthquakes. “Do you think it was a good picture to put on the cover?” “What makes it such a good picture to put on?” “Do all earthquakes cause destruction?” He responds to Kristen’s questions with a bounty of information, but she persists. “What is this diagram on page 3 meant to tell you?” “Is that important to know?” While she is probing for similar understanding as she had with the first girl who read about earthquakes, it is clear that she is not reading from a script.

When Kristen and I sit down to discuss the reading assessment, we specifically talk about the methods of asking comprehension questions. When are questions too leading? Fontas & Pinnell, who publish the kit of books and assessment materials, also run training sessions on how to use them. Kristen recalls having heated conversations with experienced teachers while watching the training videos. “How did they give a 2 [rather than a 1] when they asked so many questions?” I ask whether the point is to assess whether the student *understands* the main point, or whether it is to assess her ability to *communicate* her understanding of the main point. Kristen smiles and leans back in her chair.

I am immediately transported back to my old classroom, where my student Isabella had such difficulty answering questions in ways that the answer sheet anticipated. Once, when the entire class was stumped on how to answer my question about a molecular reaction, Isabella called out, “You know, it’s like this...” as she gestured, bringing ‘spirit fingers’ closer together and further apart. This is the motion she had used, weeks before, when I worked with her on a related concept. While her classmates initially scoffed, I beamed, impressed with her understanding—and then asked questions that guided her to the words to explain it.

After Kristen and I talk about the disparity between a student’s understanding and her ability to communicate it, I ask, “That’s a very complex issue – how much of that do you discuss with an intern now, versus let it build throughout the year?” She smiles again, “There’s a difference between the

conversation with an experienced teacher and someone who's like a deer in headlights trying to get ready. I need Katie to become more purposeful in what she's doing in calendar math. She has 20 minutes of direct instruction." Kristen then looks down at the reading assessments, almost speaking to the materials themselves, "I also need to get these assessments done for report cards this week. I'd love to talk more about them, but when? I'm off to other things and she's getting ready. We can have conversations about the assessments after." She picks her head up and looks over towards Katie working to prepare the calendar math area, "I have to be purposeful in helping her be purposeful."

### **To Learn To Teach**

*It is better to know how to learn than to know.*  
~ Dr. Seuss

As it approaches 11:30, Katie and Kristen conclude their reading assessments and have the students clean up their workspaces, preparing to go to lunch. Once the students file out the door, Kristen turns to Katie asking, "Are you ready for math today?" Katie shows her some of the papers from last week that concern her, and Kristen responds, "Okay, so what do you think you have to do next?"

Katie offers, "Quick calendar, and then the worksheet... or do I wait until the next day for the worksheet?"

"What do you think?" Kristen asks, shrugging her shoulders.

“I don’t have anything to compare it to. I think they’ll be ready.”

After Kristen asks when the monthly assessment is going to be given (on Wednesday, Katie tells her), she says, “Focus on your timing...” I am immediately alerted to this phrasing—I recognize that Kristen is about to model ‘backwards planning’, but I also doubt whether this is how Katie will hear it. When Katie uses the word, “timing”, it is always to lament how she doesn’t have the experience to know how long an activity is going to take—I worry that she’ll miss Kristen’s lesson.

Kristen continues, “...Take five minutes right now to figure out ‘what do I do today to be ready for tomorrow’, and ‘what do I do tomorrow to be ready for Wednesday’. Also, start thinking of what you can let go of and still be ready for Wednesday – look at the assessment for Wednesday and plan from there.”

Katie tells Kristen that she has been looking at the assessment since the beginning of the month, unlike last month where she never looked at it until the kids took it. Kristen enthusiastically responds, “That’s a number one rule – know what you are preparing them for.” I can’t help but smile as I remember the beautifully scripted writing that lined the hallways of where I used to teach. I was always so pleased that the phrase, ‘Begin with the end in mind’ could be seen directly outside of my classroom.

After a few minutes of writing up her plans, Katie begins to prepare the flip-board area for calendar math. It isn’t long before the students are lined up outside the door, returning from lunch. Katie situates herself near the easel, and



the students are quickly gathered around her. The energy from lunch still clings to the students as their bodies shift in their chairs, but their attention is initially focused on Katie. The first boy to be called on answers a series of related questions, before Katie switches to another student for the next one. As students attempt to describe the pattern presented, Katie's inquiries help them see the flaws and each successive answer improves upon the last. "Can you answer my question using the word 'multiple' in the answer?" "Why did you multiply 2 times 4?" "Oh, you make me so happy!" But the back third of the students are barely paying attention anymore. There is a group of students to Katie's right that is most engaged, and she has moved her direction of attention to them.

Kristen always starts her interns off with calendar math. Throughout the year they will gradually take responsibility for more and more of the school day, but calendar math is where it always begins. It is a limited amount of time, but an actual line on the report card that they'll be responsible for. Geometry is typically left to the end of the fifth grade curriculum, and thus gets short shrift if it isn't entirely pushed off when other units inevitably take longer than expected. In calendar math, they will focus on different shapes each month (October is triangles), and thus disperse geometry lessons throughout the whole year. Additionally, the calendar math curriculum focuses on pattern recognition, which is another important facet of the math standards. Kristen says that taking responsibility for this direct instruction is a good place for a developing intern to start.

Last week while we were out at recess duty, I asked Katie what she thought of calendar math—we had just come from a lesson that went quite similarly as today. “I hate doing calendar math. It’s the same thing everyday, and it’s boring.” She discussed her struggles with having kids come to the front to answer questions—it’s great engagement for them, but eats up a lot of time. Plus, when someone makes lots of mistakes, she loses even more time. “I’m pretty good at leading small groups, and moving around the room to help.” But she still wasn’t feeling comfortable leading whole-group lessons, and complained, “I know that [Kristen] has the answers, but she won’t give them to me. She thinks that I’ll figure them out, but at some point she’ll realize that I won’t. I can’t see the answers. Like today, even if I did it again, I can’t make it better – I don’t know how.”

Katie finishes her calendar math lesson with the students counting out the denominations of money that gets subtracted from their pot each day. They count in unison, before heading back to their tables. There is a seamless transition as Kristen puts several math problems on the board and students work independently on their mini-whiteboards at their seats. Kristen stops everyone when she sees that there’s a common mistake. She asks them to turn and talk with another mathematician about this problem—“what was done right and what was done wrong?”

As Kristen walks the class through the problem and teaches them how to know the number of digits that will be in a quotient, Katie looks on attentively

from the back of the room. She is actually hoping that Kristen will return to an example she used last week, explaining long division as a way to fairly split up a large amount of brownies she had baked. Katie remembers, “So that was my first time like, ‘Oh my gosh! It's about being fair. Long division is all about fairness,’ and I never thought of it that way.”

Seeing how well the students respond, Katie is always hoping to seize these nuggets, but the approach does not come naturally:

I don't know if it's 'cause I'm still stuck in the Catholic school ways of, ‘Why are you drawing a picture? This is math. There are no pictures in math. Get rid of those dots.’ But, I hope she does it one more time for my sake just 'cause that's what would make me a good teacher, and I don't have that.

Kristen has also previously referenced Katie’s Catholic school background; a big challenge for Katie will be to move away from rote memorization and traditional methods—she will need to “make math come alive”.

At 1:30, with Kristen’s math lesson over, the students head out to the playground for recess. Katie and Kristen don’t have recess duty this week. Katie comes to where I am sitting and shows me a sheet of lined paper filled with data that Kristen has given her from the calendar math lesson, as well as a small slip with her “2 stars and a wish”. Kristen uses these slips to encourage Katie to be reflective about her practice, setting it up with the topic of the lesson across the

top, and two stars and a wishbone drawn along the left side. Katie is to write things she liked about her lesson in the space next to each of the two stars, and something she wishes she could do differently next to the wishbone. In order to help guide Katie's thinking, Kristen also proposes a question at the bottom.

Kristen joins us and asks Katie what her stars are. Katie talks about how she usually goes off topic but didn't this time. Her wish is to restructure it so that it isn't boring. Kristen asks Katie about the data, "Did you see all of this?" When Katie responds, "Not the boy standing on his chair." Kristen explains that he was crouched down while standing on it. She redirects Katie's attention, "What about Blake? Did you see him..." as she energetically scoots her chair backwards. "He kept getting further and further away."

Katie's eyes drop back down to the bottom of the small slip of paper, focusing on the question Kristen posed there: *'How do you know if they have pattern?'* This question frustrates Katie. She has been trying to teach students to recognize the patterns she is creating on the calendar—what triangle will be the triangle today, which days will have a blue dot, or why is there a yellow star today? She also wonders if they are getting it, but Kristen had previously told her that she shouldn't do an assessment at the end of every calendar math lesson. She feels like this question on her slip is a contradiction.

Kristen asks, "You heard Tony say the word 'multiple', but how do you know others got it? How do you know Blake got it?" Katie abruptly answers,

“He doesn’t”, to which Kristen replies, “But how will *you know* so that you can support *him knowing*?”

Exasperated, Katie states, “I don’t know. I have tried calling on him when he’s not paying attention, so that he’ll see that it’s important for him to pay attention. But it doesn’t seem to work.”

Kristen has them shift back over to Katie’s wish, “What can you do to make it less boring? How can you build excitement... it doesn’t always have to be about drama?” I silently chuckle, recognizing that this seemingly new question is actually an expert nudge, guiding Katie towards a uniting solution.

“What about a turn and talk?” Katie hesitantly asks about Kristen’s common technique of having students briefly talk through a problem with a partner.

“Have you tried it?”

“No. Will it work?”

Kristen answers, “I don’t know. Have you seen any changes in engagement when kids do it? Have you seen how they get excited?”

“But,” the skepticism clear in Katie’s voice, “...will that be enough to also know whether they get it?”

“I don’t know. You can listen and see if you hear lots of ‘multiples, multiples, multiples’ around the room.” With each utterance of “multiples”, Kristen darts her hands to different positions, flicking her fingers making it seem

like little explosions of the word. “You can try it. Kids listen to each other, and it’s better if they figure it out.”

To illustrate her point, Kristen explains how she grouped certain kids together today during an earlier lesson. Of the four kids she was working intensively with, she paired a high achieving boy with a moderately skilled partner, and then two struggling girls together. Before Kristen can explain the work the kids had done together, Katie asks, “I thought you should pair a high with a low.”

Kristen smiles as she answers, “Can you imagine Tommy bringing Candace through her understanding? Can he really help her understand? Or would he just show that he knows?”

In eager agreement Katie replies, “I know in the book it says to pair a high with a low, but I think your way is right.”

Kristen responds, “It’s not that it’s right, but if the high student doesn’t have the skills to help the low student. If the high kid just gives the lower kid the answer, that’s no different than me giving it to them.” When she sees the emptiness in Katie’s lackluster nod, Kristen continues, “It’s just like how I let you figure it out instead of just telling you. Otherwise you wouldn’t learn to question...”

I hear a familiar loss of patience and faith in Katie’s frustrated tone when her head snaps up, and she interrupts, “... but then I would be doing it right!”

## Reflections

This portrait of Katie is part of a series of ongoing studies capturing the process of interns learning to teach. Only by better understanding interns as learners—going through the process of developing a complex skill—can we better prepare them before entering their internship, and support them during the internship. Additionally, an improved comprehension of how interns develop may inform progress in teacher credentialing, new teacher induction, professional development and teacher evaluation. Pasi Sahlberg—global expert in education reform, and former teacher educator—recently called for incorporation of a different kind of data in order to supplement our growing reliance on big data in school, saying that, “Small data in education is about phenomena and events that are occurring at the transactional level of an individual student, teacher, classroom, or school in real time.” (Sahlberg, 2018, p.38). He argues that capturing the humanity within the data is crucial to a fuller understanding, and I propose portraiture as a powerful tool in doing so. Through this specific portrait we glimpse the beginning stage of Katie’s internship and gain insight into the complexity she is navigating.

When I look back over my years of teaching, I know that the most important thing I did to support my students’ learning was to understand their thinking. Assessing whether their answers on assignments were right or wrong was just the beginning. The real work was investigating *why* they answered that way. When they got the answer wrong, understanding their thinking allowed me

to target interventions. When they were correct, illuminating their thought process informed how I could best support their continued growth.

This kind of inquiry was central to my work with students, and I know the same is true for many expert teachers. However, it seems far less common that it is extended to our work with teachers. The tests I took for my certification were simply assessing whether I knew the right answers. Of the countless professional developments I attended, I cannot think of any that targeted my thinking or decision-making process—they just provided me with a new tool or a *thing* I should do. And my yearly evaluations typically catalogued the things I did or did not do in my classroom, never framing me as a learner or attempting to uncover my process. In truth, I also rarely examined teachers' thinking. When I was asked to work with struggling teachers, our conversations invariably focused on what they did in their classrooms, rather than their *why*. It's as though we lacked the language to discuss their thinking and illuminate their process.

Recently, research organizations have recognized this lack of understanding of how teachers learn and develop—as well as the importance of filling that gap. The Institute of Education Sciences (IES) has called for more research to identify the “the key constructs of teaching and the processes by which these constructs are interconnected” as well as, “cognitive processes of professional learning and the developmental sequence of the major skills necessary for teaching.” (Institute of Education Sciences, 2017). Similarly, a study panel convened by the James S. McDonnell Foundation found that research on teacher learning had been largely



neglected, and concluded that “...education reform efforts to change classroom practices based on evidence cannot succeed without a scientific understanding of teaching and teachers as learners.” (James S. McDonnell Foundation, 2017)

Teaching is, after all, a complex intellectual skill. Those who are learning that skill, or learning to improve that skill, are at their core learners—even while they are simultaneously the teachers of others. By viewing Katie through this dual lens, I can both see the teaching skills she already exhibits with her fifth graders, and the learning process that she is going through. Whether it is from her history of babysitting or from her pre-internship education courses, Katie clearly came into this internship with knowledge of how to work closely with children. She is comfortable forming relationships with students, and knows how to engage in their learning process. She is less comfortable with her own learning process, however, and does not feel as though she is growing. This is especially true in regards to working with larger groups of students, where she has no background experience.

The dual lens may be most illuminating when looking at Katie’s pedagogical approach to teaching versus learning. I am struck by how, even as she resists the unfamiliar constructivist processes as a learner—wanting to be told what to do and given the solutions—she continues to embrace it as a teacher. Despite having experienced mostly rote learning in her own K-12 schooling, Katie has already adopted some of the same approaches I learned through UNH’s teacher preparation. She knows that it is ok for her students to initially not know the right answer, and that it is important for them to build their understanding by

working through the frustrating process of learning. Many interns using these kinds of techniques have seen them in practice for years—their teachers used progressive pedagogies when they were K-12 students. This “apprenticeship of observation” can sometimes even be a problem in learning to teach; having long witnessed teaching from the vantage point of a student and not realizing all of the aspects that are hidden from their view, interns may have a naïve sense of confidence in their understanding of the skills of teachers (Darling-Hammond & Bransford, 2007; Lortie, 1975). Katie, on the other hand, has the opposite problem. She is employing these techniques without the benefit of years of either watching them at work or experiencing them firsthand.

By viewing Katie as a learner, we can see that she is doubly challenged; these techniques cannot be learned by rote—the method she is accustomed to as a learner—and the process to develop them is slow and frustrating. It is disheartening to get it wrong at first, especially when children are counting on you, and it is even more difficult to accept that doing so is part of the learning process. While Katie is becoming a teacher she will also have to develop who she is as a learner, so that she can maintain her confidence as she learns. What will that process entail, what scaffolds will she need, and how can we best structure teacher preparation in order to support Katie and all those learning to teach?

## Notes

<sup>3</sup> Teachers and interns have given consent for their real names to be used, and in this article, those names are used. In Articles 2 and 3, pseudonyms are used for the interns and cooperating teachers, not because of the need for anonymity but because so many of the later participants had names that started with the letter “K” that it would have been too difficult for readers to follow. In Article 2, the real name of the UNH supervisor is used. All K-12 student names are pseudonyms.

<sup>4</sup> In sharing the finished portrait with Katie and Kristen, both responded that there is actually a rule. Kristen informed me “if a C or G is followed by an A, U, or O, it is generally a hard sound. If a C or G is followed by an I, E, or Y, it is generally a soft sound.” Katie shared that later that day Kristen had explained the rule to her, and she did correct the students’ understanding the next morning. As an aside, this does mean that my original dismay of the “Are You Smarter Than A 5<sup>th</sup> Grader” feeling was well warranted.

**Teaching In The Mirror –  
Autobiographical Portraits Of Interns Learning To Teach**

**A Fork In The Road**

*“I told myself, ‘Well, maybe I could do it.’ So I just made the choice...”*

~Amelia

I meet Amelia in front of her school, where she and several other teachers linger in the late-May afternoon sunshine, watching the buses pull away and listening to the clamor of middle school students fade into the distance. When she and I settle into her classroom, she is excited to share with me how her first year as a teacher has gone. I had been to her classroom in the fall to hear about the start of the school year; now I want to follow-up asking her about her experiences teaching the new science curriculum, working with students at a different grade level (she had interned in fourth grade and her current position is in sixth grade), and navigating the other trials and tribulations of her first year teaching. But I have also come wanting to talk about the past—both about her internship last year, and about her own autobiographical journey.

Amelia was part of the first cohort of interns in my study last year, allowing me to observe her classroom each week and participating in regular conversations and interviews about the development of her teaching practice. She became accustomed to me probing about her decision-making with students, not out of

criticism or judgment, but rather because the topic of my broader study is to understand the thinking that underlies interns' classroom problem-solving.

In preparation for our meeting today, I have reread and analyzed all of my field notes and interview transcripts from last year. However, with the benefit of a second cohort of interns this year, I now have a new lens and new questions to ask. I have recently conducted all of my concluding interviews with this year's interns, and they all included a topic that I never covered with last year's cohort: how their personal history impacts their development as a teacher. I now want to fill in that gap in Amelia's data.

After Amelia leads me through the ups and downs of her first school year—the lack of guidance for the new curriculum, the support of a veteran teacher next door, difficult parent meetings, and a favorite lesson with paper airplanes—I ask if we can shift gears. In our first interview, now almost two years ago, she had described her experiences as a student and explained what led her to become a teacher. Now, I'm interested in looking at something more central to who she is as a person, her personal history and background; I'm interested in her autobiography. I assure her that, *“I'm asking these questions, not because I'm trying to be nosey.”*

She laughs, and motions for me to continue. I explain the purpose of my line of questioning, which I fear might otherwise seem to be unnecessarily intrusive, *“So my fundamental belief is that teaching is, at its core, a human interaction and about human relationship.”* I compare it to other interactions and

relationships, concluding, “*And just like any other form of human relationship, who we are as people, I believe, impacts who we are in that relationship and that interaction.*”

Before pursuing my doctorate in Human Development and Education, I taught for twelve years in a variety of alternative education settings—a court-ordered therapy center, a behavior program within a traditional school, as a behavior consultant in a middle school, and at a high school specializing in social and emotional difficulties—always working with students who had struggled in a typical classroom. Teaching in these settings required technical skills and knowledge, but my experience suggested that it also heavily relied upon very *human* skills such as relationship building, empathy, understanding, and compassion. One of my principals commonly paraphrased James Comer (2001), saying, “*no learning takes place outside of a relationship.*” Framing the skills of teaching as a fundamental human endeavor has also been newly championed in the book, *The Teaching Brain* (Rodriguez & Fitzpatrick, 2014), as well as a chapter on teacher learning in a research handbook on teaching (Russ et al., 2016). I have recently co-written a book chapter focusing on the different “awarenesses” of teachers—including awareness of self as a teacher (Rodriguez & Mascio, 2018). I am interested in further exploring this connection between a teacher’s understanding of her personal “self”, formed by her autobiography, and her teaching.

Amelia nods as I describe teaching as a human relationship, emphatically answers, “*Absolutely,*” and begins to walk me through her childhood—including describing her close relationships, helping out in her father’s business, family ordeals, and being a leader in the marching band. Throughout her recounting, she describes herself as a “*worrier,*” struggling with anxiety, depression, and issues with body image. She explains how she holds a very different attitude now,

*But I've had to work hard at it. Instead of saying, "Well, why isn't my body like my friend's?" It's like okay, well, what can we do to fix something or make ourselves feel better? So trying not to push everything inside and not saying what is wrong with you, or why was I born this way? Well, no. You can do things to help yourself and make yourself feel healthy.*

I had seen Amelia enact this kind of positive attitude in her interactions with students during her internship, and I wanted to better understand its origin. I tell her that in reviewing my field notes from last year I noticed a particular day in the spring where, “*within about an hour, there were two times,*” when students approached her with negatively framed questions. One girl announced that an empty isolated desk must be for when “*someone is bad*”, and then a boy asked what would happen if his group failed an assessment. In response to each student, Amelia “*immediately reframed it in a much more positive way.*”

Amelia agrees that, “*Some of these kids have a very much fixed mindset in that if they don't get it the first time, they're obviously dumb...*” She references

popular publications on “fixed mindset versus growth mindset”; people with the former believe that their current level of ability is innate and thus defines the limits of their capacity, while people with the latter mindset believe that their abilities can change and develop with effort (Dweck, Walton, & Cohen, 2011; Dweck, Chiu, & Hong, 1995). She continues, “*So it's trying to turn that around in that, okay, you don't get it. You don't get it **right now**. It's okay.*”

She sees this particularly playing out in her math class, but also in how her students this year generally limit their self-image. “*They know that they're good at certain things or not good at certain things and at some point it's hard to even get them to try something new.*” She gives examples of her current students who play basketball or are “*good in school*”, and see themselves narrowly defined and limited in their range such as, “*Christina's the artist and that's what she's known for. But no, she's also a really good reader and she's also [so much more].*”

Amelia talks about the importance of being positive, solution-oriented, and open to unlimited potential—as a person, a teacher, and as a model for her students—and I am struck by how different this attitude is from the self-conscious worrier that she described her past self as. She agrees that she wasn’t positive or confident during childhood or even during high school or college. I am curious about what brought about her shift in mindset, and she begins her answer with, “*I think the most change, which it sounds kinda silly, the most change came, I would say four years ago...*”



After getting her undergraduate degree in zoology at the University of New Hampshire (UNH), Amelia moved south for an internship rehabilitating sea turtles. There, she began a romantic relationship, spending most of her energies supporting the ambitions of her new boyfriend rather than advancing her own career. She explains that when he unexpectedly ended the relationship two years later, she told herself, “*Well, okay now [he’s] gone and now what do I do?’ So I had to actually figure out and bite the bullet and figure out what I was going to do.*”

She realized that she wanted to teach, which would require going back to school—and this ushered in her familiar sense of doubt, “*I don't think I can do this, I can't go back to school, everybody is younger than me now, there's is no [way]... that's so much money, it's not even worth it, blah, blah, blah.*”

Having moved back home with her parents, Amelia realized that she had a decision to make, “*He has everything. I just have to start over. There is nothing I can do - either feel sorry about myself or just move on and figure out what I'm going to do.*” This fork in the road spurred Amelia to make an unaccustomed choice,

*I told myself, "Well, maybe I could do it." So I just made the choice and found out that it was just something I loved doing. And I think I'm in a better place now than I have ever been emotionally, mentally, physically, I don't know. Everything is kind of clicking.*

This time, Amelia chose positivity, to be solution-oriented, and to believe in her potential. She may think that, “it sounds kinda silly,” but this painful break-up—and more importantly the courageous self-reflection and response that it generated—is part of what makes her the teacher that she is. This is not only because it prompted her to return to UNH for a graduate degree and certification in Elementary Education, but it also laid the foundation for her teaching’s emphasis on student mindset.

