BACK TO THE CLASSROOM: LESSONS LEARNED FROM A PROFESSOR SERVING AS A MASTER TEACHER IN A SECONDARY MATHEMATICS CLASSROOM

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Abstract

The impact of a professor serving as a master teacher in a secondary classroom is examined as a means of bridging theory with practice in a university teacher education program. The gap between theory and practice has long been the focus of student teachers' complaints that the training they receive does not adequately prepare them for the realities of actual practice (Talbert-Johnson, 2006; Wilson, Cooney, & Stinson, 2005). Moreover, the gap between theory and practice is made worse by a lack of coherence between university coursework and field experiences in schools. As a result, teacher preparation programs often have little impact upon the actual practice of teachers. Research suggests that impact on teacher practice is most powerful when there is coherence between what is taught in teacher preparation programs and what students experience in their practicum. One approach for closing the gap between teacher education and classroom practice is for university faculty to be "reimmersed" in the classroom (Hoge & Jenks, 2000). This study explores how student teachers were impacted by their university methods professor who also served simultaneously as their master teacher in the classroom. As a result, student teachers were afforded the opportunity to enact reform practices in teaching. Using the framework of the Performance Assessment for California Teachers (PACT), the practices of student teachers were analyzed to determine how instruction from their methods courses transferred into actual practice. At the same time, the impact upon the professor crossing the boundary between the university and the classroom is also discussed, as well as implications for policy and practice in teacher education.

Introduction

Student teachers and recent graduates of teacher preparation programs often complain that the training they receive does not adequately prepare them for the realities of actual practice (Talbert-Johnson, 2006; Wilson, Cooney, & Stinson, 2005). At the same time, teacher candidates often experience conflicting messages between their university professors and their teacher mentors in the schools. They are sometimes even explicitly instructed to abandon the ivory tower theories taught at the university (Thomas, et al., 1998) by master teachers who essentially apprentice new teachers into traditional norms (Cavanagh & Prescott, 2007). This further limits student teachers' opportunities to experience reform practices different from the traditional classrooms they experienced as students. Further, teacher candidates are strongly

influenced by prior beliefs that are formed over years of experience as students observing their own teachers (Ciscell, 1993; Lortie, 1975). These beliefs may then lead them to discount what is taught in their teacher education courses (Fives & Buehl, 2008). As a result, teacher preparation programs often have limited impact on actual teacher practice (Cavanagh & Prescott, 2007; Özgün-Koca & Sen, 2006).

Research has shown that teacher preparation programs that do effectively impact practice are those which provide coherence between what is taught in teacher preparation courses and what is experienced in the field work (Hammerness, 2006; Clift & Brodie, 2005). Studies of New York City teachers suggest that effective teachers engaged in pre-service activities that closely approximated actual practice (Grossman, et al., 2007; Boyd et al., 2007). Thus, effective teacher preparation programs must provide opportunities for candidates to apply the theory from their classes and test their beliefs (Haritos, 2004) in conditions that approximate real practice (Grossman & McDonald, 2008). However, such a focus on experiential learning may lead to the development of "situation-specific instrumental knowledge" (John, 2002, p. 337) that may actually bias teachers against some research-based teaching practices (Joram, 2007). The challenge for teacher educators, then, is to find ways to provide learning opportunities that can be effective in helping pre-service teachers examine their preconceptions and experience research-based best practices (Younger et al., 2004).

Within teacher preparation process, the greatest influence on teaching practice comes primarily through the student teaching experience (Cavanagh & Prescott, 2007; Cooney, 1999). Student teaching is where the circles of theory and practice must necessarily intersect. And it is during this practicum phase that teacher educators have the opportunity to impact pre-service teachers' practices the most. However, it is this aspect of teacher education where university-based teacher educators the have the least influence (Grossman & McDonald, 2008) because universities cannot control what occurs in the field placements (Simpson, 1997).

One solution for creating a tighter link between the university and the classroom is through the establishment of a Professional Development School (PDS) (Burstein, 2007; Clift & Brody, 2005). At a PDS, university supervisors and master teachers collaborate to support the student teacher (Scherer, 1998). However, even at a PDS, the student teacher, the university faculty, and the cooperating teachers may not share a common objective (Clift & Brody, 2005; Simpson, 1997). For example, university supervisors are concerned with their student teachers' learning, while master teachers must also be concerned about the learning of their pupils (Tsui & Law, 2007). For the student teacher, this dual emphasis creates a tension between gaining satisfactory evaluations from the university faculty and satisfying the concerns of the master teacher, who is ultimately accountable for the performance of pupils in the classroom. Furthermore, a cultural separation between institutions stemming from the different types of practices that are valued (Gravani, 2008) and a hierarchical view of university professors and classroom teachers may further widen the gap between teacher education and practice (Craig, 2007).

Another approach for closing the gap between teacher education and classroom practice is for university faculty to be "reimmersed" in the classroom (Hoge & Jenks, 2000). Tobin, Seiler, & Smith (2005), for example, advocate a co-teaching approach. Such an approach positions the teacher educator alongside the student teacher in all aspects of teaching. Further, the teacher educator and the student teacher engage in a cycle of lesson refinement that is based in practice rather than in theory (Tobin & Roth, 2005). In another study, Burstein (2007) examined how a "professor-in-residence" impacted her methods instruction at the university.