This is not to say that this one incident defines Amelia—either as a teacher or as a person—there are many compelling experiences in her childhood, adult life, and in her teacher preparation and internship last year, that contributed to her development. But this study is not a portrait of Amelia, nor of Peyton or Heather, whose stories will be included. This study is not an individual portrait of a teacher, but rather a group portrait of interns learning to teach and the ways in which their autobiographies shape their teaching.

### **Teaching Between Parallel Mirrors**

*"Am I practicing what I am teaching? Do I know what these students already believe that might be relevant to our study of this particular principle? We are, after all, always a teacher and a group of students. Do not the very principles we are discussing apply to us while we are studying them?"*

(Holt-Reynolds, 1992, p.326)

In the early 1990’s at Michigan State University—both the epicenter and the historic height of research on teacher thinking and cognition—Diane Holt-

Reynolds (1992) wrote an article where she compared her stance as a teacher educator, to standing between two parallel mirrors where she could see infinite diminishing reflections of herself. Unlike those who prepare other professionals, such as professors of medicine or law, teacher educators are faced with the question of whether they are utilizing the very principles and practices that they insist their students learn and adopt as prospective teachers.

In particular, Holt-Reynolds was interested in how students use their personal history to understand and learn the information in class. With her own background as a high school English teacher, she saw her students heavily draw upon their personal lives in order to understand (or misunderstand) the literature they read (Knowles & Holt-Reynolds, 1994); thus, later as a teacher educator, she instructed teacher candidates in her literacy methods courses to take their students' backgrounds into account. However, once this critical pedagogical practice was reflected back in the mirror of teacher education, it required her to ask about the background knowledge that prospective teachers (her students) possess on the topic and content of her course. Don't they have a rich history that informs their beliefs about learning and teaching?

This idea that teachers draw upon their history as students was not new then and still persists today. Lortie (1975) famously explained that well before teachers begin formal career preparation, they have amassed many years in an "apprenticeship of observation", watching their own K-12 teachers. This has, more recently, been described as one of the major difficulties in learning to teach

(Darling-Hammond & Bransford, 2007). An apprenticeship of observation can be a problem because prospective and early-career teachers have a wealth of examples of what their past teachers *did* in the classroom, but no access to the thinking or intentions behind those actions. Their personal experiences, and the resulting conclusions and beliefs, impact how they see themselves as teachers and understand the teacher preparation coursework they encounter (Day, Kington, Stobart, & Sammons, 2006; Knowles, 1994; Nespor, 1987).

I believe that the apprenticeship of observation is a powerful force as prospective teachers engage their coursework, and certainly as they progress into their internships; and understanding it can better position teacher educators to help their students develop as teachers. However, in an effort to extend this work, this portrait seeks to hold up an additional mirror.

Much of the research that explores teachers' background focuses on the impact of their schooling (e.g. Blevins, Salinas, & Blevins, 2013; Flores & Day, 2006; Kagan, 1992; Trent, 2011). This of course makes sense since the topic is teaching and the conversations typically take place within a school setting. But most teacher preparation programs now encourage prospective teachers to think about each of their students as a "whole child" (Noddings, 2005), to understand their family and neighborhood context (Brown, Harris, Jacobson, & Trotti, 2014), and to attend to their social and emotional needs (Jennings & Greenberg, 2009). If the entirety of a child's autobiography impacts her development and how she learns in her classroom, then isn't similar information pertinent to the learning of

prospective teachers? Aren't teachers' rich autobiographies central to their development and learning? It is this hypothesis that guides this research inquiry.

When preparing for this study, I selected the qualitative research method of portraiture, which is uniquely positioned for use in understanding the dynamic complexities of teacher learning because it “capture[s] the richness, complexity and dimensionality of human experience in social and cultural context...” (Lawrence-Lightfoot & Davis, 1997, p.3). Portraiture produces a narrative account that specifically incorporates the broader context of the participants, combining ethnographic methods of naturalistic observation, interviews, and artifact analysis, with the self-identified perspective of the researcher. Portraiture also leads to a deeper and more authentic understanding, because its improvisational process allows the participants to be unconstrained in their responses and actions.

Throughout the two years of data collection—in which I produced hundreds of hours of field notes and interviews—my iterative analyses included regular writing of reflections, impressions, and questions, as well as continuous follow-up conversations with participants to help guide my interpretations. Rather than external forms of validity or generalizability, portraiture holds a standard of authenticity—resonating as true—for the three parties involved: the portraitist, the subjects of the portrait, and the reader (Lawrence-Lightfoot & Davis, 1997, p.247).

Through Amelia's story, we see a glimpse of how her autobiography shapes her teaching. Her past epiphanic decision to believe in herself, fuels her insistent

responses to students' negative framing, always encouraging positivity. We will next go further in-depth with Peyton, exploring her extensive equine experience and its effect on her view of student needs and behaviors. Then Heather's story provides a contrastingly dour account, extending our understanding of myriad ways interns' autobiographical journeys are crucial part of their learning to teach.

### **Horse Whispers**

*"You know what? There is a reason that they're not getting their work done."*

~Peyton

It's a cold day, typical of a New Hampshire winter, and Peyton greets her fourth graders as they return to their classroom after lunch. She is more than half way through her full-year internship at Riverslea Elementary School, and she has spent plenty of time on her own at the front of the classroom. Her mentoring teacher, Laura, has been a teacher for 16 years, and Peyton is her second intern from UNH (Amelia was her first intern, last year). Laura wants for her interns, *"to be able to use this year as kinda their first year. I want them to jump right in. I want them to act like they're the teacher right away. I give them a lot of responsibility right off the bat."*

The group of 20 students in Laura's class this year is one of the most challenging, behaviorally, that she has ever experienced. They are a significant contrast to the group Amelia worked with last year. Laura describes them as,

“*very active, very in need of structure.*” Her description displays her positivity, a trait she shares with both Amelia and Peyton, but it also seems like an understatement of the constant behavioral challenge her students present. Over the course of my career working with students with significant behavioral issues I became accustomed to outbursts and student conflicts, but when I spend a full day observing in Laura and Peyton’s classroom—although I have no responsibility to intervene or handle misbehaviors—I go home exhausted. Even though Laura recognizes that her current students are, “*a tough class to have an intern with,*” she has still insisted that Peyton teach her own lessons from the very first weeks of the school year. There have also been several occasions when Laura has been out and Peyton was in charge of the classroom all day, stepping in each time with confidence and competence.

Despite five months of joint classroom responsibilities and support from Laura, this week is different for Peyton; it’s a “solo week”. Tom Schram, UNH’s Director of Educator Preparation and the university supervisor for all of the interns at Riverslea Elementary, explains to me that interns always underestimate how taxing a solo week will be. It’s one thing to regularly teach lessons by yourself or even substitute for a full day when your mentoring teacher is out, but quite a different thing to be on your own for five days in a row. Interns can consult with their mentoring teacher after school, just as any teacher might consult with her colleagues, but the mentoring teacher stays out of the classroom for the week, and the intern handles all teaching and issues just as any teacher would in her own

classroom. The internship program requires two solo weeks and Tom encourages his interns to do their first sometime in late January or early February and their second later in March. Today is the fifth and final day of Peyton's first solo week, and it has felt like a long week.

As the students return to the classroom and put their empty lunch boxes away, they notice that there is a division problem written on the board—in duplicate, side by side—and they excitedly run to their seats. This is a game that Peyton has been using every few days, as a way to start off their math period. Each time, the students are split into two teams based on where they are sitting. After a moment in which they are allowed to confer with each other, Peyton calls on one student from each team to come to the board and race to see who is able to complete the problem (correctly) first. Recently, there have been difficulties with the students' cheering getting out of hand and disturbing the neighboring classrooms. Peyton knows that the students enjoy the game, and hopes that they'll be able to keep their volume appropriate this time and play a few rounds before moving on to the rest of their work.

*"If it gets too loud, we'll just stop and move on to the worksheet. There'll be no warning, we'll just stop, so watch the volume."* She tells the students. The students quiet down and Peyton calls on a boy from one team and a girl from the other, who both quickly jump from their seats and run to the board. As they each work on the problem—423 divided by 4—their teammates hush each other in order to keep their excitement to small shrieks and a constant buzz. Both finish



the problem and write the correct answer, but the girl gets back to her seat a split second faster; her team erupts in muffled cheers.

Peyton smiles and begins to erase the board to prepare for the next round, but then two of the boys on the winning team bounce out of their seats, high-fiving each other and let out full-throated screams of excitement. Peyton turns to the class and calmly but sternly says, "*Okay, that's it. Remember, no warning.*" She finishes erasing the board and hands out a worksheet; the students let out a unified and deflated groan.

After doing the first problem from the worksheet with the whole class on the whiteboard, Peyton asks students to work independently. She writes a list of tasks for students to work through, many of which have been carried over from previous days. The final item on the list, which students can move to only if they have finished all their other tasks, is their "passion project"; an ongoing research project of their choosing which they are working on in pairs.

Tommy is still working on one of the first math sheets but his partner, Mark, has finished all of his and is given permission to get a laptop and work separately on their passion project, comparing weapons of the two world wars. As Peyton approaches Tommy—who is looking at Mark's computer—she announces to the class, "*If those working on passion projects are disturbing their partners, they won't be able to work on it.*"

Peyton asks Tommy if he needs help on the math worksheet, and he responds, "*It's all of it. I don't know what to do.*" Peyton tells him she'll come

back when he “[has] something more specific”. This is a tactic she has increasingly used in an effort to encourage students to take responsibility for their own learning. Peyton modulates between directly providing the needed support and asking students to reflect on the specifics of their difficulty. As students become more adept in this practice, it commonly results in their being able to think through and solve their own problems.

When she returns a moment later and Tommy simply repeats his original complaint, she crouches down beside him and recounts what he's done so far. After each step she says, "*You did great on this*", until they come to the place where he is stuck.

"*I don't know how many times 86 can go into four groups.*" Tommy complains.

Peyton asks, "*Do you need to do it for 86? What about eight?*"

Tommy answers, "*Two*" and then finishes the problem independently.

As Peyton leaves Tommy to continue on his own, and turns her attention to other students with their hands raised, Tommy shifts his attention to Mark. He gives Mark a hard time about not working on the project correctly, accusing him of just looking at pictures of tanks. Mark leaves his desk, moving further away from Tommy, and sits on the rug in the front of the classroom. The rug is used for morning meeting and whole-class mini-lessons, but Peyton and Laura have also encouraged students to sit there or in a variety of other places, allowing “flexible seating” when students work independently. They have also lowered a few desks

so that students can use them while kneeling on the floor, replaced some desk chairs with yoga balls, and cleared tops of file cabinets and bookshelves so that students can use them as working surfaces while standing.

Tommy constantly looks from his worksheet to the rug, continuing to pester Mark about his lack of effort. When Mark finally complains to Peyton, she circles back to Tommy's desk. Before she can say anything, he exclaims, "*I don't know what to do!*"

Peyton crouches next to him, trying to talk through the problem but he responds, "*I'm not even on the last problem.*"

Gently placing a hand on Tommy's back, she quietly answers, "*Okay. But why is there a three here?*"

Tommy angrily retorts, "*I don't know! It's because six can be divided into two groups three times.*"

"*Great,*" Peyton answers with a smile, and leads him to the next step.

Tommy glances longingly at the rug again and says, "*I give up!*"

Peyton immediately but calmly responds, "*That isn't allowed in here,*" which prompts Tommy to shut down, putting his head on his desk.

While Peyton was unsuccessful in getting Tommy to complete his math work, I am struck by how patiently and positively she attends to him—always emphasizing his capability and successes, and encouraging him to keep moving forward. I've seen this from her all year, but to keep it up in the afternoon of her fifth solo day seems especially impressive. Later, I ask Peyton where her

“*abundance of calmness and patience comes from*” and she immediately talks about her adolescence when she began working with horses—a formative experience that is a constant theme in her reflections,

*If the horses did something, if the horse bit you, you just pretended they didn't and you kept going. So if they stepped on you and broke your foot, you pretended they didn't and you kept going. I lost my stirrup, completely broke off in the middle of a jump course one time as a kid and you keep going, like you finish.*

*...when you have to stay calm when someone's biting you in the arm - whether it's a kid or a horse - nothing that is happening in the classroom even raises an eyebrow.*

Peyton’s experiences with horses began at a pivotal time in her life, greatly contributing to her development as a person as well as shaping her as a prospective teacher. She looks back on her youth and remembers always being a very anxious child, and the way her anxiety seriously impacted her health, “*what would happen is when I was very anxious I wouldn't eat... I would just be anxious so often and my parents would fight and whatever, and my sister and I would fight, and then I wouldn't eat for days.*” By the time she was eight years old she was diagnosed with an eating disorder.

Peyton’s mother sought help from a friend who had a similar experience with her own daughter. This friend began taking Peyton to help out at her horse

barn after school. There, Peyton discovered a love of animals, a group of friends, and a place where she felt comfortable. After a few years, she began working at a larger barn where her labor helped pay for riding lessons. By the time she was 16 she was riding in competitions, teaching riding lessons, and working during summer camps at the barn. She received important mentoring about horses that ultimately prepared her for the classroom.

*Now, obviously I didn't know this back then, but now looking back on it, I think it had a huge impact on the way that I deal with kids because we were always taught with horses, if there was an issue and we made a mistake on course it was never your horse's fault. You take care of them. Their needs come first.*

*But then at the same time, things that are huge with animals are like a tone of voice... You can say whatever you want and if you say it in a happy tone of voice, they perk up and they're right there. And if you say it in a mean tone of voice, you can see them back away and use body language... So I think that kind of stuff was huge. I think recognizing body language because... like with the horses even yesterday, you see them tense before they're gonna do anything dumb. And you can see it sometimes with the kids too. You can see how they change from how they are, to getting uncomfortable, even if it's slightly before they do anything dumb. [chuckle] So it's just you have to be able to read body language to work with animals, and so practicing those skills has overflowed into kids.*

I have regularly seen evidence of Peyton translating these lessons she learned from working with horses and applying it to her teaching—reading her students’ body language and demonstrating her priority to, “... *take care of them. Their needs come first.*”

On an early spring morning, during Peyton’s second solo week, she directs students, "*Snacks and to the rug!*" in preparation for morning meeting. This part of the day is a time used for students to practice social norms—greeting one another or sharing details of their weekend—and also a time for the class to bond as a community. The meeting takes much longer than planned because students aren’t following directions and Peyton has to continuously redirect their behaviors.

Peyton asks everyone to put away their snacks and gather back on the rug for “read aloud”, a favorite ritual the children enjoy. While most of the students quickly return to the rug and sit, facing Peyton in her teacher’s chair, several boys delay, standing around the periphery or pulling up a chair to the edge of the rug. Peyton and the paraprofessional redirect them all to the rug, and then correct two boys again to sit on their bottoms, rather than kneel. As Peyton begins to read, several students—some of those previously delayed boys, but also a few of the girls who had quickly settled on the rug—start finding reasons to get up and move. One at a time, they leave to get a drink, throw away a tissue, or use the bathroom in the far corner of the room. After about five minutes, one boy asks if he can sit in a chair. Peyton’s, “*Yes*” then spurs a staggered response from eight students,

most moving to the chairs at their desks, and one fidgety girl standing at the back of the rug. The paraprofessional initially attempts to redirect those who had not received explicit permission, especially the boys who had resisted going to the rug in the first place, but Peyton allows them to stay in their new positions.

While I take note of how these mixed messages might confuse some of the students, and potentially undermine the paraprofessional's authority, I am most interested in how Peyton navigates the tension between wanting to meet students' needs and wanting for them to fulfill her expectations. She explains to me, "*I wanted everyone to start on the rug,*" but she also expected that some students might need to move in order to keep their focus, "*cause not everybody can sit on the floor for a long period of time...*" As long as the students are not distracting, and are following all of her other directions (such as discussing with a partner when cued), Peyton is fine with them leaving the rug. She points out,

*Rachel stood in the back of the class most of the time, like at the back of the rug. I'm not worried that she's not focused and engaged and paying attention, but she may not be if she was just focusing on how uncomfortable she was sitting on the rug.*

This recognition of individual needs, and understanding that students will learn more when their needs are met, reminds me of lessons from my preparation as a special education teacher. Even at a time before the now-ubiquitous calls for differentiated instruction and personalized learning, my professors stressed the

importance of knowing and responding to individual students' needs. I remember regularly hearing, "*Equal and fair are not the same thing.*" This was initially a difficult idea for me to understand and accept; treating students differently from one another felt inherently unfair. But my years in the classroom allowed me to appreciate the wisdom of this adage.

Peyton did not take many special education courses, or any courses in classroom management. Her views of attending to individual needs, even when they conflict with ideas of equal treatment, are once again rooted in her work in the equine field—although this particular view comes from a unique branch of the equine field. The larger barn where Peyton worked after moving on from her mother's friend, also offered therapeutic riding lessons for children who had a wide variety of disabilities. Peyton soon got involved with the therapeutic riding program,

*I went in and it's the same thing as we do with the little kids now. When you first start out, you do a lot of brushing and tacking up and leading and going to get horses. As you are more competent, your responsibilities escalate.*

Peyton became "more competent" after each session when she discussed with the therapeutic riding instructor what she had seen. These conversations were more practical than technical, "*At that point, I wasn't worried about what the*



*disability was. I was just worried about, 'Oh, what does this kid need? So what am I doing for this particular kid?' Not even thinking of what disability they had."*

Peyton then chose to go to UNH for college because it offered the unique opportunity to major in equine studies (with a concentration in therapeutic riding) and still participate in their five-year integrated teacher preparation program. As part of her equine studies she learned about many specific disabilities, including those that call for cautions or are contraindicated for equine therapy. For example, people with Atlantoaxial Instability, weak joints in the neck that are commonly associated with Down Syndrome, can not participate in therapeutic riding because falling off the horse could lead to paralysis or death.

Peyton's studies in therapeutic riding—both informal apprenticeship, and formal coursework—empower her to look at students' outward actions more deeply, recognizing each student's underlying needs. This is demonstrated as her first solo week comes to a close. At the end of math time, Peyton asks all of the students to put away their work, hand in worksheets if they're done, put unfinished work in their folders, return laptops to the back table, and get their things out for reading groups. They are on their second day of a historical fiction unit, which is the first time they've been asked to work in reading groups rather than read independently.

Tommy picks his head up from his desk (he had remained in that position for the last 8 minutes of math) and reluctantly joins two girls on the rug. As the girls open their books, *A Picture of Freedom: The Diary of Clotee, a Slave Girl*,

and begin to read, Tommy sits with his arms tightly crossed, fighting back tears. After waiting a minute to see whether he can regroup on his own, Peyton calls Tommy to the back of the room where they can have a private conversation.

Tommy is accustomed to brief talks with Peyton; for the past few months, they have met periodically throughout each day to track and review his behavior and fill out his behavior sheet (created by Peyton). Tommy has responded well to this individual attention, which allows him to get private feedback and helps him become more self-aware of his behaviors. While he commonly struggles with his behavior, he seems to want to do well, and beams whenever his behavior sheets reflect that he has succeeded.

This conversation, however, is not focused on his behavior sheet. Tommy immediately launches into his complaints about his reading group. He hates the book and his group, and he claims that they don't listen to him at all. Peyton listens to his grievances, explains that it's hard to do something new but says that she knows he can do it, and sends him back to his group on the rug. Moping, Tommy slowly moves towards the girls, plops himself down several feet from them, and silently cries.

After scanning the room and seeing other groups struggling, Peyton calls for a class meeting on the rug to create a Book Club Contract. She scribes the student suggestions on large chart paper, including *Pay attention and listen to your classmates*, *Compromise with group*, *Have a positive attitude*, and many other

helpful counsels. When the students head out to their afternoon recess, I have time to ask her about Tommy and his difficulty in working with his reading group.

Peyton had anticipated some of the troubles the class encountered with the unfamiliar demands of group work, but had purposefully waited to address them until today, *“without the two days of struggle they couldn't have made the contract.”* But the newly established guidelines will not actually address Tommy's difficulty. Peyton reports that he doesn't like his book because it has a female protagonist. This is exacerbated because his friends are in a group reading a book (well below Tommy's reading level) featuring a male character. Because he doesn't want to read his assigned book, Tommy then doesn't keep up with his partners as they read, and thus gets even more upset about being behind.

*“It is especially tough for him right now because he hates what they're doing in every subject; poetry in writing, division in math, and then this. And he's a kid that when he gets frustrated, it's all downhill.”*

I am immediately reminded of something Peyton recently shared with me, when we were talking about her therapeutic riding experience and its influence on her teaching. She offered a piece of advice from the therapeutic riding instructor who has mentored her since she was a teenager, *“She has more patience for kids that she feels like need more patience. And less patience, if she personally feels like, 'You don't need as much patience.'”*

Initially, I'm focused on the first half of her mentor's advice, give more patience to kids who need more patience. This is what I have seen Peyton do leading up to her solo week, and I continue to see this each week as the internship progresses. From my perspective, Peyton's "more patience" is in contrast with the amount of patience I see exhibited by other teachers and paraprofessionals, in contrast to what I would expect from interns in similar situations, and how I would expect many people would react to a child with such consistent needs. But what I never encounter is an instance when Peyton seems to display "less patience". I almost make a game of looking for this during my observations, testing my hypotheses of which students she might decide, "don't need as much patience," wanting to see if she responds to them with less patience. But each time, Peyton responds with patience, attending to each students' needs in that moment, and putting a positive spin on what's going on. Situations that many people would consider to involve "bad behavior", Peyton consistently regards as a student having unmet underlying needs.

By the time the internship comes to an end, my curiosity has peaked. In preparation for our final interview in May, I go through volumes of field notes and transcriptions of interviews, making note of the topics I would like to cover, ideas that need resolution, and particularly searching for clues about those instances when Peyton chooses to show "less patience". She has referenced her mentor's advice about kids needing more or less patience several times throughout the winter and spring, but I find one occasion when she follows it with the statement,

made dismissively with no elaboration, “*Which is something I've had to work out of, but I definitely see it in myself, too.*” I am left to wonder whether this signals Peyton possibly rejecting her mentor’s guidance, and what that might mean for how Peyton makes decisions about responding to her students.

During the final interview, Peyton and I explore many incidents and issues that have surfaced during the year. She wishes there were more recess time, intends to bring the idea of flexible seating to her own classroom next year, and disagrees with the school’s banning of fidget spinners (a small toy that proponents claim supports focus for students with attentional issues, but critics see as a classroom distraction). She regularly returns to lessons learned from her work with horses or her clients in therapeutic riding. After she talks about the tension between meeting students' individual needs, and having standards and consequences for them (including explaining why she lets some children leave the rug during a lesson) I ask her about the statement that I have been pondering, and the newly-discovered twist that follows it up. I read her quote in its entirety,

*My boss says this all the time and I think it's true. She has more patience for kids that she feels like need more patience, and less patience if she personally feels like you don't need as much patience. Which is something I've had to work out of, but I definitely see it in myself too.*

I assure her that I understand the idea behind her boss having varying levels of patience for kids that she thinks do or don’t need it, but I would like to better

understand what she means by the last part of her statement. Without missing a beat, Peyton answers,

*So I can definitely see with this group with being such a wide variety of needs, and I'll talk academically first. I had no patience with David for not getting his work done. There was no reason that he shouldn't be getting his work done. Whereas when Jimmy, or Amanda, or Chad weren't getting their work done, it was a totally different story. Because yes, academically, you have a reason for not getting your work done, and I will work with you on that. But with David who didn't have an academic reason or Tommy who doesn't have an academic reason to not be getting his work done, I didn't have as much patience with them.*

*Working out of it, is like, "You know what? There is a reason that they're not getting their work done." It's not an academic reason, but there's a reason they're not getting their work done, and I need to have just as much patience with these two kids who academically are strong, but need focus for not getting their work done and giving them the same opportunities and pushing that I'm giving to the kids who academically can't get their work done.*

I double-check with Peyton that I have correctly understood the evolution of her thinking. She feels like her initial instinct or reaction is to have less patience with those students who don't have clearly identified reasons for their

difficulties, but she is reconsidering that judgment. She now believes that those students need just as much patience, because they too have reasons for their difficulties, even though their reasons may be less obvious.

Peyton still uses her past experiences in therapeutic riding to inform her beliefs as a classroom teacher, but she is learning to use them in increasingly complex and nuanced ways. Initially, when gauging the appropriate amount of patience needed, her mental model was the drawing of a stark contrast between students in the therapeutic riding program versus those in the regular riding program. When students in the therapeutic riding program had disruptive or off-task behaviors she knew to intervene with patience, “*whereas, if it was a kid in the Mainstream Riding Program doing anything like that, it's just like, ‘No. Stop. You know better. Stop.’*” Applying that mental model to her classroom meant that students with identifiable academic difficulties called for the patience and personally tailored interventions analogous to what she had used in therapeutic riding, while the rest of the students should be handled in a no-nonsense manner, like the traditional riding students who were caught goofing around.

Peyton’s evolution in her teaching rejects that mental model and no longer sees the hard, bright line between those who do and do not deserve patience. Rather, she uses the skills and tools she gained originally as a teenager assisting in a therapeutic riding program, to help her understand *all* of her individual students’ needs and provide them with the academic or emotional support that will allow them to progress. This is not to say that Peyton does not also utilize her formal

coursework in elementary education, but the academic knowledge was shaped by her autobiography, in particular her work with horses and her work with children in the therapeutic riding program.

Like Amelia, Peyton relies on her autobiography to inform how she attends to her students' needs. They both draw upon positive lessons from their backgrounds while developing aspects of their teaching: Amelia models and teaches positive framing to her students, based upon her past experience of being empowered by such a mindset; Peyton uses the patience and ability to individualize that she learned from her equine experiences. Their learning journeys as teachers emerge from very different experiences, and are used in different ways, but one thing they have in common is that they are generally remembered as positive experiences. But how can a negatively experienced autobiography still create a context for an intern to learn?

### **Battle Scars**

“I like the naughty ones.”

~ Heather

Although the interns helped their mentoring teachers prepare their classrooms during the summer and attended the professional development days over the past week, today was the first day of school with their students. Shortly after the school day ends, Tom Schram begins the first intern seminar of the new



school year. This is the first time all of the interns under Tom's supervision are meeting together. Throughout the year, this weekly gathering will become a vital touchstone for all of the interns to process their experiences in their classrooms. After brief introductions—of the eleven interns, three are art interns and the rest span grades kindergarten through fourth—Tom asks what their impressions are of the first day. Peyton says that she expected the students to start out a bit more reserved but that was certainly not the case today, and Sharon mentions that she made sure she taught a lesson on her own so that the students would see her as a teacher. When a few of the interns in younger grades voice their surprise by how much they have to teach (and reteach) simple classroom routines, Heather—a fourth grade intern, like Peyton—assures them that it is no different with older kids.

Tom offers advice about taking notes and pictures of what they're doing to set up the classroom and start the year. He warns that they won't otherwise remember it next year when they have their own classrooms. Next he shares a list of expectations for the interns, one is that when they make mistakes, "*that's how you learn.*" Then Tom asks for each person to share three things about themselves. Because he intends to finish the round with himself, he motions that we'll start to his right, where I am sitting.

This is certainly not the first or last time that I have to make an on-the-spot decision about navigating the boundaries as a researcher doing fieldwork. Unlike more rigid methodologies, my research is dependent on building rapport, but

doing so while still maintaining the appropriate role of a researcher requires purposeful decision-making. Because I understand teaching as being fundamentally about human relationship, I also understand that it is a particularly vulnerable activity to allow others to observe. I believe that the interns will be more comfortable with my presence if it feels like I'm another person who is part of what is happening, rather than an unknown intruder. Tom has spoken about the importance of trust in the group, and I want for my participation to align with that purpose, building a trusting relationship with the interns.

I tell them that my teaching background has been with adolescents with behavioral difficulties, hoping to assure the interns that I am not expecting perfect behavior in their classrooms, but also that I am not expert in the age group that they are teaching. I also tell them that before I became a teacher, I worked in the animal field and have twice hand-raised black bears. I wish to add some lightness and off-set any sense that I am “the researcher from Harvard” who is there to evaluate or judge. I conclude with the fact that my wife and I make homemade wine. While I hope that this will also soften any notions of me being overly serious, my additional motivation is that, as a male working in an environment that is almost exclusively women, I prefer to include mention of my wife in conversations that become at-all personal.

Sitting next to me, Heather shares that she too likes “*the bad kids*,” that she runs, and she has a one-month old puppy. When we get to Peyton, she says that—like Sharon—she is also getting married next summer (in July), that she is a

therapeutic riding instructor, and just got a bunny. Finally, Tom describes his background as an elementary school teacher, and that before teaching he worked with horses. He also tells us about his wife and their adult children.

A week later, thinking that I will be able to sit in on her planning period with her mentoring teacher, Jenny, I start my morning in Heather's classroom, not realizing that she is having her first "dual cert" meeting. In addition to working towards her master's degree and certification in elementary education, Heather is also fulfilling the requirements for a certification in special education; making her a "dual certification" student.

Seated at a back table in the classroom is Heather, Jenny, Tom, a special education teacher who will mentor that aspect of Heather's internship this year, and the special education supervisor from UNH. During the meeting the expectation is set that Heather will need to find opportunities to work with students with a variety of disabilities. Heather explains that she already has had some experience working with students with behavioral issues, and echoes her comment from last week's seminar, a refrain that I will hear from her throughout the year, "*I like the naughty ones.*"

At the end of the first month of school, Heather and I finally have an opportunity to meet after school to do an introductory interview. She has wanted to be a teacher since she was in fifth grade and visited the school where her stepmother taught physical education, a school that specialized in behavioral issues.

Heather explains that her stepmother, *“was one of the only people who was certified to restrain. A student was trying to harm himself, so she had to leave the room,”* which gave Heather the opportunity to *“take over”* and assist the other teacher for a few minutes. When her stepmother returned, the other teacher, *“told my stepmom that I was going to be one hell of a teacher one day. And I was like, wow.”*

Over the years her ideas about what kind of teacher she wanted to be shifted: a Phys Ed teacher, an English teacher, and by the time she was in college an elementary school teacher. At the end of her senior year she was a long-term substitute teacher at her stepmother’s school, and found that she, *“loved being in the there. I was attacked twice, and I loved it. I’ve been called horrible names by second graders, and I loved it the whole time. I was like ‘Yeah!’”* I can relate to Heather’s interest in working with students with behavioral problems, but her depiction strikes me as sounding like someone recounting the rush of battle.

As the interview continues, she describes some of the coursework she’s taken and her related clinical experiences in schools. Talking about her future ambitions, Heather says she’ll be moving out west to join her boyfriend who’s stationed there in the Air Force, and she is nervous about facing so many unknowns. She relays a story she heard from a special education professor about a former student who also followed her significant other stationed in a southern state where, *“they did corporal punishment and the principal was like all for it and...”* Heather pauses, taking a quick breathe, and states, *“I would beat someone for*

*beating their child..."* Her face begins to flush and her voice raises, *"I couldn't do it, and that's what I'm scared about is that they're all gonna be like 'yeah, like hit students' and I'm gonna be like 'oh my God'."*

I have also heard this story from that same professor, and agree that it would be a disconcerting situation to be in. I begin to steer the conversation towards more immediate considerations, but soon Heather returns to the topic, worrying, *"I'm going to be that girl who ends up in the school with corporal punishment and I would freak out!"*

Jenny returns to her classroom for their scheduled planning meeting. Heather, now in tears, calls to her like someone wounded and pleading for medical attention, *"Oh my God. Do you participate in corporal punishment? Can you ask that? Is that like, I can't do this. I can't be a teacher, Jenny. I'm scared!"*

Jenny looks to me, initially surprised, as Heather continues in a rushed exhale, *"What if I end up at a school with corporal punishment and then I end up in trouble because they hit their students and then I hit them?"* As Jenny walks over to console Heather, her surprised look morphs into an inquisitive glare as she, with a slow and purposeful voice, accuses me, *"What did you do?"*

Jenny is fiercely protective of her interns. Her protectiveness does not seem to be about avoiding the struggles inherent in teaching; throughout the year Jenny will strive for a level of support that gives Heather the room to, *"struggle but not suffer"*. Rather, Jenny wants to create a safe space for them to engage in the struggles that are inherent in learning. I know that Jenny's concern for

Heather is sincere, but I am also confident that her tone towards me is largely in jest. Like Laura in the classroom next door, this is Jenny's second year with an intern and her second year with me in her classroom; we have spent a lot of time together—including eating lunch together at least one day a week with the whole fourth grade teaching team—and Jenny trusts that my intentions are sincere.

*“I did not expect our conversation to go this way.”* I answer truthfully, holding my hands up and suppressing a nervous laugh.

Heather and Jenny's students are generally very well behaved. They aren't like Peyton and Laura's class (spurring Heather to repeatedly complain throughout the year, *“I should have had that class”*), nor do they resemble what she encountered in her stepmother's school, or what I experienced in my years teaching. There are, however, a few children with behaviors that Heather finds challenging: a dawdling boy who passively resists almost any work set in front of him, a timorous girl who alternates between needing constant reassurance and complaining that she needs to go home or to the nurse, and a high-achieving boy who banters with Heather in a way that she commonly identifies as being defiant.

Over the next several months, Heather is drawn to work with these students, and by all accounts she does so capably. One of the requirements in UNH's internship is conducting a set of Educator Rounds. Each intern identifies a problem of practice, or focal question, and a small group of her fellow interns along with their supervisor observe class time to collect relevant data. The sharing of data afterwards is explicitly non-evaluative, but Tom also asks for the session to

end with “warm fuzzies” to counter-balance any disappointments that the data may have caused. At the end of Heather’s Educator Round in October, both Tom and Peyton observe how positive she is with the needier students. Tom recounts how her interactions with the dawdling boy, “*were always initiated and characterized by a very positive note from you to him. I think that had a positive effect on him.*”

With regard to the timorous girl, Peyton observes that Heather worked directly with her once and then continued to support her, without actually stopping each time she circled past, “*It gave her the support of an adult, which is something she seems to need. It gave her the support from an adult telling her, ‘this is what you need to do’ but it also wasn't directly doing it for her.*” Peyton also reflects on Heather’s ability to manage larger class behaviors, “*The other thing is with the entire class, when they were goofing off at the beginning you were able to get them refocused and right back to work, which is something that'd be really nice.*” Little did any of us know, so early in the year, how much of a contrast this would be to Peyton’s classroom experience.

I agree with these observations, but I also witnessed Heather’s work with these students as causing what looks to me like constant psychological skirmishes for her. On one hand, Heather is drawn to these students, she is applauded for being positive with them, and their parents celebrate that this is their child’s first year enjoying school. On the other hand, Heather complains each day at lunch that these same students are “*driving me crazy*”, she has to be repeatedly corrected

by Tom during seminar to reframe her descriptions of these students in more positive terms, and after she interacts with them she commonly turns (to where only I can see her) and mouths to herself, *“I’m going to kill him.”*

One morning in December, as her students are in the gymnasium practicing for the holiday concert, Heather and I talk more about the kind of teaching she’s hoping to do in the future. When she tells a story from her time substitute teaching, the story of a boy who threw a desk at her and called her a *“b-word,”* she exclaims, *“Bring it on!”* Once again, I sense her inclination towards combat. But this time, she also speaks of the other teachers who call these students “bad” or “naughty”, offering a contrast, *“but when I sit down with them, they’re sweeties.”* She repeats her familiar statement, *“I really like the naughty ones.”* But when I ask her why, she says that she doesn’t know. I think about how often I can see her frustration, her moments of taking a deep breathe, her eyes seeming to explode out of her head. I am perplexed by her feelings about the naughty ones.

In mid-February, Heather and I sit down after school for another interview. By this point I have started to deepen my interest in exploring the interns’ autobiographies. I have already written an article about Katie—an intern in Amelia’s cohort last year—that focused on the conflict between her traditional schooling and the constructivist teaching and learning now required of her (Mascio, under review). However, this winter I have already heard Peyton talk a lot about her equine experience. While I have not yet asked her more about her childhood, I am beginning to appreciate how the richness of autobiography may be



just as relevant to interns' learning to teach as Lortie's (1975) notion of the "apprenticeship of observation".

I have recently heard Heather make a comment that I want to explore more deeply. The timorous girl had had another difficult morning, and the counselor informed Jenny that there's a home issue that she would be following up on. Heather had responded quietly, almost to herself, "*I had a not-so-great home life, so I get it.*"

This will be my first interview where I ask an intern about more than her school experience. I have been present for countless conversations about family, friends, boyfriends and girlfriends—but never at my prompting, and typically from the periphery of the conversation. I suspect that we are about to have an uncomfortable conversation, and that this time any ensuing tears—which do come—will, at least in part, be the result of my probing questions.

I repeat Heather's reference to having a difficult family life, and simply ask if she can tell me, "*a little bit more about that.*" And Heather dives right in, "*My parents got divorced when I was in fourth grade. Shortly after, my mom entered in an abusive relationship. I have been kicked out of his house multiple times. I have been called the C word... that word doesn't even phase me any more.*"

She continues to describe her mother's drug use and regular physical abuse at the hands of her stepfather. He didn't dare to hit Heather because he feared her father's retaliation. She moved between multiple schools throughout elementary, middle and high school, finding some solace in track and soccer, but "*got*

*suspended a lot... I got kicked off of sports a lot for aggression, I was a very angry child". She describes, "I was so naughty... So I understand them. I think that's why I like them."*

Heather knows that her past may not be a healthy precursor for becoming a good teacher.

*I had a lot of rage when I was younger 'cause I was just pissed off at everyone and everything and I hated everyone. It's weird 'cause a lot of people I went to high school with are like, "Oh, what are you doing now?" I tell them I wanna be a teacher, and they're like, "What! Are you sure you're not gonna kill a kid?"*

In fact, one of the reasons Heather decided to work at the elementary level was because she recognized that older students were more likely to trigger her usual reactions to adults. Even with her elementary students it can be challenging,

*I've gone through so much therapy I know what triggers me. I know when it starts triggering me and I have a hard time walking away. Even with elementary school kids when they argue with me and I'm like, "No!" And I will argue back. I will argue back which I'm working on. From the beginning of the year to now, I don't argue as much. Usually, I roll my eyes and walk away. So that's not good. You shouldn't roll your eyes at a fourth grader.*

But Heather also knows that her background gives her a unique insight and empathy for what some of her students are experiencing. She reflects on her time as a substitute teacher at her stepmother's school, *"I understood a lot of the behavior problems, and why it was happening. They were evicted from their houses. I know how that feels. I know how it feels to literally come home and all of your stuff's outside and you're like, 'Whoa. Yay. Here we go again.'"*

She explains that she knows that, especially for younger children, behaviors have underlying problems. She resents it when other teachers describe a difficult student as, *"Oh, this kid sucks. I don't wanna work with this kid."* She insists, *"I like those students. Because obviously there's something going on if they suck."*

Most importantly, her background motivates her to work with behaviorally struggling students so that she can give them what she believes they most need, compassionate support.

*If that's what I can do for a student to be like, "Yeah, your life is shit. This is how we're going to help it." If I can be that for someone, I think that would be awesome. And that's one of the reasons I would love to work at an alternative school to be like, "Yeah, your life sucks, my life sucked too. Look where I am." I wanna give them that hope.*

Unlike Amelia, Heather did not experience a positive critical turning point in her life that she wishes to replicate for her students. Her past primarily elicits anger. Even when talking about her upcoming accomplishment of graduation she

says that she's excited because she'll, "*have [her] graduate degree and it's a big FU to [her stepfather].*"

Unlike Peyton, the impulses and skills drawn from Heather's past are not entirely advantageous for her teaching. While she has insight and empathy for those students who are so commonly misunderstood and judged, her feelings come with a combative response that requires great energy for her to suppress.

Like all of the interns in this portrait, however, Heather's past experiences influence who she is and how she sees the world; her autobiography influences how she is learning to teach.

### **Richly Filled Vessels**

*"Teachers enter the profession not as blank slates but as persons shaped by a wealth of past experiences."*

(Kitchen, 2005, p.19)

We know that prospective, pre-service, and practicing teachers are not empty vessels waiting to be filled with new knowledge of teaching. Research has shown us that their beliefs, sense of identity, and pre-existing knowledge impact how they respond to and incorporate coursework (Flores & Day, 2006; Holt-Reynolds, 2000), internships (Kitchen, 2005; Knowles, 1988), demands within their teaching practice (Beauchamp & Thomas, 2009; Day et al., 2006), and school reform (Craig, 2018).

Synthesizing decades of research, Fives and Buehl (2012) describe the three primary ways that teachers' beliefs influence their practice. First, teachers may use their beliefs as a filter for how they understand and interpret available information in their school environment. Second, they may use beliefs as a framework for how to understand and solve problems in their classroom. Third, beliefs may be a guide for practice, by determining goals and motivating values.

I embrace this description of “filters, frames, and guides”, not necessarily because I see them as fully distinct and separable functions; in practice, I think that there is a great deal of crossover. I like the description because it resonates with how most of us use our beliefs—largely informed by our autobiographies—in our everyday human interactions and relationships, which is at the core of my concept of teaching. When I console my niece about conflicts at school, I am sure that I filter her accounts through my own memory of adolescence. When I opt to bring family members on outings rather than buy them objects for their birthdays, it's because of the framework created by my own treasured memories of spending time with loved ones. When I spend my weekend helping a friend move, it is guided by my recognition that I have had times of need, and my motivation to return the same support from which I have benefitted. “Filters, frames, and guides” are how I use my autobiography to inform my interactions and nurture my relationships. “Filters, frames, and guides” are also useful in thinking about the ways Amelia, Peyton, and Heather's autobiographies create the history and context for their learning to teach.

Amelia's personal experience of self-empowerment—deciding to retake control of her life and go back to graduate school—serves as a frame as well as a guide. She understands students' growth through the framework of their becoming more positive, solution-oriented, and believing in their own potential. She is guided by wanting to instill her students with the same inner strength that she credits with improving her life. She sees their self-imposed limitations and wants to help them, "*turn that around*" so that they can bounce back from setbacks, and see themselves as more than a one-dimensional athlete, artist, or student.

Peyton's equine experience, both with horses and within therapeutic riding programs, serves as filter and frame and, I suspect, also as a guide. When she observes students in her classroom, she looks through the filter of knowing that "*there is a reason that they're not getting their work done,*" and that difficult behaviors are indicators of unseen needs. The origin of this filter is her history of reading her horses and anticipating their needs and reactions. But this filter was further reinforced when she learned to attend to the individual needs of her therapeutic riders. The role of a therapeutic riding instructor is to set individual goals and strive for individually appropriate progress. This became the framework for how Peyton understands the role of a teacher. Her framework also incorporates her experience participating in riding competitions. When something went wrong out on the course, it was her responsibility to "*keep going*" and, "*it was never your horse's fault*". Likewise, her students' difficulties are never an

excuse for her to lose patience or blame them. I also believe that Peyton's unrelenting commitment to her students is, at least in part, guided by the acceptance and support she experienced in her youth at the horse barn; she is motivated to provide that same refuge for her students.

Heather's traumatic childhood serves all three functions—creating two sets of conflicting filters and frameworks, and a single highly motivating guide. On one hand, Heather's life experience provides a filter where every interaction is potentially threatening and any conflict is interpreted as combat (“*Bring it on!*”), and it frames the purpose as winning by defeating her opponent. On the other hand, her background also provides a filter acknowledging that “*the naughty ones*” are usually suffering with overwhelming issues outside of school (“*Because obviously there's something going on if they suck*”), and a framework that the teacher should always ameliorate—rather than exacerbate—those problems. Heather's childhood is also a clear guide, motivating her to be an empathetic champion for those students most in need so that she can, “*give them that hope.*”

Each of these three interns have rich, complicated, and multi-dimensional autobiographies that create a context for who they are as people and who they are becoming as teachers. In teacher education, we seem to be missing a potent opportunity for teacher growth. If, instead of keeping it in the shadows, we shine a light on the influence that teachers' autobiographies have on their teaching, then they may become more self-aware and more fully engaged in the learning

opportunities they are offered (e.g. Hamilton, 2016; Joram & Gabriele, 1998; Trotman & Kerr, 2001).

As part of a special journal issue on exploring personal histories in teacher education, Diane Holt-Reynolds (1994) considered what could happen when teacher education ignores a prospective teacher's autobiography. Her participant, a pre-service teacher named "Jeneane", had been enrolled in a required reading course. Jeneane embraced most of the constructivist techniques taught in the course, but did so without particularly learning the theory or underlying rationales that her instructor provided. Her reasons for liking these teaching strategies were informed by her own history as an African American student in a predominantly white, affluent community, where she felt unappreciated and marginalized. She relished the potential of the constructivist teaching techniques, primarily based on her belief that their use might empower her future students by treating their voices as equal, rather than subordinate, to the teacher's voice. What Jeneane did not do during the course, however, was engage with how those strategies could also support student learning, nor did she wrestle with the constructivist principles fundamental to the course. Because her course never required her to think about the impact of her autobiography, it also never revealed that her adoption of the techniques was not based on an understanding of the underlying principles. From the perspective of a teacher educator, Holt-Reynolds considered this a missed opportunity for learning:



*When my students and I enter our classroom, we embark on a journey with an uncertain path but with a firmly understood direction. We want to focus on learning to do good teaching. All of us bring something of value. But if we fail to see how what each brings is different from what others bring, we will also fail to move beyond the place on the path where we stood when the course started.* (Holt-Reynolds, 1994, p.33)

Much of what we each bring—as students, teachers, and teacher educators—reflects, and is shaped by, our autobiographies. Teachers are encouraged to get to know their students, and use that knowledge when teaching them. Before concluding the first intern seminar of the school year, Tom Schram implored his interns, “*your job right now is to get to know your students.*” His job would be to, “*teach you how to let the kids teach you, how to teach them.*” He wanted for his interns to understand that if they get to know their students, as learners and as people, their students would provide the vital information needed to teach them.

All of us who teach teachers—whether we are teacher educators, professional development providers, administrators, mentor teachers, or supportive colleagues—must look at our practices as though we are standing between parallel mirrors. Tom’s advice to his interns is just as apt for us; we must “get to know” our learners. I also believe that those (continuously) learning teachers will benefit if encouraged to get to know themselves, having a better understanding of how

their autobiographies are part of who they are as teachers, and allowing that knowledge to support their continued growth.

### **Nothing Exists Alone: A Tool And Technique To Dynamically Capture The Complexity Of Interns Learning To Problem-Solve**

*“In nature nothing exists alone”*  
*Silent Spring* (Carson, 1962, p.51)

*“In the minds of many, the study of complexity is not just a new science, but a new way of thinking about all science, a fundamental shift from the paradigms that have dominated scientific thinking for the past 300 years.”*  
(Wilensky & Resnick, 1999, p.4)

As an understanding of student learning has become increasingly complex, it has prompted an understanding of teaching as equally complex intellectual work (Feiman-Nemser, 2001). No longer should we measure growth simply as a change of teacher behaviors (Kagan, 1992), or ask novice teachers to mimic the behaviors of experts (Berliner, 1988). We want teachers to make on-the-spot decisions in environments that are multi-dimensional and unpredictable with many factors occurring simultaneously (Doyle, 2006).