Unlike some accounts of professors returning to the classroom, Burstein's "boundary crossing" work placed her as a teacher of record in a public middle school while maintaining her full time status as a tenure track professor. While Burstein's study provided a glimpse of how university faculty might be able to hone their own skills as teacher educators, there is still very little research on how specific practices of teacher candidates are affected. More specifically, the role of a professor-in-residence as a master teacher in the classroom has not been studied as a potential mechanism for helping pre-service teachers connect theory with practice.

Connecting Theory with Practice

This study took place in 2008 at a public high school in a large urban district. As the practitioner/researcher, I taught one mathematics class at the high school in both the Spring 2008 and Fall 2008 semesters. I also mentored four student teachers who were all in their first semester of student teaching. At the same time, I taught all of the mathematics pre-service students ($n = 30$, $n = 36$) in their subject specific methods courses during this time, as well as all but four of the mathematics student teachers ($n = 25$) in their field experience seminar during Fall 2008. In this study, I investigated the impact of being a professor serving as a master teacher in a high school math class while simultaneously teaching methods courses at the university. In particular, I examined how this coherent approach to teacher preparation impacted the practice of student teachers as evidenced by the lessons that they designed and taught.

Through funding from the *Teachers for a New Era* project (Carnegie Corporation, 2001) at my university I was provided release time to teach one mathematics class at a local public high school in Spring 2008 and Fall 2008. Valley Academy High School is a public school that opened in 2004 as part of a land exchange between the university and the local school district. Even though it is located in close proximity to the university, it is not a "lab" school or a demonstration school. It is, however, a "clinical site" (Carnegie Corporation, 2001) where many teacher candidates are placed for their student teaching assignment. The faculty of the high school work closely with the university to provide a unique learning experience for their students. The students, however, are not selected according to any special criteria. They are drawn randomly from the surrounding neighborhood to relieve overcrowding within the attendance boundaries of three other local high schools. Therefore, the demographics of the school mirror that of the schools in the district. For example, 80% of the students are Hispanic, Black, or other minorities. Of the nearly 1,000 students, 57% qualify for Title 1 and only 3% list English as their home language.

In Spring 2008, I was the instructor for an "Algebra Readiness" class for students who had failed Algebra 1A in the previous fall semester. In California, Algebra 1 is considered an eighth grade standard, so students taking algebra in high school are already one year behind their peers. Of the 19 students who were in this class, five were English learners and six had Individualized Education Plans (IEPs) for various learning disabilities. Most lacked proficiency with basic arithmetic skills and with operations of signed numbers. In fact, many relied on multiplication tables or number lines in order to perform basic operations. Because of their prior lack of success in algebra, all of these students entered the class with negative attitudes as well as a low sense of efficacy. As a result, they resisted mathematical tasks that required intellectual effort and often shut down quickly. Not surprisingly, these students also exhibited many inappropriate behaviors such as constant acting out and shouting out during lessons.

In Fall 2008, I taught a "Math Tutorial Lab" for the 30 lowest incoming freshmen who were concurrently enrolled in a regular de-tracked algebra class. All of these students were

selected because they were below proficient based on standardized state tests and lacked basic computational skills. Six students had IEPs, including three who required additional support with a resource teacher. Eventually, their progress was so weak that they were pulled out to work with a special education teacher the remainder of the semester. Many additional students were designated English learners and some did not even know the meaning of words such as "product" or "denominator." Like the students in Spring 2008, the many of the students in my class had a negative disposition toward mathematics. At the same time, they had poor study habits and were behaviorally challenged. They lacked self control and acted impulsively much of the time. This proved to be an ongoing challenge throughout the semester, especially because the class was organized for group work the entire semester.

In both my spring and fall classes, there was no assigned curriculum. The content was based on state standards to support the students in learning algebra. Lesson activities were developed collaboratively by the student teachers with me during much of the semester and were based on reform principles of teaching mathematics (NCTM, 1991, 2000). Each learning activity was created around the learning needs of the students and provided opportunities for them to explore and discover the concepts themselves. However, this approach to teaching can make a teacher feel vulnerable and out of control.

Research suggests that teachers find comfort and a sense of mastery in the traditional approach of telling because it provides them with well defined boundaries for content and "clear prescriptions for what they must do with that content" (Smith, 1996, p. 388). Teachers also often feel pressured to continue using traditional methods because students can also be uncomfortable with new teaching approaches that do not just give them the procedures or the answers. The safety of working collaboratively, on the other hand, gave my student teachers the confidence they needed to take many risks in trying new teaching methods. As a result, they began practicing the strategies that I taught in my methods classes. For example, we combined graphs, tables, equations, and word problems based on direct variations to explore the concept of slope. It was only after weeks of investigation that we began to ask students to formalize their definition of slope. Similarly, we approached solving linear equations conceptually by exploring the intersection of two linear equations (i.e., $3x + 1 = 2x + 3$ as the intersection of $y = 3x + 1$ and $y = 2x + 3$). As a result, most pupils eventually changed their dispositions toward mathematics and their success even translated into many of their other classes as well.