There is a difference between teachers who simply see what is happening in front of them—the observable outcomes of learning and behavior—and teachers who go further and look deeper to perceive the “how” and “why” of what is happening. Relatedly, there is an important difference between education researchers seeing that teaching is complicated, versus researchers who go further and use tools and techniques that can actually illuminate the dynamic and complex

nature of how those teaching skills develop. This paper calls for both teachers and researchers to go further and make those respective shifts in what they look for and how they consider it. Only through an advanced understanding of teaching and teacher learning, can we better support teacher development and school improvement (James S. McDonnell Foundation, 2017).

Eilam and Poyas (2006) identify skills central to classroom problem-solving, including requiring those who are learning to teach to: 1) increase their awareness of the complexity in the classroom, and 2) use a cognitive lens to look for the thinking that underlies observable behavior, and see patterns of interactions involving these cognitive aspects. For clarification, Eilam and Poyas (2006) use the term “cognitive lens” to include teachers’ consideration of students’ intellectual as well as affective processes; it is used in contrast to teachers considering outward and observable behaviors.<sup>5</sup>

In order to best support teachers as they prepare for such complex work, and acknowledging teachers as learners when developing their skills, teacher educators and researchers need a more complete understanding of the development of this process. Recognizing the complexity of teachers’ thinking, thus calls for new ways to assess and analyze that complexity.

The aim of this study is to demonstrate the insights that can be gained by using a novel approach to capture and dynamically analyze the development of thinking involved in classroom problem solving. The study focuses on Eilam and Poyas’ (2006; 2009) two skills above: the interns learning to view the classroom

as a complex and dynamic system—thus going beyond observable levels of the system—and the interns utilizing a cognitive lens. In order to represent the complexity and interrelated nature of those skills, this study utilizes dynamic analysis of intra-participant variation and change over time. The results and analysis from three interns—during their full-year clinical experience completing a comprehensive teacher preparation program—is shared as an example of the value of the assessment tool and analytic technique.

The following review starts by describing the classroom as a complex system, and the ecological thinking required for teachers to problem-solve within that system (Davis & Sumara, 2006). Next, it brings together literature from several fields that illuminate the process of becoming problem solvers in complex systems, including research on adaptive expertise (Fisher & Peterson, 2001; Hatano & Inagaki, 1984; Soslau, 2012), novice/expert studies (Eraut, 2007; Jacobson, 2001), and the learning of complex systems (Jacobson & Wilensky, 2006; Levy & Wilensky, 2008; Perkins & Grotzer, 2005). Lastly, the review shows how a long history and wide range of theories of teacher development—regarding both stages of development (Berliner, 1988; Van Manen, 1977) and components of development (Jay & Johnson, 2002; Kagan, 1992)—embrace the importance of using a cognitive lens in teaching and teacher problem-solving; of particular interest is research on teacher noticing (Van Es & Sherin, 2002; Wolff, Jarodzka, & Boshuizen, 2017).

The results for each intern are then presented along with discussion as examples of the kind of change that interns undergo, but more importantly as examples of the kind of insights that can be reached through the use of this novel tool paired with a dynamic systems approach. It is true that, while many teachers and teacher educators clearly recognize teaching as difficult and complicated, a shift in practice will be required for many to improve their understanding of the classroom as a complex and dynamic system, and increase their use of a cognitive lens. It is just as true, that even researchers who believe in the necessity of that development for teachers, may need to undertake a similar shift in order to understand that development in a dynamic and complex way. This paper aspires to contribute to both of those needed shifts.

### **Complex Problem-Solving in Classrooms**

Jacobson (2001) describes a complex system as being “characterized by the interactions of numerous individual elements or agents (often relatively simple), which self-organize to show emergent and complex properties not exhibited by the individual elements.” (p.42) A classroom clearly fits this description, with such internal elements as the curriculum, class norms, schedules, and subjects, as well as external elements such as school rules, and broader community norms; and such agents as numerous individual students, teachers, paraprofessionals, and other school staff, as well as families and community members who interact with each of those agents. When these people and features interact in dynamic ways the

results are highly complex, far exceeding what would be understood when looking at each piece in isolation.

For example, two typically well behaved children may erupt in violent argument—one stressed by a traumatic incident at home that morning, the other with frustration gradually built over a month’s worth of lessons that left her feeling like a failure, both exacerbated by the absence of a third classmate who is typically a calming effect, and then all of it ignited by the lack of outdoor recess due to rain. A teacher who understands the complexity of the classroom will look for these contributing factors, and respond accordingly. Teachers who only see the outburst in front of them will only be able to respond to the outcome, and will not be prepared to avoid future incidents. Non-complex thinking about the classroom environment prevents teachers from truly understanding incidents like these, neglecting issues of motivation, social networking, learning and development (Jay & Johnson, 2002)—just as Rachel Carson warned that environmental crises stemmed from people not understanding that, “In nature, nothing stands alone.” (Carson, 1962, p.51) Navigating such an environment requires ecological thinking (Davis & Sumara, 1997), or the ability to see how everything is linked to everything else.

How do teachers gain this complex ecological thinking? Encouraging and supporting metacognition is commonly used to improve a wide variety of learning. For teachers this is important, but does not go far enough; the complexity of classroom problem-solving—understanding how ill-defined problems occur in an

unstable environment with conflicting values and priorities—requires even more flexibility and adaptability than metacognition typically calls for. This is demanding and complex work that requires an additional process and developing an additional set of skills: understanding the classroom as a complex system, and using a cognitive lens. The novel assessment tool created for this study, and dynamic analysis technique used, may empower teacher educators in facilitating their interns' development of those skills, and enable researchers to better understand that development.

### **Learning Complex and Dynamic Systems**

As prospective teachers develop the skill of understanding the classroom as a complex system, teacher educators and researchers will need new tools and techniques to assess and monitor those skills in order to support their development. These tools and techniques can be modeled after similar approaches in other fields of research, such as studies of adaptive expertise, novice/expert comparisons, and learning of ecosystem science.

**Adaptive expertise and novice/expert research.** Adaptive expertise is the ability to appropriately assess and respond to contextualized problems (Hatano & Inagaki, 1984), and it has been studied both inside and outside of the teaching profession. Teachers who are able to think about and solve problems in their classroom, viewing it in its messy complexity, are those who have developed adaptive expertise (Soslau, 2012). It is not simply a hallmark of expertise; it can be lacking in content experts (Wineburg, 1998) and can be developed in content



novices (Fisher & Peterson, 2001). Adaptive expertise is needed to problem solve in complex environments because it is, "...the ability to apply knowledge effectively to novel problems or atypical cases in a domain without glossing over distinctive features or factors." (Crawford, Schlager, Toyama, Riel, & Vahey, 2005, p.5)

Adaptive expertise has been shown to be valuable in the classroom. For example, Crawford and colleagues (2005) asked biology teachers to think aloud while examining student work to diagnose student understanding and misunderstandings. They analyzed teacher thinking for such aspects as causal reasoning and cognitive flexibility. Their findings show connections between adaptive expertise and the teacher's ability to systematically explore the student data and attend to novel content.

Related to research on adaptive expertise is the study of novices and experts in fields that involve complex systems, such as engineers, accountants, nurses (Eraut, 2007), doctors (Boshuizen & Schmidt, 2008) and scientists (Jacobson, 2001). Jacobson (2001) describes the difference between novice and expert as respectively having "clockwork mental models" and "complex systems mental models". The latter allows for problem solving that overcomes commonly held beliefs and perceives multiple causes that interact in decentralized ways. These studies on adaptive expertise, and on novice/expert professionals, demonstrate the importance of focusing on problem-solving and understanding complex systems.

**K12 ecosystem education.** Professionals, however, are not the only ones who make conscious strides in better understanding complex and dynamic systems. A foundation for understanding how individuals think about complex systems has been created by research on K12 ecology education. This study seeks to build upon that foundation. This line of inquiry may not be intuitive—there are certainly important differences between child and adult learning, between the roles of teachers and students, and between the content of classrooms and natural ecosystems—but the kind of ecological stance that adaptive teaching requires, “has a great deal in common with biological sciences...” (Doyle, 2006, p.98), the learning of which have been well studied by complex-systems researchers.

One particularly germane field of research is studies involving children’s learning of ecosystem science. Students have great difficulty learning deeply about ecosystems, particularly struggling with the inter-relatedness of disparate parts and the resulting complex causal relationships (Grotzer, 1993). Student learning of ecosystems thus makes for fertile ground to understand the challenges and supports in learning about complex systems.

There are natural default assumptions that people make—and experts overcome—which stymie their ability to comprehend the more complex causal relationships that exist in ecosystems and other complex systems; these include an inclination to look for obvious (rather than non-obvious) factors, temporally proximal (rather than distal) factors, and spatially proximal (rather than distal) factors (Grotzer, 2004). In essence, people tend to look for causes and effects that

are detectable with their senses, and are in the “here and now” (Grotzer, 2012; Grotzer & Solis, 2015).

Even children, however, are capable of overcoming these default assumptions and gaining deeper learning of complex systems (Grotzer & Basca, 2003; Schulz & Sommerville, 2006). The fact that children are capable of thinking more complexly if they are supported appropriately, should give us hope that adults—who commonly have similar struggles understanding complex systems (Hmelo-Silver, Marathe, & Liu, 2007)—have the potential to do so, as well. One aspect of assessing prospective teachers’ problem solving, therefore, is to examine whether they are overcoming those default assumptions.

In addition to students’ default assumptions of obvious and proximal factors, learning causality in complex systems is further restrained by difficulty making connections between different levels of the system (Levy & Wilensky, 2008). For example, a whole ecosystem of microorganisms interact with and feed off the detritus in the forest, but the events at this level of the system are commonly overlooked by students explaining the decomposition of a fallen tree (Grotzer & Basca, 2003; Perkins & Grotzer, 2005). Once again, however, children are capable of overcoming this kind of difficulty. When students take into account multiple levels of a system, they are able to better understand the complex causal relationships that transcend levels (Wilensky & Resnick, 1999). This suggests that adults, too, may better understand complex systems if they explicitly investigate underlying levels of the system.

As part of assessing teachers' problem-solving, it is necessary to investigate whether teachers are considering underlying levels of the complex system of the classroom. In ecosystems those underlying levels may be microorganisms and chemical cycles, but in a classroom, the underlying level—creating the *how's* and *why's* of what is seen—is psychological. Understanding the emerging phenomena of problems in the classroom require examining underlying levels of the system—the thoughts, feelings and motivations of those involved. This calls for the use of a cognitive lens.

### **Teachers Using a Cognitive Lens**

Many pre-service and novice teachers focus their attention on the externally observable aspects of their classrooms, minimizing their consideration of the cognitive nature of the teaching and learning process (Ethel & McMeniman, 2000; Joram & Gabriele, 1998; Wolff, van den Bogert, Jarodzka, & Boshuizen, 2015). Use of a cognitive lens—attending to the inner workings of students' thoughts, feelings and motivations—allows more expert teachers to connect prior knowledge to new learning, and interpret behaviors rather than simply describe them (Hogan, Rabinowitz, & Craven III, 2003; Wolff et al., 2017).

Dewey (1904) reflected upon the difference between novice and expert teacher thinking when laying out his ideals for teacher preparation. He eschewed the apprenticeship model of teacher preparation, where interns adopt the actions of their mentors, because it creates beginning teachers who "...seem to know how to teach, but they are not students of teaching." (p.10) He preferred the laboratory

model for the teaching practicum, to discover the implications of theory and get better at the thinking required for teacher development. Novice teachers, he observed, primarily attend to students' outer attention—the external behaviors they exhibit. In contrast, expert teachers are able to attend to students' internal attention, or their mental and emotional processes, because they are equipped with theories of learning and development to guide their inferences and conclusions. While Dewey does not use the term, this is essentially what Eilam and Poyas (2006; 2009) later describe as the use of a cognitive lens.

Throughout modern history there have been theories of different stages of teacher development as well as different components of teacher development—of particular interest, teacher noticing—and all support the importance of a cognitive lens in teaching. This study embraces the common thread between these theories, and seeks to assess how interns use a cognitive lens to take into account the thoughts and feelings of those involved in their classrooms.

**Theories of teacher development stages.** Many proposed stages of teacher development, created in the late 20<sup>th</sup> century, echoed Dewey's focus on developing a cognitive lens—even if they, too, do not mention it by name. Van Manen (1977) identified three progressive levels of reflection, moving from effectiveness of actions, to incorporating pedagogical implications, and peaking with inclusion of moral implications of that pedagogy. Berliner (1988) speculated five stages of development from novice to expert, starting with context-free rules targeting observable behaviors, and gradually incorporating more contextualized

aspects of thought and emotion. Ammon and Levin (1993) proposed five increasingly-constructivist levels of pedagogical conception, starting with what students do when shown, and culminating with students solving problems with teachers guiding their thinking across domains. All of these progressions include some increase in a teacher's use of a cognitive lens, and they inform many studies that have followed into recent times (e.g. H. Lee, 2005; Russ et al., 2016; van den Bogert, van Bruggen, Kostons, & Jochems, 2014).

**Theories of teacher development components.** Other researchers have proposed different elements or components of teacher development, such that teachers have the potential to grow in each of the areas rather than progress from one area to another as in the previously discussed stages. Many of these frameworks include aspects related to the cognitive lens. For example, in a seminal review of research on pre-service and beginning teacher development, Kagan (1992) identified components of teacher growth that included knowledge of students and metacognition—which necessitate a cognitive lens directed either at students', or teachers' own, thoughts and feelings. Later, Jay and Johnson (2002) proposed a typology of teacher reflective practice, with descriptive, comparative, and critical reflection—all of which can progress if teachers increase their use of a cognitive lens.

**Teacher noticing.** Similar to descriptive reflection, Van Es and Sherin (2002) describe how teachers “learn to notice”. Even within this narrow focus of noticing and interpreting events in the classroom—apart from deciding how to

respond to those events—teachers benefit from improved use of a cognitive lens. There are three aspects of noticing: identifying actions that are important, connecting actions to underlying principles of teaching and learning, and using contextual information to understand the actions. While the latter two aspects have obvious need of a cognitive lens, even the first aspect benefits from improved use of it. Identifying what actions are important to attend to may initially begin with visually scanning the room—something, unto itself, that novice teachers struggle with (van den Bogert et al., 2014)—but a cognitive lens adds important information such as the learning or emotion that underlies the action in question. Pre-service teachers may improve in each of the three aspects of noticing (Van Es & Sherin, 2002).

A major difference between novice and expert noticing and interpreting classroom events, is their use of a cognitive lens (Wolff et al., 2015). When examining video clips of classroom lessons, expert teachers were more likely to interpret the function of actions rather than just describe them, focus on student learning rather than outward behavior, and include multiple viewpoints rather than just their own (Wolff et al., 2015; Wolff et al., 2017). Additionally—and related to the default assumptions that impede understanding of complex systems—experts also used more information that was temporally distal to the event in question (Wolff et al., 2017).

### **Two Inter-Related Problem-Solving Skills**

As discussed in the work of Eilam and Poyas (2006; 2009), teachers must approach classroom problems with both an understanding of the classroom as a complex system, and the use of a cognitive lens. By building upon the field of complex systems learning, as described above (e.g. Grotzer & Basca, 2003; Perkins & Grotzer, 2005), We see that these two skills are themselves inter-related. In order to better grasp the causal relationships that exist within a complex system, teachers must overcome default assumptions—and thus take into account spatially and temporally distal, and non-obvious information—as well as make connections between the different levels of the system. A teacher who only takes into account the information at the time and place of a problem will be limited in her response; she may see an off-task student and simply redirect him back to his work. In contrast, a teacher who understands the complex system will take into account that the off-task student had an altercation earlier at recess and may need to be taken aside to process before he will be able to work.

In classroom problems, an especially important level of the system is the thoughts and feelings of those involved. This particular form of non-obvious information is only accessible with use of a cognitive lens. Teachers who are not using a cognitive lens only take into account the observable behavior, thus missing a large amount of what is happening for students and themselves; they may see a student distracting her classmates, and simply reprimand her from across the room in order to stop the behavior. In contrast, a teacher using a cognitive lens may take into account that the public reprimand may unnecessarily cause embarrassment to



this typically shy and fragile student; the teacher might also recognize that her desire to reprimand the student may actually be driven by unrelated feelings of irritation with a colleague, rather than the seriousness of the current situation.

Clearly, understanding the classroom as a complex system, and using a cognitive lens are distinct yet inter-related skills. Teacher educators would be well served to understand how these two skills interact with one another when their interns are solving problems in the classroom. Likewise, classroom researchers who incorporate the study of these skills will better capture the teaching process.

Studies of children, novice/expert comparisons, teachers, and pre-service teachers demonstrate that people can and do improve in both their understanding of complex systems, and in use of a cognitive lens. However, new tools and techniques can be used to better understand how these two skills develop over time and in relation to one another. The research question for this study is: what insights and understanding can be gained by using a new tool that captures an interns' problem-solving in regards to his/her complex-systems thinking and use of a cognitive lens; and furthermore, what insights and understanding can be gained by using dynamic analysis techniques to examine that data?

This study captures the dynamic relationship of those two skills, in the context of a full-year internship that concludes a comprehensive university-based teacher preparation program. Multiple times during the year, interns were asked to share their thinking in regards to a recent classroom problem—using a novel online tool specifically created for this study. The factors shared in their

descriptions were each separately coded for 1) whether they overcome the default assumptions that inhibit understanding the classroom as a complex system, and 2) how they use a cognitive lens. State space grids (DiDonato, England, Martin, & Amazeen, 2013; Lewis, Lamey, & Douglas, 1999)—a dynamic analysis technique that focuses on intra-participant variation and change (described in the methods section below)—were then used to examine the dynamic relationship between the two skills, and their joint development throughout the internship. I will demonstrate how the novel tool and innovative technique can be used to capture changes in the interns' complex-system thinking, in their use of a cognitive lens, in who their factors focus on, and in how they use their factors. In other words, I will demonstrate how teacher educators can investigate their interns' problem solving skills, and how researchers can use dynamic analysis to more fully understand the development of those skills.

## **Methods**

### **Participants**

This study takes place within the context of a larger, multi-year, multi-method study of teacher-intern development—and focuses on three interns during the 2016-2017 school year, in order to highlight the value of probing intern problem solving using dynamic analyses. Participation in the study was voluntary and uncompensated.

The internship is the final phase of the University of New Hampshire's (UNH) elementary teacher preparation program, resulting in teacher licensure as well as a Master's of Education degree. Two of those interns participated in the university's five-year program, joining their undergraduate and graduate work. The third intern—having previously graduated from a non-education-related major and worked for several years—pursued the Post-Baccalaureate option, which requires two years of graduate work to complete the same requirements. All three interns were Caucasian females, and ranged in age from 23 to 27.

### **Procedures**

A survey was distributed to the interns through an online platform, Qualtrics. Its purpose was to probe their thinking used when problem-solving in their classroom. The survey was administered multiple times during their 2016-2017 internship: initially, in the fall at the start of their internship; then, in the winter at the end of the first semester, and; finally, in the spring at the end of their internship. The results were analyzed, identifying the factors used in their problem solving, how those factors were used, how they indicate the interns' view of the classroom as a complex system, and their use of a cognitive lens.

### **Measures**

The survey was developed during the spring of 2016 using a process adapted from Gehlbach and Brinkworth (2011). This process uses an iterative method that synthesizes scholarly knowledge and the voice of prospective respondents, to create survey items that accurately represent the desired construct

and will be appropriately understood by survey participants. At the end of the development process, the pilot survey was distributed to 15 teachers. Data and feedback from the pilot informed final modifications to the survey.

The survey (see Appendix A) has four open-ended questions, which together are designed to assess the interns' thinking when problem solving in the classroom: 1) The interns described a recent time they had to make a decision either in response to student behavior or difficulty in student learning, including what they chose to do in response; 2) They listed other possible options they considered when making that decision; 3) They listed the factors they took into account when making the decision; and 4) They described how they used the factors to decide between the options.

### **Primary Analysis**

Data were downloaded, compiled, and blinded to obscure identification of participants as well as timing of the survey, creating nine anonymized responses.<sup>6</sup> For each response, the answers to the first and final questions were combined into a single narrative, describing the classroom problem and the thinking involved in the intern's problem solving. The second and third questions in the survey—asking to list the alternative options considered, and factors used to choose an option—were not directly analyzed, but rather provided support for interns' description of their thinking (Fischer & Kennedy, 1997; Urzúa & Vásquez, 2008). Two coders analyzed the combined narrative for each response, first to identify the

factors and then to code each factor using three separate coding schemas, as described below.

**Identifying factors.** The two coders each separately analyzed the narrative, identifying within each sentence any options that the intern had considered and any factors the intern used to choose between options. The coders then discussed and came to consensus on the list of factors and options, and identified whether each factor was used to support or exclude a chosen or disregarded option.

**Seeing the classroom as a complex system.** In order to problem-solve within a complex system, it is necessary to overcome many default assumptions that stand in the way of complex causal reasoning. Three such assumptions that are particularly germane to this study are taking into account non-obvious (rather than the default of obvious) information, as well as spatially and temporally distal (rather than the default of proximal) information (Grotzer, 2012).<sup>7</sup> Interns who are not overcoming any of these default assumptions (thus only considering obvious information and spatially and temporally proximal information) are not demonstrating an understanding of the classroom as a complex system. In contrast, those who are overcoming one or more of those default assumptions are increasingly viewing the classroom as a complex system.

In the first stage of analysis each factor was analyzed for whether it was obvious or non-obvious, whether it was spatially proximal or distal, and whether it was temporally proximal or distal. Factors that simply relied on an intern's

sensory input were considered obvious (e.g. “student was making noise while moving”, or “student was calm at the time”), while factors that require additional input or information were non-obvious (e.g. “many students appreciate humor”, or “that restriction doesn’t allow kids to be kids”). Factors are considered spatially proximal that used information from within the same physical space as the problem-solving process (e.g. a teacher intervening on a playground incident taking into consideration what is happening on the playground), or spatially distal if they utilize information from outside of that space (e.g. a teacher intervening in the classroom taking into consideration what happened on the playground). When factors utilize information that comes from the same timeframe (e.g. within that same class period) then it was coded as temporally proximal, but when it comes from the past or future (e.g. what happened last week, or intending to build a foundation for future learning) then it was coded as temporally distal.

The two coders separately coded each factor, and then compared their codes. Initial agreement was assessed at 86%. The differences were discussed and resolved until there was 100% agreement. A composite score was created for each factor using this schema; each factor receives a point for each default assumption that is overcome. For example, a factor that is obvious and both spatially and temporally proximal is scored as a zero, whereas a factor that is non-obvious and both spatially and temporally distal is a three (see Table 1).

Table 1. <i>Explanations and examples for scoring of intern's factors on complexity</i>			
<b>Score</b>	<b>Description</b>	<b>Example</b>	<b>Explanation</b>
0	The factor does not overcome any of the three complexity-related default assumptions. It is obvious (rather than non-obvious). It is temporally proximal (rather than distal), and spatially proximal (rather than distal).	<i>The student got up out of his seat after being asked to remain seated.</i>	It's in the here and now, and was simply seen.
1	The factor overcomes one of the complexity-related default assumptions. It is non-obvious (rather than obvious). It is still in the here and now—temporally and spatially proximal (rather than distal).	<i>The student was <b>embarrassed</b> when her classmate refused to work with her.</i>	It's still in the here and now, but the intern had to think about the student's feelings.
2	The factor overcomes two of the complexity-related default assumptions. It is non-obvious. It is also either temporally distal or spatially distal.	<i><b>Last week</b> the student was <b>frustrated</b> when he struggled with division problems.</i>	It's still about the classroom, but the intern thought back to a different time, and thought about the student's past feelings and learning.
3	The factor overcomes all three of the complexity-related default assumptions. It is non-obvious as well as both temporally distal and spatially distal.	<i><b>At home</b>, this student is <b>used to</b> adults <b>constantly</b> ignoring his disruptive behaviors.</i>	This is about the student's thoughts in a different time and place.