This work of designing lessons collaboratively with my student teachers was based on two important models of professional development: Cognitively Guided Instruction, or CGI (Carpenter, et al., 2000) and "cognitive coaching" (Costa & Garmston, 2002a, 2002b). The CGI model of professional development helped my student teachers rehearse new strategies and reflect on their own practices based on careful examinations of student thinking (Carpenter, Fennema, & Franke, 1996). Although CGI was designed primarily for elementary mathematics teachers, its approach was still applicable to high school teachers because of its focus on teachers' inquiry of their own understanding of mathematical ideas and of their students' understanding of those ideas (Carpenter, et al., 1989). At the same time, I also used the cognitive coaching model to support my student teachers in developing the "five states of mind" possessed by self directed learners: *efficacy*, *consciousness*, *craftsmanship*, *flexibility*, and *interdependence* (Costa & Garmston, 2002a, 2002b). These five qualities are also key characteristics of effective teachers. For example, Ashton and Webb (1986) found that teachers with a high sense of efficacy were also the ones who brought about the greatest student achievement. Craftsmanship is demonstrated by the design of rich lessons that are both intellectually challenging and

accessible to all learners. And consciousness is what guides instructional decisions based on the teacher's awareness of her own understanding of content as well as that of her students' thinking.

Cognitive coaching, combined with a CGI approach, allowed me to help my student teachers develop and reflect on their lessons as they examined their students' thinking. Research shows that such an approach is generative, in that analysis and reflection of practice allows teachers to experience ongoing improvement (Kilpatrick, Swafford, & Findell, 2001). Thus, I worked with my student teachers each day to identify the areas where our students needed intervention. By focusing on our students' thinking and understanding, I helped the student teachers examine their teaching practices and analyze what worked and what did not work in their lessons. Furthermore, I helped them recognize *why* something worked or did not work through the use of reflective conversations and daily analyses of student work samples. This then supported the student teachers in making their instructional decisions for subsequent lessons. In the process, the student teachers were able to connect the theories they were learning in my methods class to the realities of the classroom.

Teacher preparation programs often have limited impact on actual practice because teachers' prior beliefs may then lead them to discount what is taught in their teacher education courses (Fives & Buehl, 2008). Research also suggests that teachers must often experience a change in practice before they will change their beliefs (Loucks-Horsley, et al., 2003; Fennema, et al., 1996; Thompson, 1992). By facilitating inquiry-based learning that connected practice to theory I provided a learning experience that was transformative. To see the impact that my unique instructional model had upon the practices of my student teachers I utilized a qualitative approach based on descriptive analyses of lessons that they planned and taught. This vital aspect of teaching practice was analyzed through the framework of the Performance Assessment of California Teachers (PACT).

The PACT Framework

The PACT was developed by a coalition of teacher preparation institutions to provide an authentic assessment of teacher candidates' knowledge and skill for teaching. Candidates are assessed on their lesson planning, delivery of instruction, assessment of student work, and reflections of their own practice. Since classroom observations (and video records) are the most proximal indicators of classroom practice (Stecheer et al., 2006; Kennedy, 1999), the PACT assessments have "the potential to provide more direct evaluation of teaching ability" (Pecheone & Chung, 2006, p. 23).

The central feature of the PACT is the Teaching Event (TE), a summative assessment that is modeled after the assessments for the National Board for Professional Teaching Standards and the Interstate New Teacher Assessment and Support Consortium (Pechone & Chung, 2006). Besides the *Context for Learning* task, which is not scored, the TE is organized around four primary tasks: *Planning Instruction and Assessment*, *Instructing Students and Supporting Learning*, *Assessing Student Learning*, and *Reflecting on Teaching and Learning* (PIAR). The TE requires teacher candidates to select a "learning segment" for which they submit artifacts such as lesson plans, assessment materials, student work samples, and video clips of classroom teaching. They also submit commentaries to explain the context and content of their sequence of lessons, as well as the thinking behind their instructional decisions (Sata & Curis, 2005). Lastly, the TE includes commentaries in which the candidates analyze their own practice and reflect on the effectiveness of their lessons.

The scoring of the TE is based on multiple guiding questions and corresponding rubrics on a 4-point continuum (see Table 1). Based on pilot studies in 2002–2003 and 2003–2004, the TEs were found to have content validity for assessing the standards of California's Teaching Performance Expectations (TPEs) (Pechone & Chung, 2006). Factor analyses of the TEs further confirmed that the assessment tasks represent meaningful domains of teaching expertise. Bias and fairness reviews also found that there were no significant differences based on the race, ethnicity, or native language of the candidates. The only significant differences in scores were that females scored higher, and candidates in urban or inner-city schools scored lower than candidates in suburban schools. Scorer reliability was at 90% the first year and 91% the second year for score pairs to be exact matches or within 1 point. Further, there was strong agreement between holistic scores and analytic scores. In fact, 90% of non-PACT-calibrated faculty and supervisors agreed with the candidates' scores on 15 to 17 of the Guiding Questions in the rubrics. This agreement suggests that the TE is valid and credible for assessing teacher competence.

Table 1: Rubric for Guiding Questions 1–4 (PACT Consortium, 2007, 2008)

Guiding Question 1 ***How do the plans structure students' development of conceptual understanding, procedural fluency, and mathematical reasoning skills?***			
Level 1	**Level 2**	**Level 3**	**Level 4**
• The standards, learning objectives, learning tasks, and assessments either have **no central focus or a one-dimensional focus** (e.g., all procedural or all conceptual).	• The standards, learning objectives, learning tasks, and assessments have an overall focus that is **primarily one-dimensional** (e.g., procedural or conceptual). This focus includes **vague connections** among computations/procedures, concepts, and reasoning/problem solving strategies.	• Learning tasks ***or*** **the set of assessment tasks** focus on multiple dimensions of mathematics learning through **clear connections** among computations/procedures, concepts, and reasoning/problem solving strategies. • A **progression** of learning tasks and assessments is planned to build understanding of the central focus of the learning segment.	• Both learning tasks ***and*** **the set of assessment tasks** focus on multiple dimensions of mathematics learning through clear connections among computations/procedures, concepts, and reasoning/problem solving strategies. • A progression of learning tasks and assessments guides students to build **deep understandings** of the central focus of the learning segment.

Guiding Question 2 ***How do the plans make the curriculum accessible to the students in the class?***			
Level 1	**Level 2**	**Level 3**	**Level 4**
• Plans **refer** to students' experiential backgrounds[1], interests, or prior learning[2] that have **little or no relationship** to the learning segment's standards/objectives. OR • There are **significant content inaccuracies** in plans that will lead to student misunderstandings.	• Plans **draw on** students' experiential backgrounds, interests, or prior learning to **help students reach** the learning segment's standards/objectives. • Plans for implementation of learning tasks include **support to help students** who often struggle with the content.	• Plans draw on students' prior learning **as well as** experiential backgrounds or interests to help students reach the learning segment's standards/objectives. • Plans for learning tasks include **scaffolding or other structured forms of support**[3] to provide **access to grade-level** standards/objectives.	All components of Level 3 plus: • Plans include **well-integrated** instructional strategies that are **tailored** to address **a variety of specific student learning needs**.

[1] Cultural, linguistic, social, economic
[2] In or out of school
[3] Such as multiple ways of representing content; modeling problem solving strategies; relating pictures/diagrams/graphs and equations; strategic groupings of students.

Guiding Question 4 *How does the candidate actively engage students in their own understanding of mathematical concepts, procedures, and reasoning?*			
Level 1	**Level 2**	**Level 3**	**Level 4**
• Students have **limited opportunities** in the clip(s) to engage with content in ways likely **to improve their understanding of mathematical concepts, procedures, and reasoning**. OR • The clip(s) **do not focus** on mathematical concepts, procedures, and reasoning. OR • Classroom management is problematic and **student behavior interferes with learning**.	• Strategies for intellectual engagement seen in the clip(s) offer **opportunities for students to develop their own understanding** of mathematical concepts, procedures, and reasoning.	• Strategies for intellectual engagement seen in the clip(s) offer **structured opportunities** for students to **actively develop** their own understanding of mathematical concepts, procedures, and reasoning. • These strategies reflect **attention to student characteristics, learning needs, and/or language needs**.	• Strategies for intellectual engagement seen in the clip(s) offer structured opportunities for students to actively develop their own understanding of mathematical concepts, procedures, and reasoning. • These strategies are **explicit**, and **clearly reflect attention** to students with diverse characteristics, learning needs, and/or language needs.

Because the Teaching Event is a summative assessment, candidates are not provided feedback on their submissions. However, my university has modified the TE to provide a formative assessment of the candidates in their first semester of student teaching. This *Preliminary* Teaching Event (PTE) is a condensed version of the full TE in which candidates are asked to submit artifacts and commentaries for just one lesson rather than a series of lessons. Using the PACT TE as my framework for analysis, I focused on three specific aspects of planning and instructing assessed by the PACT rubric (PACT Consortium, 2007, 2008):

1) How do the plans structure students' development of conceptual understanding, procedural fluency, and mathematical reasoning skills?
2) How do the plans make the curriculum accessible to the students in the class?
4) How does the candidate actively engage students in their own understanding of mathematical concepts, procedures, and reasoning?

Additionally, I also analyzed the student teachers' PTE reflections to determine how they provided support for academic language development and other learning needs of their students. Because extensive training is provided to calibrate scorers for consistency and accuracy, reliability is ensured for this validated assessment. As a trained scorer, I was able to use the student teachers' PTE submissions, as well as their lesson plans as rich sources of data. Additionally, I used my own reflections and notes to provide additional contextual details to further explain the student teachers' work.