**Using a cognitive lens.** Complex systems have different levels of interactions, and understanding observable problems in the complex system of a classroom calls for teachers to consider phenomena on underlying levels (Van Es

& Sherin, 2002; Wolff et al., 2017), such as the thoughts and feelings of those involved; this requires use of a cognitive lens, as described in the review above. In the second stage of analysis each factor was analyzed for whether it used information at only a surface level (e.g. “the student yelled”, or “the rest of the kids stopped working”), or information that uses a cognitive lens (e.g. “the student was embarrassed”, or “the other students needed to feel safe”), or information external to the incident (e.g. “the school rule is no running” or “the purpose of a book club is for students to share their thinking”).

All factors at the surface level or using a cognitive lens—thus, excluding external factors—were also identified as focusing on the student in question, on the intern themselves, or on others involved. Therefore, there were seven codes for this analysis: external factor, surface level regarding the student in question, surface level regarding self, surface level regarding others, cognitive lens regarding student, cognitive lens regarding self, and cognitive lens regarding others.

After the factors were coded for complexity (as described above), they were separately coded for use of a cognitive lens. The two coders separately coded each factor, and then compared. Initial agreement was assessed at 91%. The differences were discussed and resolved until there was 100% agreement. There is no composite score for this coding schema, but rather, seven categories: external criteria; surface level for the student in question, self, or others; cognitive lens for the student in question, self, or others.



**Factor's role in decision-making.** In addition to the two etic coding schemas used, a third coding schema emerged from the data. In the interns' descriptions of the problem, and their problem solving process, they described factors either in relation to the chosen option (e.g. their actual response to the problem) "Option A", or in relation to alternative options (e.g. other responses they were considering) "Option B". Within each of these two groups, two sub-groups were present—those factors that were in favor of their respective option, and those that detracted from the respective option. Therefore, there existed four categories of factors in regards to use in decision-making: 1) in favor of Option A, such as "I had him sit at the back because his movements were distracting other students"; 2) against Option A, such as "while I didn't want to embarrass him, having to sit back there might have that effect"; 3) in favor of Option B, such as "knowing that it's right before recess, maybe I should have just let him move around" and; 4) against Option B, such as "I didn't discipline him more sternly because the initial instructions were given in a group setting where it's difficult for him to listen".

These four categories are then re-grouped together in consideration for which direction they moved the intern in her decision-making—towards the chosen option, or towards alternatively considered options (see Table 2). The first and third categories—factors in favor of Option A, and factors against Option B, respectively—are in support of the chosen option; these are color-coded in shades of blue, the former dark blue and the latter light blue. In contrast, the fourth and

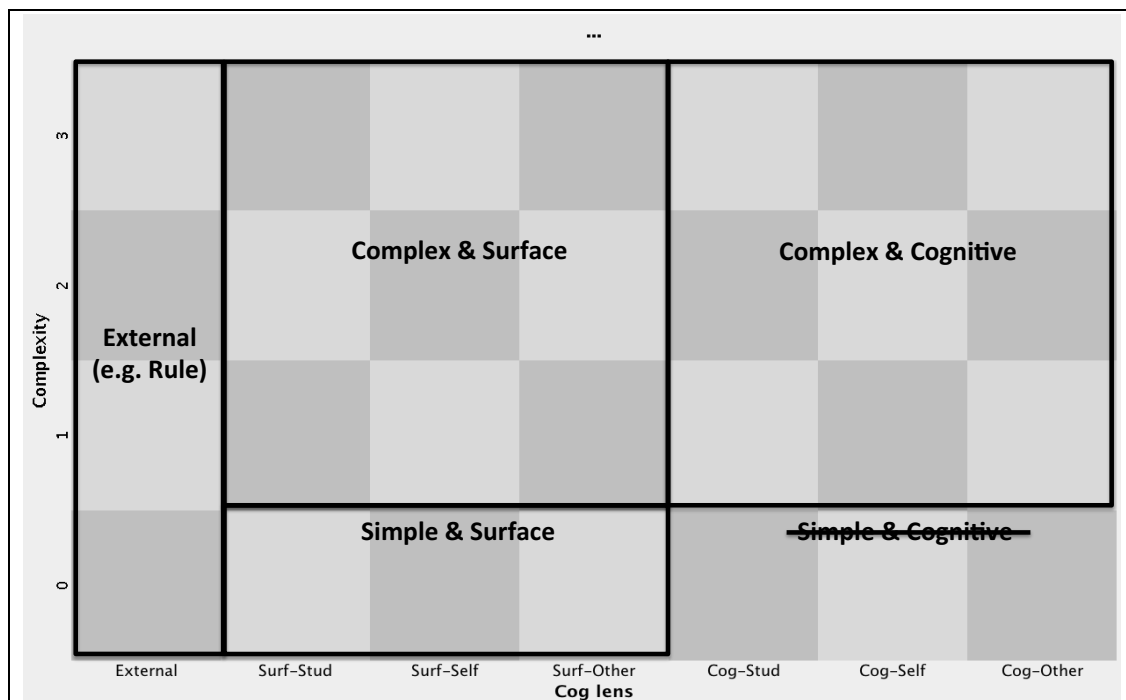
second categories—factors in favor of Option B, and factors against Option A, respectively—are considered to be in support of alternative options; these are color-coded in shades of red, the former dark red and the latter light red. Therefore, in visual representations of the data, each factor is represented as one of four colors—dark or light blue if they are weighed in support of the chosen option, and dark or light red if they are weighed in support of alternatively considered options.

Table 2. <i>Color-coding of factor's role in decision-making</i>			
	Option A (chosen option)	Option B (alternatively considered options)	
In favor of option	Pro- Option A	Pro- Option B	
Against option	Anti- Option A	Anti- Option B	
Note. Color of cells corresponds to color-coding of factors in state space grids. Blue (dark or light) are in support of the chosen option. Red (dark or light) are in support of alternatively considered options.			

**State space grids.** After analysis was complete, participant responses were un-blinded to identify participant and time of survey, allowing intra-intern data over the course of the year to be appropriately connected. This data was imported into Gridware (Lamey, Hollenstein, Lewis, & Granic, 2004) in order to create state space grids (Hollenstein, 2013; Lewis et al., 1999). State space grids (SSGs) allow visualization of multiple data points on two or three dimensions

(Hollenstein, 2013), and the ability to analyze complex dynamic systems (van Vondel, Steenbeek, van Dijk, & van Geert, 2017).

In a basic sense, a SSG is essentially a scatterplot graph that can utilize ordinal, nominal or categorical variables, by displaying it as categorical on both the X- and Y-axes. This creates a grid—in the case of the present study with four rows and seven columns, resulting in 28 individual cells (see Figure 1)—where each cell is a possible “state” that a system may exist in at any given time or



**Figure 1. Regions of the SSG.**

**Axes** - Y-axis represents the number of default assumptions a factor overcomes (obvious rather than non-obvious, temporally proximal rather than distal, and spatially proximal rather than distal); X-axis represents the use of surface level information versus cognitive lens, and whether the factor is focused on the student in question, self, or others involved.

**Regions** – External criteria are pre-determined dictates from outside of the incident, such as a school rule. Simple-and-surface factors do not overcome any of the default assumptions or use a cognitive lens. Complex-and-surface factors do overcome one or more of the default assumptions but don't use a cognitive lens. Complex-and-cognitive factors do overcome some of the default assumptions and also use a cognitive lens. There is no Simple-and-cognitive region, because using a cognitive lens by definition is non-obvious and thus results in a minimal complexity score of 1.

instance. Additionally, a third dimension of data may be represented, with each point on the grid signified in an appropriate color. The purpose of a SSG is to go beyond conventional analysis, representing the data as a dynamic system. This is not simply another analysis tool, but rather a tool that supports a fundamentally different way to think about and analyze data—a dynamic systems approach (Hollenstein, 2013).

While many conventional methods of assessing development focus on the variability between individuals or groups of individuals, dynamic systems approaches—such as SSGs—seek to capture variability for an individual over time (DiDonato et al., 2013). At each time that an intern completed the survey, she used multiple factors (ranging from 9 to 25) in her problem-solving. Some of those factors could be obvious, proximal, and surface level about the student in question; other factors could be non-obvious, temporally distal but spatially proximal, and use a cognitive lens about the student’s classmates; and yet other factors could be many other combinations. The intern may use a wide and dispersed variety, or many factors that cluster together (DiDonato et al., 2013).

An intern’s problem-solving at any given time is represented by both the clustering of factors used, as well as any variation—which conventional methods may mistake as “noise”—that occurs; this, together, is her SSG profile. Examining how the intern’s profile changes over time provides a better understanding of her growth and learning (Hollenstein, 2013). Each intern’s survey response was plotted on a SSG, with the placement of each factor

represented as a point in two dimensions—the y-axis representing the number of complexity-related default assumptions the factor overcame, and x-axis representing the seven categories of how a cognitive lens was used. Additionally, the points were color-coded to represent whether the factor was used to support or oppose either the chosen option or an alternatively considered option. Thus, a single SSG represents the intern's problem solving at that time, and comparison between her grids demonstrates change in problem solving over time.

**SSG regions.** Each SSG has four rows and seven columns, resulting in 28 individual cells. In order to aid in visualization and analysis (Hollenstein, 2013), the cells are grouped into four regions (see Figure 1): 1) external criteria comprises the four cells in the first column, and includes factors of any complexity that originate from outside of the context (e.g. school rules or other dictates); 2) simple-and-surface comprises three cells with a complexity level of zero utilizing surface-level information about the student in question, self, or others involved (e.g. the student was yelling); 3) complex-and-surface comprises nine cells, also utilizing surface-level information about the student in question, self, or others involved—but at a complexity level between one and three using information that is non-obvious and possibly spatially and/or temporally distal (e.g. a new student has a past history of running away from his classroom and school); and 4) complex-and-cognitive comprises nine cells at a complexity level between one and three that utilize a cognitive lens towards the student in question, self, or others involved (e.g. the student had a good morning, but the math lesson made her feel

self-conscious). There are three cells that do not fall within any of the four regions, because it is not possible for factors to reside there—use of a cognitive lens is by definition, non-obvious, thus there is no region with a complexity of zero in the right-side of the SSG.

By viewing these four regions of the SSG, it is possible to identify meaningful clustering of factors, and more easily analyze an intern's profile. The region of external criteria was not commonly used, and is qualitatively different from the other three regions—factors in this region typically are meant to usurp a teacher's decision-making process, providing a pre-determined dictate. Most of the factors in this study fell within the three remaining regions; these can most easily be understood as whether a factor overcomes any complexity-related default assumptions, and if so, whether it uses a cognitive lens or not. In other words, simple-and-surface factors do not overcome any of the default assumptions or use a cognitive lens, complex-and-surface factors do overcome one or more of the default assumptions but don't use a cognitive lens, and complex-and-cognitive factors do overcome some of the default assumptions and also use a cognitive lens.

### **Secondary Analyses**

Using the data in the SSGs, I performed three kinds of secondary analysis in order to understand isolated aspects of each intern's change over time. These conventional forms of analysis reveal the regions where interns' factors cluster, who the interns focus on, and how the factors were used in the interns' decision-making process.

**Regions.** First, I calculated the percentage of factors in each region, and created a chart representing each of the three time points in order to identify potential changes in clustering over time (e.g. Figure 2a). This provides insight into whether, over the course of the year, an intern changes in her view of the classroom as a complex system—if she shifts from a large proportion of her factors being simple-and-surface to either complex-and-surface or complex-and-cognitive, then she has improved in being able to think outside of the time and place of the problematic incident. This analysis and chart also illuminates whether she changes in her use of a cognitive lens—if she shifts from primarily simple-and-surface or complex-and-surface, to primarily complex-and-cognitive, then she has improved in taking into account the thoughts and feelings of those involved in the problem she is attempting to solve.

**Focus.** Secondly, I conducted an analysis combining individual SSG columns based on the person(s) the factor focused on; for example, the factors that used surface-level information about the student in question were combined with the factors that used a cognitive lens on the student in question. This results in four possible foci—student in question, self, others involved, and external criteria—used to create a chart representing each of the three time points in order to identify potential changes in focus over time (e.g. Figure 2b). This provides insight into whether, over the course of the year, an intern changes who she takes into account when solving a problem. An intern may start off with all of her factors being about the student involved, but over time be able to also consider the

impact on the rest of the students in the class. Likewise, an intern may start off either mostly focused on herself or completely disregarding herself, and over time be able to take her own needs into account in an appropriate way.

**Use in decision-making.** Lastly, I identified the number of factors that supported either the chosen option or the alternatively considered options, combining the light and dark shades of each color (described above). A chart showing the proportion of factors supporting the chosen or alternatively considered options—blue and red, respectively—for each time point, allows examination of potential changes in factors' role in decision-making over time (e.g. Figure 2c). For example, an intern who starts off with very few factors supporting her chosen option but then increases the proportion of those throughout the year, may be demonstrating growing confidence. Or, if an intern has no factors that support alternatively considered options, then she is not critically analyzing her choices.

## **Results and Discussion**

The analyses in this study are intra-participant in nature, providing a dynamic understanding of each intern's problem solving at three time points throughout her full-year internship, as well as patterns of change between those time points. For each intern, there are three SSGs: one for her problem solving in the fall at the start of the internship, one midway through in the winter, and one at the end in the spring. For each of the three interns, I first present the findings of



the three secondary analyses—the proportion of factors in the different regions, with the different foci, and taking different roles in their decision-making.

It is important to remember that even though the secondary analyses display the intern's use of a cognitive lens and her understanding of the classroom as a dynamic and complex system, those analyses do not represent the intern's thinking itself in a dynamic and complex way—that is the purpose of the SSGs. To that end, I then present how visualization of the SSGs can reveal patterns in the dynamic relationship of the interns' factors—beyond what can be gleaned from the secondary analyses—thus providing examples of the value for research to utilize dynamic analysis techniques. Each intern's section then concludes with a discussion of potential use for a teacher educator, including possible interpretations—rather than assertions—regarding the analyses for each of the intern's data.

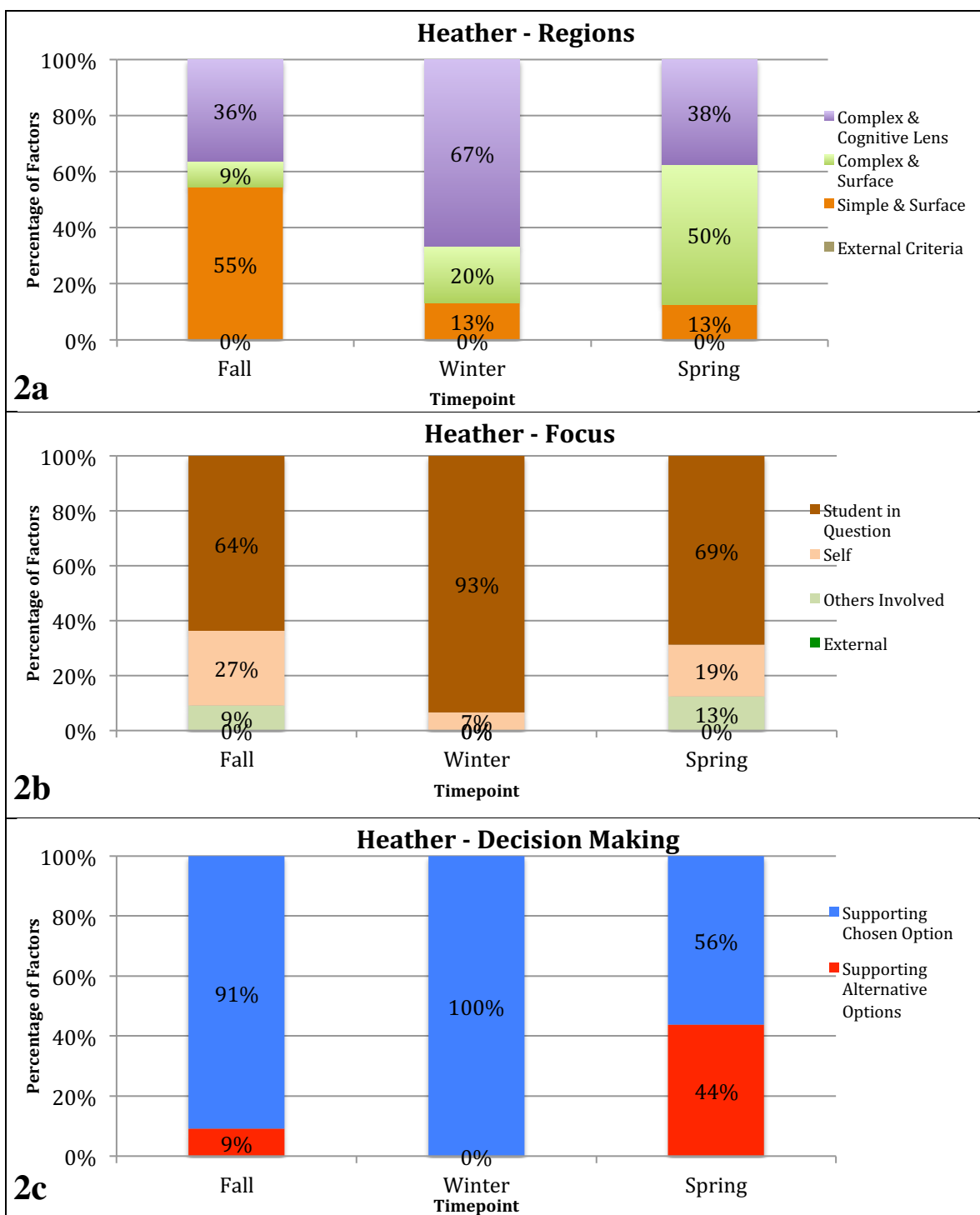
## **Heather**

**Regions.** Heather showed considerable change throughout the year in regards to the distribution of her factors in the four regions (Figure 2a). In the fall, approximately half of her factors were simple (55%) and the other half were complex—of the complex factors, the majority were complex-and-cognitive, and the small remainder were complex-and-surface (36% and 9%, respectively). In both the winter and spring, only a small minority of factors (13% each time) was simple; of those factors that were complex, in the winter a larger proportion used a cognitive lens rather than surface level information (67% vs. 20%, respectively),

while in the spring the reverse was true (only 38% complex-and-cognitive vs 50% complex-and-surface).

**Focus.** In regards to the focus of Heather's factors, there was noticeable change from fall to winter, with her spring time-point largely mirroring the fall (Figure 2b). In both the fall and spring, approximately two-thirds of her factors focused on the student in question (64% and 69%, respectively), with a large minority focusing on self (27% and 19% respectively), and the small remainder focused on others involved (9% and 13% respectively). In the winter, between these two time points, however, 93% of her factors focused on the student in question, and all of the small remainder focused on self, with no factors focused on others involved.

**Decision-making.** Perhaps the largest change for Heather was in the role of the factors in her decision-making (Figure 2c). Virtually all of the factors in the fall and winter were in support of her chosen option (91% and 100%, respectively). In the spring, however, there was almost an even split between factors supporting her chosen option versus those supporting alternatively considered options (56% vs. 44%, respectively).

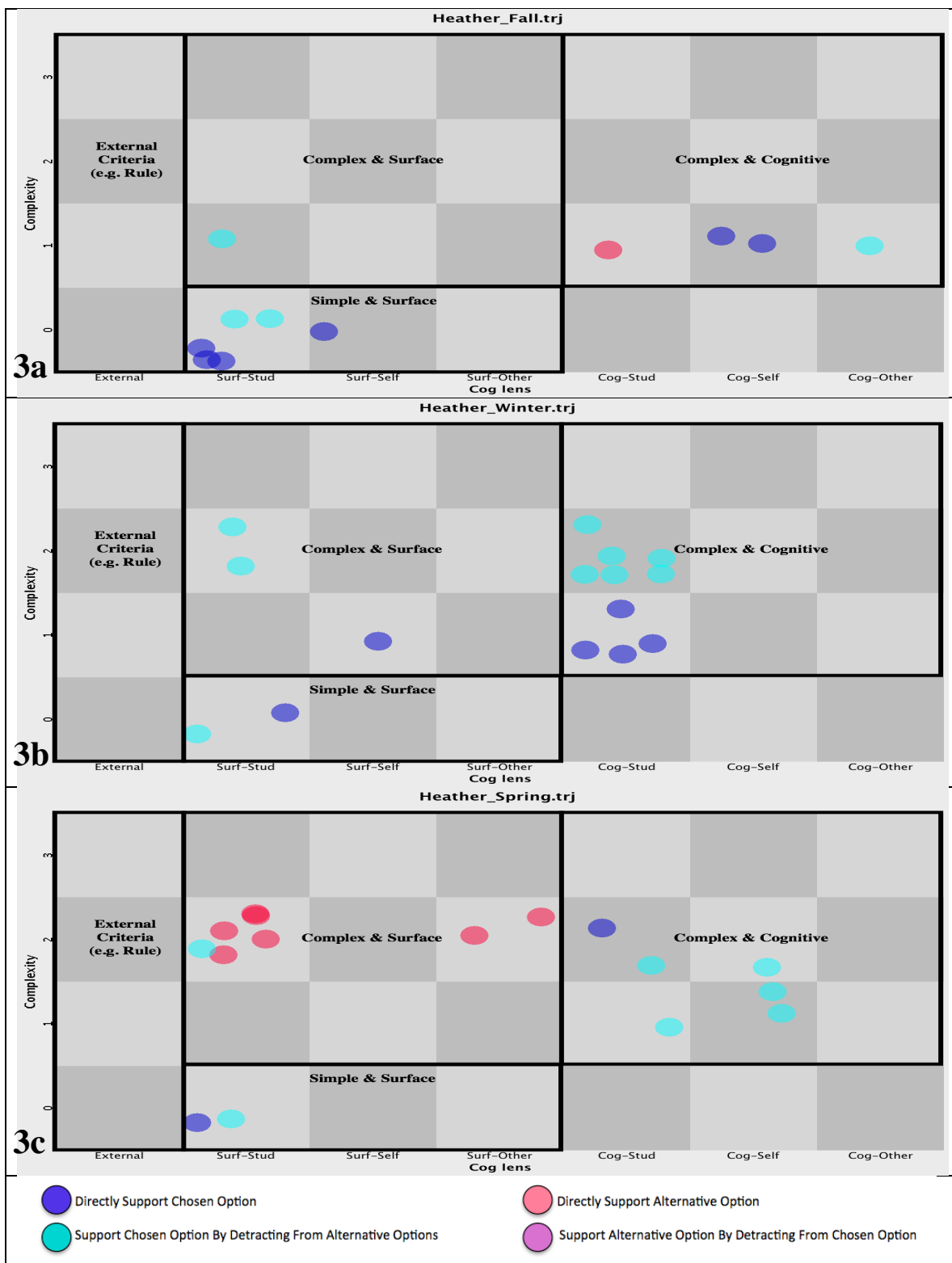


**Figure 2. Heather's Problem-Solving.**

**2a** – The percentage of Heather's factors that fall within each of 4 regions—complex-and-cognitive, complex-and-surface, simple-and-surface, and external criteria—in the fall, winter, and spring.