Student Teachers

The "traditional" program at my university provides two semesters of student teaching. The first assignment requires student teachers to transition into teaching one class period of mathematics around the fifth or sixth week of the semester under the supervision of an experienced master teacher. This teaching assignment is followed by a second practicum where the candidate assumes responsibility for teaching on the first day of the semester, but still under the close watch of a master teacher. The student teachers upon which this study is based were all enrolled in a field experience seminar during their first semester of student teaching (see Table 2).

Table 2: Summary of Student Enrollment in "Traditional" Program

	First Semester Student Teachers	Enrolled in Seminar	Enrolled in Methods	Enrolled in Seminar *and* Methods
Spring 2008	**6**	**0** (with me) **6** (with another professor)	**30** (with me)	**3**
Fall 2008	**15**	**11** (with me) **4** (with another professor)	**36** (with me)	**7 (+2 from Sp. 08)**

In Spring 2008 there were six candidates in their first semester of traditional student teaching, not including "interns," who were already employed full time with temporary credentials. All six had their field experience seminar with another professor. During that same semester there were 30 students enrolled in the methods course for teaching secondary mathematics. Three of the six student teachers were also enrolled in this methods course, along with a number of interns. The other three had previously taken methods with other professors. In Fall 2008 there were 15 traditional candidates who were in their first semester of student teaching, four of whom were enrolled in a different multi-disciplinary seminar as part of a special program with a local school district. The other 11 candidates were all enrolled in my field experience seminar, along with additional candidates in their second semester of student teaching. At the same time, seven of the 11 candidates were concurrently enrolled in my methods course. Among the four out of the 11 who did not take methods in Fall 2008, two had previously taken methods with me in Spring 2008. Thus, a total of nine candidates in my field experience seminar in Fall 2008 also had me as their methods instructor at some point.

Of the three student teachers in my Spring 2008 methods class, one was placed with me at the high school where I taught. In Fall 2008 the two student teachers who were placed with me were among the nine who were also enrolled in my methods course. For this study, I examined the Preliminary Teaching Events (PTEs) of the four student teachers who worked me and compared their submissions with that of the other 14 traditional students teachers in 2008. Out of my four student teachers, only one did not take a methods course with me.

Ayesha, the first student teacher from Spring 2008, had a degree in art and had already taken some credential coursework at another university. She had always had an affinity for math had completed Calculus by the end of her senior year in high school. She also had prior experience as a private tutor and as a clinician for two different learning centers for students with disabilities. Immediately before her first semester of student teaching, Ayesha had been employed as a substitute teacher for a public school district. According to Ayesha, teachers need to reach out to their students creatively and connect to them to create an environment that fosters the enjoyment of learning. However, the majority of her experiences as a math student were in traditional classrooms where the teacher demonstrated and the students imitated the procedures.

Bae was the only student teacher who did not take a methods course with me. She has had teaching and tutoring experience in her native country of Korea, where she grew up with traditional lecture-based classrooms. In addition to taking credential courses at the university, Bae also tutored part time at a community college while caring for her two children, one of whom was in middle school. Bae worked with me in Spring 2008 and often struggled in her verbal communications. However, her diligent work ethic and gregarious personality served her well in connecting with her students.

Cindy, one of my student teachers in Fall 2008, had a degree in philosophy and completed up to Calculus in college. Before deciding to become a teacher she had worked as a loan officer and most recently as a substitute teacher for a public school district, including a

long-term position in English at a middle school. As a student, Cindy's experience was also based in traditional teaching approaches. In fact, her own experiences with group work had been negative because members of her group often did not contribute their fair share of work.

Dean, my second student teacher in Fall 2008, was a senior majoring in mathematics. He was part a "Four Year Integrated" program that allowed students to complete their bachelors degree and earn their teaching credential at the same time. According to Dean, almost all of his math teachers "taught in a step by step manner" and always gave much practice to take home. Not surprisingly, Dean felt the same about the need for "plenty of practice." He had always been strong in procedural math and had experienced success as a tutor in mathematics with his clear explanations of procedures.

In addition to these four student teachers, there were also 14 other first semester student teachers, not including full time interns, who also submitted a Preliminary Teaching Event (PTE) in 2008 (see Table 3). All but five of these 18 student teachers had taken my methods class at some point. The 18 PTE submissions provided me an opportunity to compare the nature of work submitted by the student teachers as well as note patterns in their submissions. Eleven of those submissions were scored by other trained faculty who were all calibrated according to PACT guidelines. Their feedback on the students' work served to reduce biased conclusions.

As final note, the placement of all the student teachers was made by me without any prior contact with the individuals. Thus, no special criteria were applied in who would be assigned to work with me. In fact, three of student teachers who were placed with me were assigned because they had schedule conflicts with their initial placements. So it was actually quite random in how my student teachers ended up with me.