**2b** – The percentage of Heather's factors (regardless of being surface level or using a cognitive lens) that focus on either the student in question, self, others involved, or external criteria, at the fall, winter, and spring time points.

**2c** – The percentage of Heather's factors that support the option they chose in response to the problem, versus that support alternatively considered (but non-chosen) options, at the fall, winter, and spring time points.



**Figure 3. Heather's SSGs.**

3a, 3b, and 3c – State Space Grids of Heather's factors used in classroom problem solving during the fall, winter, and spring, respectively. Y-axis represents the number of default assumptions a factor overcomes (obvious rather than non-obvious, temporally proximal rather than distal, and spatially proximal rather than distal); X-axis represents the use of surface level information versus cognitive lens, and whether the factor is focused on the student in question, self, or others involved. Colors of points represent how each factor was used in decision-making, supporting either the chosen or alternatively considered options.

**Research use of SSGs.** While the secondary analyses demonstrate change for Heather over time, visual inspection of the SSGs provides a more dynamic picture of those changes. This section will explore two such uses. First, the data regarding the focus of Heather's factors (Figure 2b) could easily be interpreted as there being little change over the year, ascribing the winter data as an anomaly—but dynamic analysis using the SSGs shows that change did indeed occur. Secondly, the data regarding Heather's use of her factors (Figure 2c) accurately shows a change in the spring, but use of the SSGs provides deeper vision of that change.

***Factors' focus.*** Figure 2b shows that in the fall the factors were largely focused on the student in question, but looking at the SSG (Figure 3a) shows that this is only true for surface level factors—the small number of factors using a cognitive lens are well distributed between the three foci. In the winter (Figure 3b), the focus within surface level factors stays similarly concentrated, but the cognitive lens is now also exclusively focused on the student in question, solely accounting for the large shift between the two time points seen in Figure 2b. While Figure 2b suggests that the spring factors largely return to the distribution seen in the fall, examining the SSG in Figure 3c reveals that it is dissimilar in regards to the surface versus cognitive lens factors.

On the surface (left) side of the SSG, the majority of factors are still focused on the student in question, with a few focused on others involved and none focused on self; in contrast, on the cognitive lens (right) side of the SSG,

there is an even split between a focus on the student in question and focus on self, with none focused on others involved. The visualization of the cognitive lens side of the grid challenges the idea that the spring data “returns” to the same state as the fall. Rather than the winter data being considered “noise” that distracts from the static nature of the focus of Heather’s factors throughout the year, the dynamic analysis using SSGs shows that Heather’s focus was not static at all.

*Factors’ role in decision-making.* Visual examination of the SSGs also provides insight regarding the distribution of factors in support of Heather’s chosen option versus the alternatively considered options. Figure 2c shows that in the spring the factors are approximately evenly split between which options they support, but the SSG (Figure 3c) shows an uneven distribution of those factors. All of the factors in support of alternatively considered options, are complex-and-surface level and exclusively focused on students—either the student in question or others involved. The majority of factors that support the chosen option, however, is complex-and-cognitive and focuses on either the student in question or Heather herself. This presents an interesting question for future research, which would not be considered without the dynamic analysis of the SSGs; is it common for interns who have shown the ability to use a cognitive lens, to then only think at a surface level when they first begin to think more critically about alternative options?

**Potential use by a teacher-educator.** In the fall, Heather starts out with either simple or low-complexity factors, but throughout the year becomes

progressively more complex. But this is primarily in regards to factors that are about non-chosen options. In the winter, when she considers how to support a frequently struggling girl who is trying to avoid work, Heather only thinks outside of the here or now when she is thinking about *why not* to choose alternatively considered options—such as she can't send the girl to the nurse because that's a common way to avoid work, but shouldn't use discipline because the girl may just be responding to earlier disruptions in routine. All of the factors that are reasons why she *should* do what she chose, were within the here and now, although most did use a cognitive lens—she talked with the girl and let her take a quick walk in order to connect with her and distract her from the headache that she was complaining about. A teacher educator could find it useful to explore with Heather why it is that only non-chosen options elicited thinking outside of here and now—which continued in the spring.

In the spring, Heather wrote about intervening at the end of the day when one boy had been picking on another all day. During this problem solving, not only were her most complex factors about alternatively considered options rather than her chosen option, but also most of them were actually *in support* of those non-chosen options. While these factors in support of non-chosen options were amongst the most complex she considered, they were exclusively surface level rather than cognitive—she should have talked to both boys in the hallway since the targeted boy rarely has this kind of problem with others, or she should have sent the aggressor to the office earlier when he had thrown a pair of scissors.

None of the factors supporting alternative options delved into the thoughts or feelings of anyone involved.

During this spring problem solving, the only factors that used a cognitive lens were those that supported her chosen option—to talk with and then move the aggressor away from the other boy. In supporting this option, she took into account the behavioral learning that the misbehaving boy needed, the fact that she had imperfect knowledge of the prior incidents earlier in the day, and other considerations of thoughts and feelings for the boys and herself.

It may be initially safer to question oneself at the surface level, but critical reflection requires using a cognitive lens for that purpose as well. A teacher educator could potentially help Heather think about the learning and feelings that her chosen option may have undermined, or the emotional and learning advantages of some of the alternatively considered options.

## **Peyton**

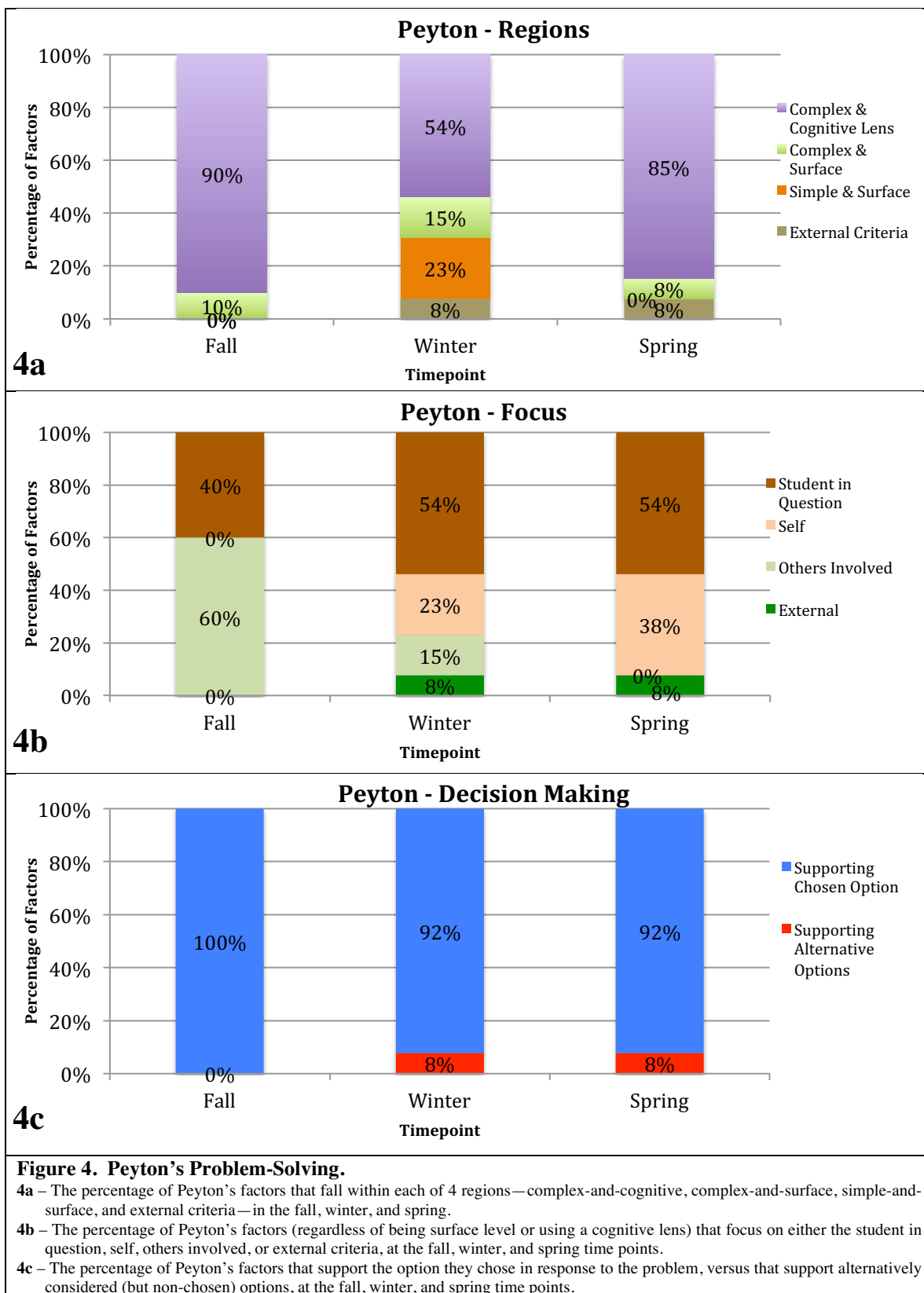
**Regions.** Peyton showed a change in regional distribution of factors throughout the year, although the distribution in fall and spring are very similar (Figure 4a). In both fall and spring the vast majority of factors (90% and 85%, respectively) are complex-and-cognitive; in the fall the small remainder of factors are all complex-and-surface, while in the spring the remainder are evenly split between complex-and-surface and external criteria. At neither time point does she use any factors that are simple-and-surface. In the middle of the year, however,

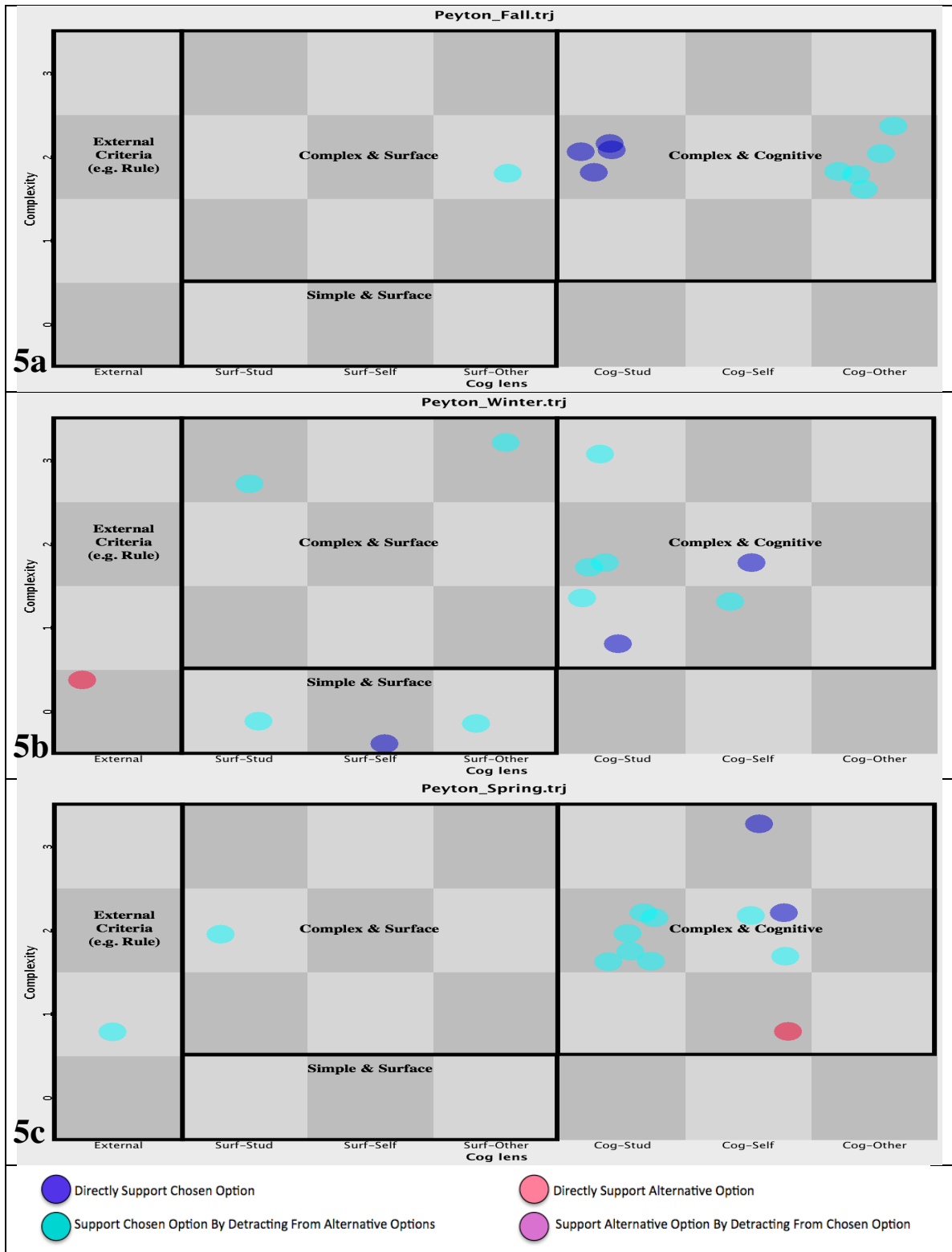


she uses factors in all four regions, with only half located in complex-and-cognitive and a quarter in simple-and-surface.

**Focus.** Peyton also showed considerable change in regards to who her factors focused on (Figure 4b). In the fall her factors were exclusively, and almost evenly split between, a focus on the student in question and a focus on others involved (40% and 60%, respectively). In the winter and spring, approximately half of the factors are still focused on the student in question, but instead of the other half being solely focused on others involved, the remaining half of factors is more dispersed; in the winter only 15% are focused on others involved, and in the spring no factors are. At both the winter and spring, most of the other half is focused on self (23% and 38%, respectively), with the small remainder coming from external criteria.

**Decision-making.** There is very little change over time for Peyton in regards to whether factors were used in support of the chosen option versus alternatively considered options (Figure 4c). In the fall, all of her factors were in support of her chosen option, and in the winter and spring 92% of her factors were in support of her chosen option.





**Figure 5. Peyton's SSGs.**

**5a, 5b, and 5c** – State Space Grids of Peyton's factors used in classroom problem solving during the fall, winter, and spring, respectively. Y-axis represents the number of default assumptions a factor overcomes (obvious rather than non-obvious, temporally proximal rather than distal, and spatially proximal rather than distal); X-axis represents the use of surface level information versus cognitive lens, and whether the factor is focused on the student in question, self, or others involved. Colors of points represent how each factor was used in decision-making, supporting either the chosen or alternatively considered options.

**Research use of SSGs.** This section will illustrate two ways in which the dynamic analysis using SSGs provides an understanding beyond the secondary analyses presented. First, while Peyton shows minimal change in whether her factors support her chosen option versus alternatively considered options (Figure 4c), the SSGs do show a steady shift in how those factors support her chosen option. Secondly, visual analysis of the SSGs shows a pattern of dispersal that is consistent with dynamic transitions (DiDonato et al., 2013), and would not be detected otherwise.

*Factors' role in decision-making.* Despite the limited change in how factors were used as shown in Figure 4c, examination of the SSGs does provide some additional insights. Figures 5b and 5c do show that the single factor supporting non-chosen options is located in a different place on the two SSGs at those time points—a simple external criteria in the winter, and in the spring a low complex-and-cognitive. More importantly, within the rest of the factors that support the chosen option, there is a shift throughout the year in the proportion that do so directly versus those that do so by detracting from the alternatively considered options. In the fall, there is almost an even split between the two, but in the winter and spring the latter becomes increasingly predominant. Heather also showed a similar gradual increase in the proportion of factors that detract from the alternatively considered options—future research could explore whether this is a common pattern.

*Factors' dispersal.* Visual inspection of the three SSGs also reveals a broader pattern of change over the three time points moving from tight clustering, to wide dispersion, back to different and slightly less-tight clustering. In the beginning of the internship, virtually all of the factors are in the complex-and-cognitive region; this is shown in the secondary analysis (Figure 4a), but Figure 5a shows further clustering by how the factor supports the chosen option—factors that directly support the chosen option (dark blue) are exclusively focused on the student in question, while factors that detract from the alternatively considered options (light blue) are exclusively focused on others involved. By the end of the internship (see Figure 5c), the factors that detract from alternatively considered options are primarily focused on the student in question, a variety of kinds of factors are focused on the intern herself, and no factors are focused on others. In the winter—in between these two different clustering patterns—the factors are highly dispersed; there is a factor in every row and in six of the seven columns. As discussed in the following subsection regarding teacher educator use, this pattern is recognized as a common structure of growth in dynamic systems; future research could specifically focus on the conditions that nurture this pattern for intern problem-solving.

**Potential use by a teacher-educator.** Teachers, and those becoming teachers, are commonly told to be selfless and have a pure focus on students—but teaching is an interactional relationship that requires understanding the role of self, as well (Rodriguez & Solis, 2013; Rodriguez & Mascio, 2018). In the fall, Peyton

uses no factors focused on herself, but that changes during the year. By the spring, one-third of her factors are focused on self, with a variety of complexity levels and used in a variety of ways in her decision-making. The transition in her thinking may be of particular interest to a teacher educator.

A dynamic understanding of learning—in this case, Peyton’s learning to incorporate self into her teaching decisions—anticipates a transitional phase to appear unstructured (DiDonato et al., 2013). A learner reorganizes her thinking when she makes large changes in her cognition, many times outwardly appearing as a “dip” or regression in ability immediately before a large jump (Dawson-Tunik, Commons, Wilson, & Fischer, 2005; Gershkoff-Stowe & Thelen, 2004; Granott, Fischer, & Parziale, 2002). Peyton’s wide dispersal of factors in her winter SSG—more diverse than either of the other two interns at any time point—may be evidence of such reorganization.

This is not to suggest that tight clustering is necessarily better than using dispersed factors for any given problem-solving situation. There is good reason to want an intern to take a wide variety of things into consideration when deciding how to respond to a behavioral or learning difficulty in her classroom. As a teacher educator—like any educator—moments of change or difference, however, provide unique opportunities to understand learners. What is it about the winter problem that made Peyton’s process so different? Was it a moment of reorganization in her development, was it idiosyncratic to that particular problem,

or was it contextual in nature? The SSGs can provide great fodder for teaching and learning conversations.

## **Sharon**

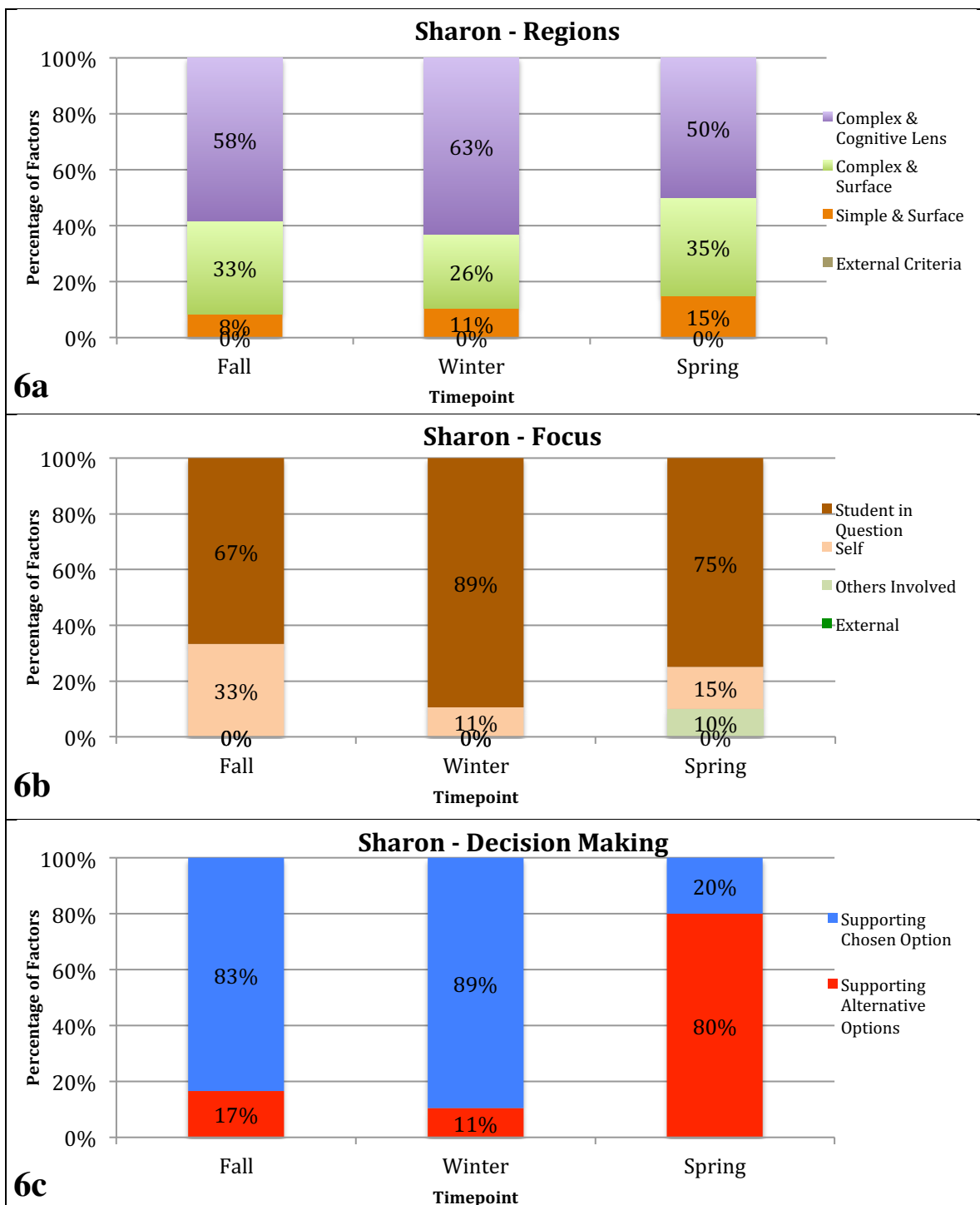
**Regions.** Sharon showed little change in the proportion of her factors in each region, over the course of the year (Figure 6a). At each time point, half or slightly more than half of her factors were complex-and-cognitive (ranging from 50%-63%), a large minority were complex-and-surface (26%-35%), and the small remainder were simple-and-surface (8%-15%). She did not use any external criteria at any of the time points.

**Focus.** Sharon did show some small change in who the factors focused on, although the majority of factors always focused on the student in question (Figure 6b). In the fall, two-thirds of her factors focused on the student in question, and the remaining third focused on self. In the winter, the proportion of factors focused on the student rose to 89%, with the small remainder still focused on self. In the spring, 75% of her factors still focused on the student in question, but the other quarter was split between self and others involved. As already reported, none of her factors at any time point came from external criteria.

**Decision-making.** Sharon had significant change in how she used factors in her decision-making throughout the year (Figure 6c). In the fall and winter, the vast majority of her factors were supportive of her chosen option (83% and 89%, respectively). This is well-aligned with the other two interns, as well as an

understanding of “confirmation bias”—the natural inclination to notice evidence that confirms our beliefs, and overlook evidence that challenges those beliefs (Gehlbach & Brinkworth, 2008). In the spring, however, the proportion reversed with only 20% of her factors used to support her chosen option, and 80% in support of alternatively considered options. This distribution was unique to Sharon.