Impact on Student Teacher Practice

Designing lessons based on student needs is generally considered difficult, if not impossible, by new teachers. In fact, even experienced teachers have a hard time applying research-based practices to actual classrooms in less than ideal situations (Clift & Brody, 2005). As a result, new teachers resort to a reliance on the textbook with lesson planning being reduced to simply determining which section of the book to present on any given day. Such lessons are often procedural in nature and treat different topics in mathematics discretely without making connections across the different representations of the concepts. Further, the progression of lessons are not guided by the developmental needs of learners. Instead the lessons typically follow the organizational structure of experts who already possess an advanced understanding of the subject (Nathan & Petrosino, 2003). Thus, it was important for me to examine the extent to which my student teachers connected various types of knowledge based using a progression based on the learning needs of students. Table 3 summarizes the main characteristics of the PTE lessons.

The primary source of data for this study came from the PTE submissions from the teacher candidates who were in their first semester of student teaching. My analyses focused on two guiding questions from the *Planning* task and one guiding question from the *Instructing* task. In particular, I examined the student teachers' lesson plans for the following: 1) the degree to which their lessons connected procedures, concepts, and reasoning (i.e., a balanced focus); 2) the thoughtfulness of their sequencing of learning tasks to make content accessible and to promote understanding (i.e., access to content); and 3) strategies and structured opportunities that support learning and intellectual engagement (i.e., opportunities to engage).

Table 3: Summary of Teaching Practices (note: highlighted students did *not* take methods with me)

***n* = 18**	**GC 1** ***Balanced Focus***	**GC 2** ***Access to Content***	**GC 4** ***Opportunities to Engage***
Ayesha*	***Original investigation task*** • Conceptual and procedural focus • Connections between concepts and representations • Thoughtful progression • Deep understanding	***Supports developed by ST*** • Builds on prior learning • Structured support (guided investigation) • Academic language supports	***Engagement strategies evident*** • Intentionally structured supports • Responses based on informal assessment
Bae*	***Original investigation task*** • Conceptual and procedural focus • Connections between concepts and representations • Thoughtful progression • Deep understanding	***Supports developed by ST*** • Builds on prior learning • Structured support (guided investigation) • Academic language supports	***Engagement strategies evident*** • Intentionally structured supports • Responses based on informal assessment
Cindy*	***Original investigation task*** • Conceptual and procedural focus • Connections between concepts and representations • Thoughtful progression • Deep understanding	***Supports developed by ST*** • Builds on prior learning • Structured support (manipulatives, guided investigation, group work) • Academic language supports	***Engagement strategies evident*** • Intentionally structured supports • Responses based on informal assessment
Dean*	***Investigation task developed by MT*** • Conceptual and procedural focus • Connections between concepts and representations • Thoughtful progression • Deep understanding	***Supports developed by ST*** • Builds on prior learning • Structured support (guided investigation, group work) • Academic language supports	***Engagement strategies evident*** • Intentionally structured supports • Responses based on informal assessment
Ellen*	***Scripted lesson from curriculum*** • Conceptual and procedural focus • Connections between concepts and representations • Progression determined by curriculum • Deep understanding	***Supports embedded in curriculum*** • Builds on prior learning • Structured support (manipulatives, guided investigation, group work) • Academic language supports	***Engagement strategies evident*** • Intentionally structured supports • Responses based on informal assessment
Francis*	***Scripted lesson from curriculum*** • Conceptual and procedural focus • Connections between concepts and representations • Progression determined by curriculum • Deep understanding	***Supports embedded in curriculum*** • Builds on prior learning • Structured support (guided investigation, group work) • Academic language supports	***Engagement strategies evident*** • Intentionally structured supports • Responses based on informal assessment
Gloria*	***Original investigation task*** • Conceptual and procedural focus • Connections between concepts and representations • Thoughtful progression • Deep understanding	***Supports developed by ST*** • Builds on prior learning • Structured support (manipulatives, guided investigation, group work) • Some academic language support	***Engagement strategies evident*** • Intentionally structured supports • Responses based on informal assessment
Hanna*	***Original investigation task*** • Conceptual and procedural focus • Connections between concepts and representations • Thoughtful progression • Deep understanding	• ***Supports developed by ST*** • Builds on prior learning • Structured support (manipulatives, guided investigation, group work) • Some academic language support	***Engagement strategies evident*** • Intentionally structured supports • Responses based on informal assessment

Ingrid*	***Original investigation task*** • Conceptual and procedural focus • Connections between concepts and representations • Thoughtful progression • Deep understanding	***Supports developed by ST*** • Builds on prior learning • Structured support (guided investigation, group work) • Some academic language support	***Engagement strategies evident*** • Intentionally structured supports • Responses based on informal assessment
Jenna*	***Original investigation task*** • Conceptual and procedural focus • Connections between concepts and representations • Thoughtful progression • Deep understanding	• ***Supports developed by ST*** • Builds on prior learning • Structured support (manipulatives, guided investigation, group work) • Some academic language support	***Engagement strategies evident*** • Intentionally structured supports • Responses based on informal assessment
Kevin*	***District developed concept lesson*** • Conceptual and procedural focus • Connections between concepts and representations • Curriculum determined by the district lesson plan • Deep understanding	***Supports embedded in lesson*** • Builds on prior learning • Structured support (manipulatives, guided investigation, group work)	***Engagement strategies evident*** • Intentionally structured supports • Responses based on informal assessment
Lucy*	***District developed concept lesson*** • Conceptual and procedural focus • Connections between concepts and representations • Progression determined by the district lesson plan • Deep understanding	***Supports embedded in lesson*** • Builds on prior learning • Structured support (manipulatives, guided investigation, group work)	***Engagement strategies evident*** • Intentionally structured supports • Responses based on informal assessment