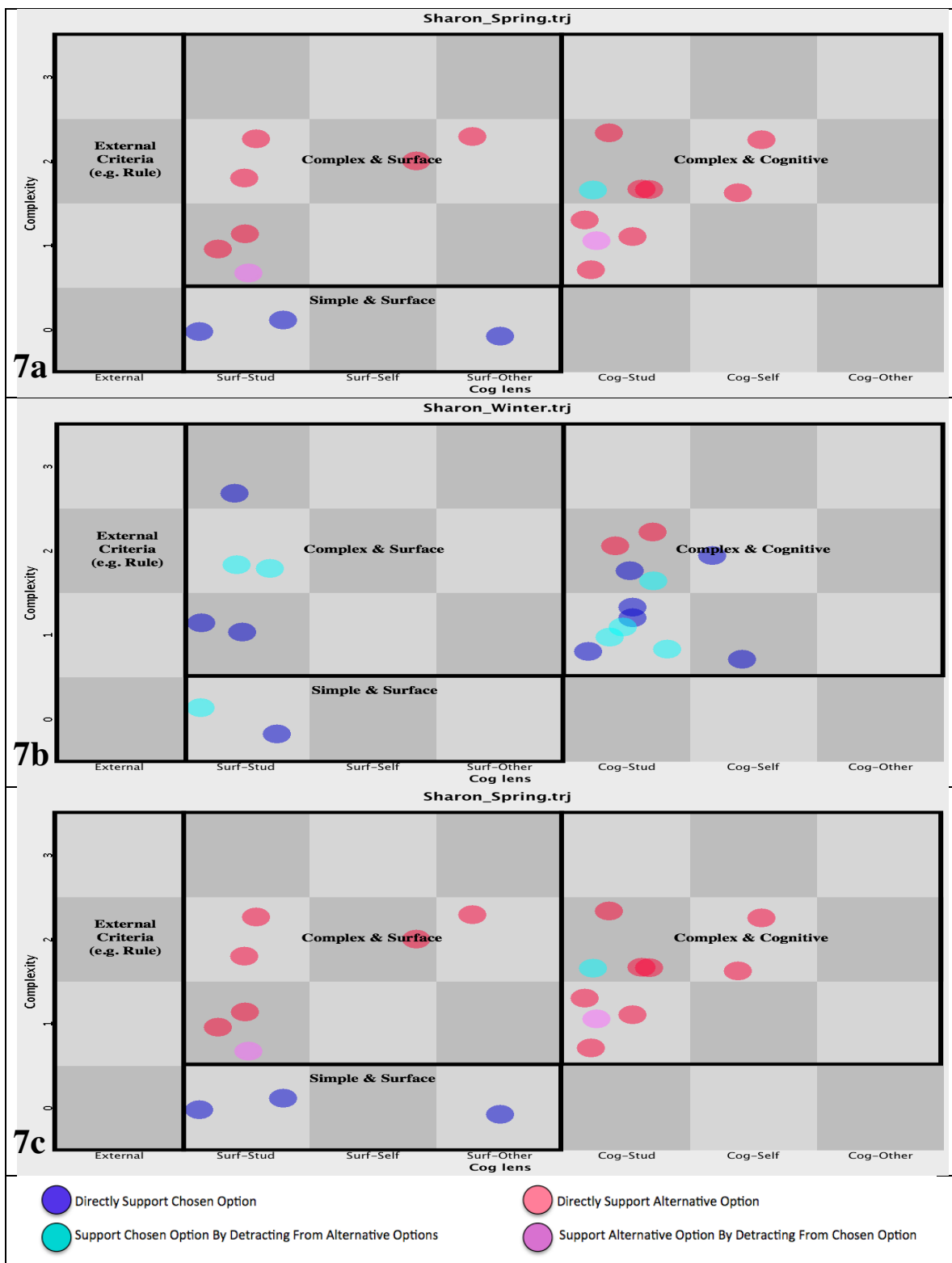


**Figure 6. Sharon’s Problem-Solving.**

**6a** – The percentage of Sharon’s factors that fall within each of 4 regions—complex-and-cognitive, complex-and-surface, simple-and-surface, and external criteria—in the fall, winter, and spring.

**6b** – The percentage of Sharon’s factors (regardless of being surface level or using a cognitive lens) that focus on either the student in question, self, others involved, or external criteria, at the fall, winter, and spring time points.

**6c** – The percentage of Sharon’s factors that support the option they chose in response to the problem, versus that support alternatively considered (but non-chosen) options, at the fall, winter, and spring time points.



**Figure 7. Sharon's SSGs.**

7a, 7b, and 7c – State Space Grids of Sharon's factors used in classroom problem solving during the fall, winter, and spring, respectively. Y-axis represents the number of default assumptions a factor overcomes (obvious rather than non-obvious, temporally proximal rather than distal, and spatially proximal rather than distal); X-axis represents the use of surface level information versus cognitive lens, and whether the factor is focused on the student in question, self, or others involved. Colors of points represent how each factor was used in decision-making, supporting either the chosen or alternatively considered options.

**Research use of SSGs.** Unlike Heather and Peyton, Sharon's SSGs do not illuminate any hidden shifts in total distribution of factors throughout the year. While the total number of factors changes, thus making for different numbers within each region, the general clustering appears quite similar between time points—as is shown in the secondary analysis in Figures 6a and 6b. The most significant change for Sharon is her use of factors; this change can be detected in the secondary analysis (Figure 6c) but the process of that change can be more deeply examined through the SSGs.

In the fall, the only two factors supporting non-chosen options are located towards the lower left side of the SSG, in either the surface-and-simple region or at the low-end of the surface-and-complex region (see Figure 7a). In the winter, there are still only two such factors, but they are located in the upper-right part of the SSG in the complex-and-cognitive region (Figure 7b). In the spring, the vast majority of factors support non-chosen options—including two that directly oppose the chosen option—and of the factors that do support the chosen option, the majority are simple-and-surface level (Figure 7c). This suggests that the factors supporting alternatively considered options—in other words, factors that made her think that she should have done something else—first became more complex and cognitive, and then dominated her thinking, leaving only simple and surface level factors to support what she had done. Future research could explore whether this pattern of change is common among interns or teachers, and the implications for teaching practice.

**Potential use by a teacher-educator.** The most noticeable change for Sharon is the change in color of the factors—in the spring the vast majority of the factors she considered in her problem solving were in support of options other than the one she chose to do. In isolation, this SSG could suggest an intern who is unsure of herself, or is making a poor choice despite knowing better. However, when the content of her narrative and the details of the problem and factors are considered, different interpretations are more likely.

The student in question was a boy who had struggled throughout the year with attention and impulsivity. The specific problem the intern wrote about was an incident when the boy got up to get a drink multiple times during her lesson, despite all students being asked to stay seated. Because his seat was at the front of the room and the water at the rear, and because of his vocalization and movements, he was disrupting other students' learning. The third time he got up, Sharon decided to have him stop mid-sip and sit at an empty table at the back of the room for the remainder of the lesson.

Even while redirecting him, Sharon worried that the boy may be embarrassed, and recognized that he may not have internalized the initial instruction for everyone to stay seated. She chastised herself for not checking in with him before the start of the lesson, wondered why she hadn't changed his seat previously, and made note of the need to provide him more manipulatives. These were a few among the many factors that posed and supported better options than what she chose.

Sharon was being highly and critically reflective—beyond what would be anticipated at such an early stage in her career (Jay & Johnson, 2002; Kagan, 1990; Van Manen, 1977). A teacher educator could use this information in subsequent conversations and observations. For example, it may be important that this critical reflection doesn't become self-doubt and undermine her sense of efficacy and confidence. Follow-up may also be needed to support the intern putting some of her proposed interventions into place—did she change the boy's seat afterwards, and where to; what kind of manipulatives may be helpful; and does she then check in with the boy preceding lessons that occur immediately before recess? All of this information could equip a teacher educator to continue supporting Sharon in her skill development.

### **Implications**

*“When a complex adaptive system is portrayed as a learning system (whose components are humans) the move to educational contexts seems quite natural. This application of complexity science and new concept of learning creates new ways of imagining and talking about educational processes.”*

(Newell, 2008, p.8)

The current lack of understanding of teacher learning undermines the potential of many education reforms to make real improvements for schools and students (e.g. Grossman, Loeb, Cohen, & Wyckoff, 2013). Improving teaching quality must rely on a sophisticated understanding of teacher learning, taking into

account changes in a variety of skills and knowledge, and the complex and dynamic ways in which those changes take place.

Recently, research organizations have recognized this lack of understanding of how teachers learn and develop—as well as the importance of filling that gap. The Institute of Education Sciences (IES) has called for more research to identify “the key constructs of teaching and the processes by which these constructs are interconnected” as well as, “cognitive processes of professional learning and the developmental sequence of the major skills necessary for teaching.” (Institute of Education Sciences, 2017)

This study responds to that call: researching teachers as learners, and using a dynamic approach appropriate to studying learning. Teachers are neither born nor built—they are human beings who learn to problem-solve in the complex system of their classroom just as any person learns to understand and problem-solve in a complex system—and we must study how they learn those skills if we wish to improve their learning. For students, our understanding of how they learn skills such as reading or thinking mathematically, allows us to design experiences and curriculum that begins the learning process and supports it at each stage of development. In contrast, while we know *that* people learn how to teach, the lack of research using dynamic analysis has left us without a full understanding of *how* that learning process takes place. This leaves an insufficient foundation for those who work to prepare and support teachers.

This study combines a tool for probing interns' problem solving, and a technique of dynamic analysis—SSGs—that can provide greater insight into the development of teacher's problem-solving skills. In combination, these can be used for both the practice of teacher education, as well as the future research of intern and teacher development.

### **A Tool And Technique For Teacher-Educators**

As demonstrated above in the discussion of each intern, the assessment and dynamic analysis of interns' problem solving can be used by teacher educators to understand and support their interns' development. These allow conversations to go beyond simply identifying “best practices”, and encourage deeper reflection on the intern's decision-making process. Is the intern considering a wide variety of options when problems arise? Is she thinking about the thoughts and feelings of those involved? Is she appropriately considering all who will be affected by the problem and her response? Is she taking into account factors that span outside of the time and place? Ultimately, to what degree is she seeing the classroom as a complex and dynamic system, and how is she using a cognitive lens; and just as importantly, is she developing in her use of those skills? By using this tool and technique, a teacher educator can better understand an intern's problem solving process, and at the same time, the intern herself can also become more self-aware.

While the SSGs and related analyses capture intern problem solving in a complex and dynamic way, each SSG is simply a snapshot of their thinking in regards to a particular problem in a particular context at a particular time. As

should be the case with any form of data, interpretation of each SSG profile, and the changes between the SSGs should be done with caution. Both teacher educators and interns can use this data in concert with other information, such as the specifics of the problem situation—as modeled in the discussion of Sharon—as well as other observations and discussions about the intern’s teaching practice.

An important word of caution is called for, regarding using this tool and technique to create a binary definition of an intern’s problem-solving skills. It is not the case that a specific SSG profile is necessarily “bad”, while another is “good”. In regards to learning the skills of teaching, interns should be seen as what they are—learners. Teacher educators can therefore use appropriate pedagogical techniques to support the intern as they continue to learn and grow. After all, when a student takes a math assessment, a good teacher does much more than show him the results and tell him whether it’s good or bad; a skilled teacher takes time to understand how the student was solving the problems, and supports them along the path of improvement.

Relatedly, there are also no specific regions of the SSG that should be considered bad, and therefore should be avoided. While it is desirable for an intern to include complex and cognitive factors, it is not undesirable for them to also include simple and surface factors. For example, if a student has knocked over his desk in frustration, it’s important for the intern to think about what has led to this level of frustration, but she shouldn’t ignore the potential danger that is



present in the here and now. Interns should be encouraged to consider all factors that are contextually appropriate to the problem situation.

Teacher educators may also attend to the kinds of problems that their interns are focusing on. For example, in this study all three interns focused on behavioral challenges each time they reported on a recent decision they made, despite the tool offering for them to consider a situation either, “in response to a student having difficulty in their learning, or in response to student behavior.” While it is beyond the scope of the present study to interpret the meaning of these interns’ focus on behavior, a teacher educator may investigate the reason for such choices. This could be a result of interns feeling less prepared for classroom management, the use of teaching techniques that instigate challenging behaviors, or a classroom setting that is structured in such a way that requires greater control of behaviors. In response, a teacher educator could respond (respectively) with more techniques for classroom management, assistance in identifying trigger points or needed support for individual students, or insights about classroom structures that encourage student self-regulation such as Expeditionary Learning, cooperative learning, or problem-based learning (e.g. Thomas, 2000; Weinbaum et al., 1996; Zimmerman, 2008).

### **A Tool And Technique For Research**

The insights gained through use of this study’s data collection tool and analytic technique, offer important possibilities for future research. The implications go beyond research on interns, and extend to research on teachers of

all levels of experience. By embracing classrooms and learning as dynamic and complex systems, there are two major implications for researching teachers and teaching—what should we measure about teachers, and how should we examine those measurements?

First, we should measure the degree to which teachers understand the complexity and cognitive nature of their classrooms, and how those understandings influence the decisions they make. Rather than measuring whether teachers have pre-specified knowledge, or match checklists of behaviors, this study probes their problem-solving in regards to understanding the classroom as a complex and dynamic system. This is the required development for interns to become adaptive experts as teachers.

Secondly, just as teachers must understand their students' learning as a complex and dynamic system, researchers must understand teacher learning as a complex and dynamic system. This has implications for how research decisions are made and will require a different approach to analysis of data. Even when data are collected that examines a specific aspect of teacher thinking, if conventional methods are used to analyze that data, the researcher is not capturing the teacher's thinking or learning as a complex and dynamic system. Dynamic analysis—such as the use of SSGs—is essential to investigate how inter-related aspects of teacher thinking develop, and can reveal important nuances of changes that may have otherwise been discarded as anomalies.

With these two implications in mind, the design of this study could expand in a number of directions in the future —using more data on a similarly small number of interns, including many more interns, and/or include teachers at varying points in their careers.

**Few interns with more data.** There is value in studying a small number of participants in great depth (Horner et al., 2005; Morse, 2000). The current study could be enhanced with either more time points using the same survey and SSG analysis, or by supplementing the three time points with qualitative data. The former would bring the design closer to micro-genetic analysis, which SSGs were initially designed to analyze. The latter could include field observations, interviews, or participatory research where the interns would be part of analyzing and interpreting their own data. Either enhancement would provide both researchers and teacher educators great insight in the development of the participating interns.

**More interns.** In the current study, difference between the three time points could represent development, but it could also represent differences in types of problems being solved, or specifics in the given situation. Variation in an individual's performance is expected when learning is understood as a dynamic process, and it is impacted by time, level of support, and context (Fischer & Bidell, 2006; Fischer & Rose, 2001; L. T. Rose et al., 2013). By replicating this study design with a large number of interns, intra-participant patterns may emerge, allowing researchers to make inter-participant comparisons.

For example, many interns may show a similar pattern as Peyton, moving from tight clustering to dispersal to different clustering. If this is the case, their backgrounds, classroom contexts, or types of problems could reveal a group “type”—perhaps regarding incorporation of self into the factors, or perhaps something all-together different. If all of the interns are in the same teacher preparation program, group differences may be identified in regards to the internship sites, intern characteristics, or prior coursework. If interns are from different programs, researchers could investigate the impact on lengths of internship, or structures of programs.

**More than interns.** Established classroom teachers could also easily take the same online survey, allowing research on teacher development. If interns were followed into their teaching careers, this could include longitudinal data. If teachers at a variety of experience levels participated, then researchers could conduct cross-sectional analyses. Either kind of study could inform a wide variety of questions in researchers’ quest for understanding teacher development. Are there expected growth trajectories for teachers in their problem solving over time? How is that trajectory related to their preparation, support in their teaching environment, types of schools, or a vast number of other factors?

### **Limitations**

Supplying the same or equivalent problems to all interns would have allowed easier inter-participant comparisons, and supplying the same or equivalent problems at each time point would have allowed easier intra-participant

comparisons. Allowing interns to choose their own recent problem—rather than supply them with a hypothetical—however, was a purposeful choice.

The skill of problem solving in the classroom is not developed in the abstract, but rather using situated knowledge and situated cognition (Ethel & McMenemy, 2000; Kennedy, 1999); interns must recognize a situation in their classroom as being a problem, and realize what kind of factors are necessary to solve it. Hypothetical problems, like laboratory-based tasks, define the parameters and necessary data in a way that is inauthentic to problems in real-life complex systems (Grotzer & Tutwiler, 2014). How a teacher identifies and defines a problem is a core part of his/her thinking in the classroom (Wolff et al., 2017), and changes in that thinking is a key part of the development this study wanted to capture.

Even when teachers or interns are shown videos of real-life classroom events, there is an important difference in how they reflect on the actions depending on whether the video is of their classroom or someone else's—in their own classrooms, they are able to notice more but are less critical about what they see (Kleinknecht & Schneider, 2013; Seidel, Stürmer, Blomberg, Kobarg, & Schwindt, 2011). The decision made in the current study's design was to capture the authentic problem solving in each intern's actual experience, allowing them to define the parameters, maximizing what they are capable of taking into account, and assessing the level of thinking that they truly utilize in their process.

## Conclusion

Classrooms and learning, much like natural ecosystems, are complex and dynamic systems. Solving problems in such a context—which is what teachers do—requires ecological thinking and understanding how all parts and levels of the system interact. This means that teachers must take into account factors that are outside of the here and now, and are non-obvious such as the thoughts and feelings of those involved. Capturing and analyzing teacher thinking in such a complex and dynamic endeavor itself requires researchers to utilize dynamic techniques.

This study probed interns problem solving three times during their full-year internship, and analyzed their thinking using SSGs—a dynamic analysis technique. The results are an in-depth understanding of each intern’s thinking at each time point, and how that thinking changed over time. There is great potential for the tool and technique to be utilized by teacher educators wanting to support their interns, or researchers wanting to reveal patterns and differences in intern and teacher development.

## Notes

<sup>5</sup> The use of the term “cognitive” can be controversial, conjuring what is now referred to as “cold cognition”—a strict separation of thinking from feeling. More recently, researchers (e.g. Damasio, 1994; Immordino-Yang & Damasio, 2007; LeDoux, 1994), have recognized the interconnected nature of affective and rational thought processes, leading to a broader acceptance of “warm cognition”.

The term “cognitive lens” used in the current study is aligned with the latter use of the term.

<sup>6</sup> Because the interns completing the survey were also a part of a larger study that included field observations, their anonymity can not be fully assured. My knowledge of the interns did give some indication of their identity (although not the timing of the response), based on specifics that they described in regards to their classroom problem solving. This was partially mitigated by combining their data with other survey responses such as their mentoring teachers (who would theoretically be describing similar classroom problems). Additionally, the second coder was naïve to any information about the participants.

<sup>7</sup> In the literature on complex causal reasoning, these three default assumptions are not the only important assumptions to consider. For example, a model central to this author’s work (Grotzer, 2012) has a total of nine assumptions—the other six being: linear vs. non-linear causality; event-based vs. steady states; sequential vs. simultaneous causes; intentional vs. unintentional agents; deterministic vs. probabilistic reasoning; centralized vs. distributed causes. In studies that directly assess a participant’s understanding of a system (e.g. “please explain how this system works”), all of these factors can be assessed. In the present study, participants were not asked to describe the system, but rather report on the factors they took into consideration when choosing between possible solutions to a problem within the system; the factors described in making their decision are not expected to illustrate features of any of these six additional

assumptions. Each of their factors could, however, be assessed for whether they are obvious vs. non-obvious, spatially proximal vs. distal, and temporally proximal vs. distal, thus leading to the choice of that coding schema.



## Concluding Chapter

**Seeing Interns “Big” –  
Conclusion To A Mixed-Methods Study Of Interns Learning The Skills  
Of Teaching**

*“To see things or people small, one chooses to see from a detached point of view, to watch behaviors from the perspective of a system, to be concerned with trends and tendencies rather than the intentionality and concreteness of everyday life. To see things or people big, one must resist viewing other human beings as mere objects or chess pieces and view them in their integrity and particularity instead.”*

(Greene, 2000, p.10)

When Maxine Greene wrote the passage above, almost twenty years ago, it was part of a call to action for teachers to stand up against the forces from outside of their schools that threatened to remove the humanity from their profession. She and other empowered teachers saw schooling “big”, with a focus on the people whom they teach, whom they work with, and who live within their communities. She warned that those who see, “schooling small [are] preoccupied with test scores, ‘time on task,’ management procedures, ethnic and racial percentages, and accountability measures, while [they] screen out the faces and gestures of individuals, of actual living persons.” (p.11)

Dr. Greene describes these two ways of seeing school as a dichotomy, working in direct opposition to one another. Her fear of schools being dominated by those who see it “small” resonates with my own concerns for current trends in education. The reform movement so far this century has been dominated by

seeing small (Hargreaves & Shirley, 2012). The current Global Education Reform Movement, aptly referred to as “GERM” (Sahlberg, 2014), embraces standardization, high-stakes accountability, narrowing of the curriculum, and corporate models.

I believe that, for the sake of “the actual living persons”, we must reverse these trends; but I do not actually believe that seeing school “small” *has to be* the enemy of seeing it “big”. I believe that two changes—albeit, nontrivial paradigm shifts—can bring these two ways of seeing school closer together. The first paradigm shift is to redefine how we understand the “complexity” of learning; the second is to alter how we regard teachers, appropriately considering them to be continuous learners. After explaining these two paradigm shifts, I will show how they are fundamental to my dissertation study and how, together, these shifts have the potential to reinforce the humanity of children and adults in our schools. In order to explore this, I will start where all of my thinking about education starts: in the classroom.

### **Paradigm Shift #1 – Truly Understanding “Complexity”**

I was a K-12 teacher for twelve years, working in a variety of settings and filling a variety of roles, but always specializing in working with students who had not been successful in their previous classrooms. There were always two principles about teaching and learning that guided my practice: 1) Teaching is, at

its core, a human interaction and about human relationship, and; 2) Learning is a complex system.

The first principle is reflected in quotes that are ubiquitous in education, such as James Comer's (1995) "No significant learning occurs without a significant relationship," or "Students don't care how much you know until they know how much you care," attributed to John C. Maxwell. In my experience with students, learning stops when a relationship goes bad, and it can only resume if the relationship is repaired. In large part, that was a key to my success as a teacher—I created positive relationships with my students.

The second principle is a recognition that began with rejection of simple "empty vessel" notions of learning, where students passively receive knowledge from their teachers. A long history of cognitivists (e.g. Bruner, 1983; Fischer & Bidell, 2006; Piaget, 1955; Vygotsky, 1978) have shown that learning requires active construction of knowledge, which is affected by a myriad of variables including context, past learning, and social support. I was taught during my teacher preparation that my primary job was to understand my students' thinking, including why they thought incorrect answers were correct, so that I could better teach them. I thus attribute another large amount of my success in the classroom to my ability to identify and analyze the variables impacting my students, and then respond accordingly.

In some ways, my two principles may seem at odds with one another. The principle of "teaching as a human relationship" tends to conjure warm images of

bonding activities and long (perhaps inefficient) discussions. In contrast, the principle of “learning as a complex system”—with its technical connotation—more likely draws a sterile picture of “data walls” and skill-based drills.

But I never experienced my principles as a paradox, and the explanation of why is central to my first proposed paradigm shift for education: when I say, “learning is a complex system”, I mean “complex”, not, “complicated”.

### **Defining A Complex System**

In the English language, the words “complicated” and “complex” are synonyms, signifying that something has many connected parts. When teaching science lessons, I would remind my students that “easy” is not the same as “simple”, and “difficult” is not the same as “complicated or complex”. What I did not explain—or even fully comprehend at the time—is that in complexity science, there is an important difference between “complicated systems” and “complex systems”. Davis and Sumara (2014) explain the difference:

...although a complicated system might have many components, the relationship among those parts is fixed and clearly defined. If it were carefully dismantled and reassembled, the system would work in exactly the same way. However, there exist some forms that cannot be dismantled and reassembled, whose characters are destroyed when the relationships among components are broken. Within these sorts of complex systems, interactions of components are not fixed and clearly defined, but are subject to on-going co-adaptations. The behaviors of simple and complicated

systems are mechanical. They can be thoroughly described and reasonably predicted on the basis of precise rules, whereas the rules that govern complex systems can vary dramatically from one system to the next. Moreover, these rules can be volatile, subject to change if the system changes. Such precariousness arises in part from the fact that the “components” of the complex system... are themselves dynamic and adaptive. (p.11)

In contrast to the complicated system of a machine, the iconic example of a complex system is a living organism (Newell, 2008). The difference is not simply that complex systems have more parts than complicated systems (although this is commonly the case). The real difference is that the relationship between the parts of a complex system is a vital aspect of the system, as it allows the system itself to change in response to the environment. Complex systems adapt, while complicated systems simply run.

### **Metaphors Matter**

So, a complicated system is technically different from a complex system – does that really matter? Yes, it matters a lot! It matters because when I say that learning is a complex system I imagine it as a living organism, while someone who seemingly agrees with my description may actually conceive of it as a machine. This difference matters because the metaphors we use to describe phenomena also act as filters and parameters for how we think about those phenomena (Lakoff & Johnson, 1980).

A recent book, *The Gardener and the Carpenter* (Gopnik, 2016), discusses similarly conflicting metaphors for parenting. The author presents the prevailing parenting metaphor as being a carpenter. While parents clearly know that their children are not pieces of furniture being built, a great deal of our society (particularly in the middle class and affluent portions of society) supports this implicit model; parents use Baby Einstein, search for the right preschool in order to assure the right college, send their children to SAT preparatory courses, sign them up for all-consuming extra-curricular activities, and fuel an industry of parenting books and consultants—all based on the fundamental idea that following the right blueprint will allow parents to build the right product.

A proposed contrasting metaphor for parenting, better grounded in decades of child development theory and research, is a gardener. Gardeners know very clearly that they are not building their plants—the plants are growing. This does not absolve the gardener of all responsibilities for the quality of the growth, but it does change how she assesses that growth and how she intervenes if the growth is undesirable. Most plants grow with a great deal of variability, and a gardener would barely give attention to bends in branches or exact shape of foliage; she isn't assessing the quality of growth based on whether the plant looks precisely like a predetermined picture of the plant, but rather on whether it is thriving. But if a plant is not growing well, the gardener rarely considers replacing a stem or repairing the leaves; the gardener attends to soil, water, nutrients, sunlight, and other environmental factors that interact with the plant. Essentially, the gardener

knows that her plant—a living organism—is a complex system and she must understand the components and relationship between those components in order to determine how to support its growth.

Let us return to the two metaphors for learning in school, proposed earlier: the complicated system of a machine, and the complex system of a living organism. If learning is like a machine, then it is either running effectively or it is not. If the machine is not running effectively, then the parts must be analyzed and the faulty parts must be either repaired or replaced. If a teacher holds this complicated-but-not-complex-system metaphor for learning—even if it is subconscious, and even if she intellectually knows that knowledge is constructed rather than transferred—she will likely default into “empty vessel” approaches to teaching. She will look to repair or replace the parts that are broken. Teachers or administrators with this metaphor can still care deeply for their students as people; but building relationships will be, at best, a distraction from their duties of “fixing” their students. If I had held this metaphor for learning, my two principles would have been at odds with one another.

In contrast, if learning is like a living organism, then it is growing. This doesn't preclude the idea that some organisms are not growing well enough, and that the teacher's job is to help it grow better. But it does change the association between my two principles. Analyzing a complex system requires understanding the interfaces between the parts, and a teacher who holds this complex-system metaphor recognizes that her relationship and interactions with her student is an

essential component of the student's learning system. Strengthening the human relationship with her student provides better insight into all of the parts of the student's system, and understanding the dynamic interactions between those parts allows the teacher to build an even stronger relationship which, in turn, fosters learning.

Because I conceived of student learning as a complex (rather than just complicated) system, my two principles were synergistic rather than conflicting. Because of the nature of where I taught, by the time most students arrived in my classroom they and their families had developed a very negative relationship with schooling. Additionally, many had challenges stemming from outside of school that made it difficult for them to learn, such as past and present trauma, hunger, housing insecurity, substance abuse, and mental illness. While I had little control over any of those parts of their system, it was still critical that I understood those parts and the interactions among those parts. Building a new and positive relationship with my students and their families allowed me to appreciate their complex systems, and use that knowledge to inform how I taught each of them. This uniting of my principles is only possible if learning is understood as a complex—rather than complicated—system.

### **Interns Attending To Complex Systems Of Student Learning**

In my dissertation, I support this paradigm shift, understanding that learning is complex like a living organism rather than complicated like a machine. This is reflected in each of my three articles, as I capture how the interns



investigate the complex system of their students' learning. In my first portrait, *Can You Just Tell Me?!*, Katie resists the temptation to simply "fix" her students' mistakes, despite having only experienced direct instruction in her own K-12 schooling. She recognizes the misunderstandings that her students hold, and asks questions to help them discover these mistakes and construct their own new knowledge—like a gardener supplementing the soil with nutrients for a plant to take up on its own terms.

In my second portrait, *Teaching In The Mirror*, each of the interns attends to their students' complex learning systems. A prime example would be when Peyton identifies the various reasons that make it difficult for her students to complete their work. If she had approached these difficulties with a mechanical understanding of learning, she would have searched for the skill deficit within each student that needed to be fixed; instead, understanding that learning is like a living organism, she forms relationships with her students that provide insights into their systems and then attends to their barriers—whether they are physical discomfort, academic difficulty, or emotional struggles—so that her students can thrive.

My third article, *Nothing Exists Alone*, is explicitly grounded in the concept that the classroom—like learning—is a complex and dynamic system that teachers must navigate. By asking interns to share their thinking when problem-solving, I capture the ways in which they understand their students as complex systems. How they utilize a cognitive lens, is based on how they understand the emotions

and thoughts that make up underlying levels of their students' learning systems. How they consider information that is non-obvious and outside of the immediate time and place of the incident, is based on how expansive they understand their students' learning systems to be.

In each of my three articles I share the ways in which interns conceptualize, investigate, and attend to the complex system of their students' learning. This adheres to, and reinforces the first proposed paradigm shift, that learning is complex rather than just complicated. While this first paradigm shift focused on questions of *what* (is the difference between complex and complicated) and *how* (is learning a complex system), the next poses the question of *whom*.

### **Paradigm Shift #2 – Teachers Are Learners, Too**

When I was a K-12 teacher, my success in working with my students occasionally led administrators to ask me to mentor other teachers who were struggling with those students. I have written elsewhere about my relative lack of success in helping my colleagues, largely attributing the difficulty to our misguided focus on what we each did in the classroom rather than how we thought about our decisions and the kinds of relationships we created with students (Mascio, 2015). Upon further reflection, I realize that there was an additional major obstacle to my being able to help my colleagues improve their practice, and it is the same obstacle that gets in the way of many otherwise good ideas in school

reform and improvement: I wasn't really thinking about my fellow teachers as learners.

### **How We Think Of, And Do Research On, Teachers**

This is the second paradigm shift that is needed in education—we must consider teachers as learners. This is not to say that thinking about teacher development and learning is a wholly novel idea (e.g. Sarason, 1993), but we have rarely done so in the same ways that we think about child development and learning. In *Nothing Exists Alone*, I present several theories of teacher development from over the last several decades (e.g. Ammon & Levin, 1993; Berliner, 1988; Jay & Johnson, 2002; Kagan, 1992; van den Bogert et al., 2014; Van Manen, 1977); in some ways, many of these present teacher development akin to Piaget's (1955) stages of child development, identifying *what* teachers look like *when* they learn. What they are largely missing, however, is *how* that learning takes place—a key insight required to help support a learner. Because we see children as learners, we study them in ways that create valuable approaches to support their learning; scaffolding, utilizing the zone of proximal development, and looking for multiple learning pathways, all came from studying how children learn (Fischer & Rose, 2001; Piaget, 2013b; Vygotsky, 1994). This is not how we commonly study teachers.

Even in the clinical phase of teacher preparation, where the interns are unambiguously regarded as learners, research tends not to focus on the “how” of their learning. A recent review (Cochran-Smith et al., 2015) of 1,500 studies

identified three primary lines of research. The first is how interactions within the intern triad (intern, mentoring teacher, university supervisor) impact opportunities to learn to teach, commonly focusing on how interns navigated the competing demands of their university supervisor and mentoring teacher. The second line of research is how altering the characteristics of the triad impact the experience and outcomes of interns, such as introducing technology to increase communication, or pairing multiple interns with a mentoring teacher. The third line analyzes the relationship between the interns' outcomes and either their personal characteristics or the internship site characteristics; for example correlating interns' demographics with their sense of agency as a teacher, or the school climate of the internship site with the intern's teaching practices in their first year of teaching. All of this research is valuable, but it does not go far enough. Essentially, while these three lines of research all look at factors that are believed to impact the intern's learning and/or at outcomes of that learning, they do not illuminate the learning process itself.

If we truly consider teachers as learners we can, and must, utilize our advances in understanding child development and learning in order to better understand teacher learning. Our understanding of children's learning has improved dramatically throughout the last century (C. D. Lee, 2016); cognitivists built upon behaviorists, and in turn provided the foundation for increasingly advanced insights into the learning process. This progress is what allows for my first proposed paradigm shift—conceiving of learning as a complex (rather than

just complicated) system. This very shift calls for teachers to think deeply and use sophisticated decision-making skills, which clearly require a great deal of learning on their part. It follows, then, that we use the same approach to investigate teacher learning as we have used to make our advancements in understanding student learning.

As I presented in my introductory chapter, Kurt Fischer's (1980; Fischer & Bidell, 2006) Dynamic Skill Theory (DST) is an advanced theory of learning that "has three important implications for education: it reframes how we understand student learning, it calls for different approaches that teachers must learn and utilize, and it shifts how we should do research on teachers who are (continuously) learning to teach." (p.4). My dissertation study embraces the advanced understanding of student learning (as reflected throughout this summary chapter); it looks for the interns' utilization of the approaches called for by DST (as foreshadowed in the introductory chapter, and found in each article); and it explicitly adheres to DST's implications for investigating teacher learning (as explained in the introductory chapter, and illustrated in the following section).

### **Interns As Learners**

When we understand learning as a complex system—as DST describes—and also truly consider teachers as learners, there are several important implications for examining teacher learning. First, research must seek to discover the multiple pathways of teacher learning, which prohibits discarding individual idiosyncrasies as "noise" and instead investigates intra-participant patterns (L. T.

Rose et al., 2013). Second, research must capture the dynamic and context-dependent nature of teacher learning, which requires rich qualitative methods and/or specialized quantitative techniques that allow for dynamic analyses. Last, research must seek to illuminate the complexity of teachers' thinking, which requires going beyond checklists of behaviors, or quizzes of predetermined knowledge. Each of my dissertation articles makes the shift to consider teachers (in this case, teacher interns) as learners, and thus heeds DST's implications for teacher research.

In my first portrait, *Can't You Just Tell Me*, Katie's identity as a learner threatens to stymie her progress as a teacher. The narrative takes place in the fall of her full-year internship, and she has already shown a strong emerging use of constructivist pedagogical techniques, such as creating cognitive dissonance and allowing students to puzzle through challenges. However, progression in her teaching practice—entailing learning how to better use these techniques—will require Katie to push through her own challenges and make sense of the puzzles that her mentoring teacher poses; but Katie's own traditional (direct instruction) K12 schooling has left her ill-prepared to handle her own cognitive dissonance. As an early participant in my dissertation study, Katie's struggles highlighted the importance of seeing each intern as a learner, and her learning as a complex system. The specifics of Katie's story are unique to her experience, but the findings helped to steer the rest of my study; it was clear that I needed to investigate each intern's complex system of learning.

Guided by this insight, my second portrait, *Teaching In The Mirror*, further explores the ways in which autobiography shapes how interns learn to teach. Amelia (a classmate of Katie's from the first year's cohort), Peyton, and Heather (both from the second year's cohort) all completed the same teacher preparation program at UNH and interned at the same elementary school, but each of their complex learning systems are rooted in their personal histories and experiences. The epiphanies, overcome challenges, retrospective insights, and haunting traumas are all dynamic components of their growing ability to teach; they are the soil and sunshine for their budding teaching skills—their setting of objectives for student self-concepts, their comprehension of the challenges students wrestle with, their grasp of student engagement, and their handling of student behaviors. Each of their stories is personal to them, and each is important in understanding the complex system of interns' learning.

In my final article, *Nothing Exists Alone*, I ask the second cohort of interns (Peyton and Heather, joined by Sharon) to report their thinking while problem-solving in the classroom; what options did they consider, what factors did they take into account, and how did they use those factors to choose between the options? By using State Space Grids (Hollenstein, 2013), a dynamic analysis technique, I am able to examine the dynamic nature of multiple skills each intern is developing: how they are thinking outside of the here and now, whether they are using a cognitive lens, and how they are utilizing each factor. Because Peyton, Sharon, and Heather share their problem-solving three times during the year, I am

also able to analyze each of their individual patterns of change. This article offers a tool and technique that can be used by either researchers or teacher educators to better understand the learning of interns and teachers.

Each of these three dissertation articles overtly considers the teacher interns as learners. I am not seeking to classify any of the interns as effective, or needing to be fixed; they aren't machines. I seek to understand how they are growing, adapting, and learning; like a gardener investigating her growing plants, I explore the many components of their learning system to better understand emerging properties of their learning. I believe that our teachers and students will all benefit if more of the education system seeks to do the same.

### **Paradigms, Paradoxes, and Possibilities**

*“[Traditional paradigms of teacher research] have, unwittingly or not, silenced teachers' voices and teachers' lives. The process of rehabilitating the teachers' voices is likely to be painstaking and contested. It is not by chance that paradigms have silenced the teacher but without such rehabilitation we believe much of the research on teachers will continue as arid and decontextualized, irrelevant for the teachers it so systematically silences and disenfranchises.”*

(Goodson & Cole, 1994, p.103)

Teachers in the United States right now are understandably unhappy. Teacher attrition is twice that of other high-achieving nations, most teachers leave because of dissatisfaction, and the biggest reasons cited for that dissatisfaction are, “pressures associated with test-based accountability, unhappiness with



administrative support, and dissatisfaction with teaching as a career.” (Carver-Thomas & Darling-Hammond, 2017, p.30) And who could blame these teachers in a time when so many people from outside of the profession—and yet in positions of power over it—“see school small”, while also not understanding learning as truly complex, and not considering teachers as learners?

In recent years, many “reformers” have based their arguments on ill-informed paradigms. One powerful example is *Waiting For Superman* (Guggenheim & Kimball, 2011), which has an animated depiction of student learning as a teacher opening a student’s head and pouring knowledge in, with the explanation, “It should be simple – A teacher filling her students’ heads with knowledge and sending them on their way. But we’ve made it complicated.” Most people who know much of anything about learning already know that it is far more complicated than this, but far too few realize that it is actually complex—an important distinction.

A great deal of policy has also been based on the faulty idea that teachers don’t improve after the first few years of teaching (Jacob & McGovern, 2015; Kane, McCaffrey, Miller, & Staiger, 2013; Rivkin, Hanushek, & Kain, 2005); this reinforces the non-complex-system notion of removing ineffective teachers like worn-out parts of the school machine, and replacing them with cheap and poorly-prepared new parts (since they aren’t expected to last long either). These kinds of findings could never be accepted when studying learners. If we ever had data saying that learners stopped growing after a couple of years we would conclude

that either the method of assessment was profoundly flawed, or the system they were in was contaminated in a way that stymied their growth—we would never conclude that further years are pointless.

With the prevalent paradigms in education seeming to misunderstand the complexity of learning and neglecting to properly view teachers as learners, we have allowed strange paradoxes to occur. Even in schools that want students to adopt a growth mindset, administrators look to get better teachers rather than help their current teachers grow; districts that promote a desire for students to see learning as a journey still measure their teachers with a single score representing a single moment in time; communities that want every child to feel cared about accept policies that discard teachers if their effectiveness score is too low; advocates who want students to be free thinkers also want teachers to follow a script; and change agents who most want students to see formal education as a valuable path forward are still happy to hire people who never took courses on how to teach.

This does not have to be the case! The two paradigm shifts—understanding learning as a complex system, and considering teachers as learners—can go a long way to help bring seeing “small” and seeing “big” closer together, and thus restore humanity to education. In the old paradigms, only students are seen as learners and those who see school “small” examine their learning, “through the lenses of a system... taking a primarily technical point of view.” (Greene, 2000, p.11) This casts teachers as a gear in the machine, to be repaired or replaced if student

learning isn't effective enough. In the new paradigms, learning is like an ecosystem that includes both teachers and students, connected to each other as well as a web of other members and aspects of their learning system. If those who wish to look "through the lenses of a system" wish to fully understand such a (complex) system they too will have to "resist viewing other human beings as mere objects or chess pieces and view them in their integrity and particularity instead." (Greene, 2000, p.10)

There are a small but growing number of people in education who are calling for these paradigm shifts, and leading the way in utilizing them. At a time when so many policy makers and researchers in the United States lean towards a mechanistic solution to improving education, other countries such as Finland (Sahlberg, 2014; 2018), provide alternative models that cherish the humanity of their children and understand that schooling takes place within the larger system of society. Others call for schools to look beyond individuals' "human capital" to see the "professional capital" within the school system that truly empowers teaching and learning (Hargreaves & Fullan, 2012), as well as system-oriented methods that should be employed to bring about reform (Hargreaves & Shirley, 2012).

Increasingly, funding organizations (e.g. Institute of Education Sciences, 2017; James S. McDonnell Foundation, 2017) have called for researchers to focus on the learning processes of teachers in order to better inform policy decisions. A recent book, *Teaching in Context: The Social Side of Education Reform* (Quintero, 2017), features a collection of research that focuses on the contextual components

of teachers' learning systems. And there is a new push for professional collaboration (e.g. Fullan & Hargreaves, 2016; Hargreaves & O'Connor, 2017), empowering teachers to learn in the same ways that we know students learn best. I hope that my work will join these inquiries and others, to promote the possibility of understanding teaching and learning in a way that honors—rather than screens out—the “actual living persons” that are engaged in the work.

## **Appendix A. Intern Survey**

### **Survey**

#### **Part 1 - A Classroom Decision**

- 1) Please think of a recent time when you had to make a decision in your classroom – this could either be in response to a student having difficulty in their learning, or in response to student behavior. You will be asked follow-up questions about this situation, so it may be easier to pick one that is not too simple.

Please describe the situation, including what action you chose to take.

- 2) Most times when we make a decision, we have choices of how to respond - there are multiple actions we are deciding between.

*For example, if I am planning a meal and have decided on making spaghetti and meatballs, there were other possible menus I may have been considering - such as:*

- 1. Lasagna with salad, or*
- 2. Meatloaf with potatoes, or*
- 3. Fish with asparagus.*

You have already told us what action you chose to take in your classroom, and now we'd like to know what other choices you were deciding between.

What were other possible actions that you were considering taking?  
(Please fill in as few or as many of the following spaces as needed)

- 3) Commonly when we are choosing what action to take, we are using multiple factors to make that decision. These are the things that we think about and use while we are making a choice.

*For example, when I was deciding on my menu, I may have been thinking about:*

- 1. What I ate last night*
- 2. What my wife likes to eat*
- 3. What I have in the refrigerator*
- 4. How much time I have to cook*
- 5. How many people will be joining us*
- 6. Whether or not I want left-overs*
- 7. ...and many more factors*

In the classroom situation you had described, what factors did you take into consideration when deciding on your action?

(Please fill in as few or as many of the following spaces as needed)





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<sup>1</sup> A full explanation of the three pathways can be found in the original text (Knight & Fischer, 1992). In short, the traditional pathway for learning to read is represented as starting with 1) word definition, followed by parallel development of 2a) letter recognition and 2b) rhyme recognition, which then converge in development of 3) reading recognition, followed by 4) rhyme production and finally 5) reading production. The alternative pathways have separate branches that did not ultimately unite to jointly lead to reading production. For example,

one alternative includes three separate branches from 1) word definition—one branch is 2a) reading recognition directly followed by 3a) reading production, a second branch is 2b) letter identification, while the third branch is 2c) rhyme recognition followed by 3c) rhyme production.

<sup>2</sup> Some examples of these calls for research reform include: preregistering hypotheses and proposed analysis technique so that post-hoc analyses and p-hacking are not represented as predicted findings; use of confidence intervals rather than p-values, both because they are more stable and because they are a more authentic representation of whether findings are to be trusted, and; inclusion of effect sizes to better represent whether a finding is “significant” in the way that the word is meant in the English language rather than in statistics.

<sup>3</sup> Teachers and interns have given consent for their real names to be used, and in this article, those names are used. In Articles 2 and 3, pseudonyms are used for the interns and cooperating teachers, not because of the need for anonymity but because so many of the later participants had names that started with the letter “K” that it would have been too difficult for readers to follow. In Article 2, the real name of the UNH supervisor is used. All K-12 student names are pseudonyms.

<sup>4</sup> In sharing the finished portrait with Katie and Kristen, both responded that there is actually a rule. Kristen informed me “if a C or G is followed by an A, U, or O, it is generally a hard sound. If a C or G is followed by an I, E, or Y, it is



generally a soft sound.” Katie shared that later that day Kristen had explained the rule to her, and she did correct the students’ understanding the next morning. As an aside, this does mean that my original dismay of the “Are You Smarter Than A 5<sup>th</sup> Grader” feeling was well warranted.

<sup>5</sup> The use of the term “cognitive” can be controversial, conjuring what is now referred to as “cold cognition”—a strict separation of thinking from feeling. More recently, researchers (e.g. Damasio, 1994, Immordino-Yang & Damasio, 2007, LeDoux, 1994), have recognized the interconnected nature of affective and rational thought processes, leading to a broader acceptance of “warm cognition”. The term “cognitive lens” used in the current study is aligned with the latter use of the term.

<sup>6</sup> Because the interns completing the survey were also a part of a larger study that included field observations, their anonymity can not be fully assured. My knowledge of the interns did give some indication of their identity (although not the timing of the response), based on specifics that they described in regards to their classroom problem solving. This was partially mitigated by combining their data with other survey responses such as their mentoring teachers (who would theoretically be describing similar classroom problems). Additionally, the second coder was naïve to any information about the participants.

<sup>7</sup> In the literature on complex causal reasoning, these three default assumptions are not the only important assumptions to consider. For example, a model central to this author's work (Grotzer, 2012) has a total of nine assumptions—the other six being: linear vs. non-linear causality; event-based vs. steady states; sequential vs. simultaneous causes; intentional vs. unintentional agents; deterministic vs. probabilistic reasoning; centralized vs. distributed causes. In studies that directly assess a participant's understanding of a system (e.g. "please explain how this system works"), all of these factors can be assessed. In the present study, participants were not asked to describe the system, but rather report on the factors they took into consideration when choosing between possible solutions to a problem within the system; the factors described in making their decision are not expected to illustrate features of any of these six additional assumptions. Each of their factors could, however, be assessed for whether they are obvious vs. non-obvious, spatially proximal vs. distal, and temporally proximal vs. distal, thus leading to the choice of that coding schema.