Mark*	***Interactive lecture*** • Primarily procedural focus • Some connections between representations • Practice book problems • Limited connections	***Some supports provided*** • Builds on prior learning • Limited structured support (manipulatives, student pairing)	***Engagement strategies unclear*** • Limited intellectual engagement • Limited response to students
Natalie*	***Interactive lecture*** • Procedural focus • Limited connections	***Some supports described*** • Builds on prior learning • Use of graphic organizer for notetaking	***Engagement strategies unclear*** • Limited intellectual engagement • Limited response to students
Olivia*	***Interactive lecture*** • Procedural focus • Practice book problems • Limited connections	***Some supports described*** • Unstructured use of white boards	***Engagement strategies unclear*** • Limited intellectual engagement • Limited response to students
Pedro*	***Supervised seat work*** • Procedural focus • Practice book problems • Limited connections	***Some supports described*** • Unstructured use of group work (students merely seated in group formation with no interaction)	***Engagement strategies unclear*** • Limited intellectual engagement • Limited response to students
Rachel*	***Lecture only*** • Procedural focus • Limited connections	***Supports minimal*** • Note taking format	***Engagement strategies absent*** • Following directions only • No response to students
Sandeep*	***Lecture developed by MT*** • Procedural focus • Limited connections	***Supports minimal*** • PowerPoint presentation • Textbook examples	***Engagement strategies absent*** • Following directions only • No response to students

*All names have been changed to protect the identities of the student teachers.

Balanced Focus

Based on the PACT rubric, lessons which had a "balanced focus" had clear connections between concepts and procedures. Twelve out the 18 PTEs had a balanced focus. Six candidates submitted PTEs that were primarily focused on learning a procedure. Three out these six engaged their students in interactive lectures in which students were called to perform procedures or give procedural responses. One of the six student teachers who provided a procedural focus assigned seatwork from the textbook and walked around the room to provide individual assistance. In Pedro's class, the students were seated in groups. However, there was no structured group interaction or discourse among the students who were seated together. In fact, Pedro noted that the seating arrangement was out of the norm for him. Two additional candidates, Rachel and Sandeep, provided lectures in which students were asked to simply copy notes quietly. These two candidates were pleased with their PTE submissions particularly because the students worked quietly on task. Rachel, for example, commented that her lesson was successful because the students adhered well to her behavioral standards.

> "*The day went very well. Surprisingly the students seem to behave perfectly. It was one of my best class sessions, and I think that this really showed me that I captured everyone's attention. I will definitely be using the activity lecture again.*"

In contrast, all four student teachers who worked with me submitted lessons that provided opportunities for students to connect multiple representations of concepts. The tasks in their lessons were carefully sequenced based on students' learning needs and were designed to build a deep understanding of the topic. Ayesha, for example, explicitly designed her lesson to help students connect linear equations and their graphs. She sequenced a set of worksheets to steer her students from determining the slope and y-intercept of lines toward writing equations of lines given their graphs. Similarly, Bae provided worksheets that guided her students towards sketching graphs given slopes and y-intercepts. What made their activities different from traditional lessons was that there was limited explicit instruction from the teacher. Instead, the students were asked to complete carefully scaffolded problems and make observations and draw conclusions. In her Planning Commentary Cindy described a process that she shared with Ayesha and Bae, who all designed their own lessons.

> *"The lessons that take place in the classroom are built upon the prior day's lesson to insure that the students see the connection that is being made and that the concepts are cohesive."*

While my student teachers were not the only ones who submitted lessons that had a balanced focus, only four of the other eight students (Gloria, Hanna, Ingrid, and Jenna) designed their own original lessons. The remaining five who had a balanced focus (Dean, Ellen, Francis, Kevin, and Lucy) either used scripted lessons from their CPM textbook or implemented the school district's quarterly "concept lesson." Further analysis revealed additional subtle distinctions between the lessons submitted by these eight student teachers and the four who worked with me.

Gloria and Hanna were assigned to the same master teacher who implemented many of the practices promoted at the university. As a result, they collaborated on almost all of their lesson planning. For their PTE entry, both submitted an original hands-on lesson investigation of the converse of the Pythagorean Theorem. The two candidates had prepared popsicle sticks of varying lengths which the students used to constructed triangles. Those triangles that satisfied the condition of $a^2 + b^2 = c^2$ were noticed by students as right triangles. Further, the lesson

attempted to promote a deeper understanding of triangles with questions such as "can there be two obtuse angles in a triangle?" Even though this lesson was designed to promote discovery, it was unclear if students truly discovered any connections. This was because students were asked to complete a table (such as Table 4) *after* they had already learned that $a^2 + b^2 = c^2$ was true for right triangles. In other words, simply computing the numbers given would have provided the intended discovery without any need for exploring with the popsicle sticks.

Table 4. Sample worksheet from Gloria's PTE

Side lengths (same units)	Do the side lengths $a^2 + b^2 = c^2$?	Is the triangle a right triangle?
3, 4, 5		
5, 6, 10		
6, 8, 10		
4, 4, 4		
4, 5, 7		
3, 6, 9		

Ingrid's lesson also asked students to discover mathematical relationships. She wanted students to generate area formulas for parallelograms and trapezoids based on sketches on graph paper. Though the intended activity had the potential for students to discover area formulas, it was unclear that they were able to do so, particularly for trapezoids. In fact, most students were not even able to generate the area formula for parallelograms. In the end, Ingrid simply told the students what the formulas were and had students practice computing them. The weakness here was that the lesson did not provide specific things for students to observe in order to discover that $A = ½ (b_1 + b_2)$, for example.

In the case of Jenna's lesson, students were asked to model the procedure for solving equations such as $2x + 3 = 7$ using envelopes and pennies on balance beams borrowed from a science class. The step-by-step instructions carefully guided the students through the process and asked the students to generate their own equation as a conclusion. While this activity was very hands-on, the conceptual development was weakened by the fact that students had already been instructed on the procedure for solving equations. It was unclear if students were able to make connections between the concept and the procedure.

While Gloria, Hanna, Ingrid, and Jenna all put a great deal of thought into their lessons, it was clear that these types of lessons were not the norm. For example, Ingrid commented that "Doing the activity it was different to the students because they are use to the textbook problems and they do not really try hand on math or deductive reasoning." Similarly, Gloria reflected that her activity was "a pleasant change from using just their notebooks and the white boards." These comments suggest that even though the student teachers implemented reform type lessons for the PTE, they were still unaccustomed to doing so. In fact, one of the two student teachers who implemented a district concept lesson remarked:

> "*Working in groups was also ineffective as I found certain groups off task several times. Placing the students in groups of four may have been too much stimulation for them, especially with the high number of students with learning disabilities in the class, even if the more severe students were separated. Another ineffective part of the lesson was the divide between what made logical sense and what was seen on the graph. The way that the lesson was presented by the district seemed confusing at best.*"

In contrast, the four student teachers who worked with me were involved in planning and implementing discovery lessons consistently throughout the semester. Cindy, in particular, became a strong advocate of group work and student centered instructional practices even though she began the semester feeling "lost" without a textbook from which to teach.

> *"Since group work takes place daily in the classroom that is a routine the students are used to. They know that each individual is responsible for contributing and sharing ideas and rationales. ... Instead of the answer just being given my teaching strategy is the facilitate the discovery of their answer. I ask questions such as: 'How did you come up with the current answer?' or 'Is there anything you feel unsure about and why?' or 'What do your peers in your group think of your rationale?'"*

Of the other three student teachers who engaged in reform practices (Dean, Ellen, and Francis), one worked with me and two were assigned to other teachers at the same school where I taught. Their master teachers used the College Preparatory Mathematics (CPM) curriculum, in which lessons are carefully scripted to provide rich learning opportunities for students. For Ellen and Francis, this meant that they were also inducted into reform practices immediately. The significant difference, of course, was that they had little opportunity to create their own original learning activities. Even though Dean, my fourth student teacher, did not submit an original lesson for his PTE, he and the other student teachers in my class were given the freedom to experiment. Co-teaching with me gave them the opportunity and the support that they needed to create original curriculum materials aligned with the principles taught in their methods course. This process allowed them to see how research-based practices could actually be enacted with real students. As a result, these four developed a number of original lessons that were engaging and empowering for the students.

Access to Content

One of the most important aspects of effective teaching is in making content accessible to students. The primary focus in PACT is on "structured forms of support" that draw on students' prior knowledge, experiences, and interests. Such structured support include multiple ways of representing content and specific strategies to help students attain learning goals. Analysis of PTE entries reveal many interesting contrasts.

Mark had the strongest lecture based lesson among the six who submitted procedural-focus lessons. He did punctuate his lecture with an "equation strip" activity in which students were asked to sequence steps of solving an equation that were written on different strips of paper. This brief activity did provide some intentional structure to support learning. In a similar manner, Jenna also structured her lesson to support students in learning a procedure. The only difference was that she attempted to help students connect the procedure with a conceptual understanding through the use of balance beams. Natalie and Olivia, however, focused strictly on students recalling procedures and responding with correct answers. In all six procedural-focus lessons, the primary means of support was in the form of a systematic presentation of content through lecture.

The 12 balanced-focus lessons, on the other hand, guided learning using deliberately chosen strategies. Ellen, Francis, Kevin, and Lucy implemented strategies that were prescribed while Dean used a set of learning activities that was created collaboratively with the master teacher. Nonetheless, the student teachers were intentional about the strategies they used to guide learning. For example, Ellen used Algebra Tiles to help students model trinomials in order

to determine binomial factors. She provided a worksheet which directed students to explore a set of trinomials, their dimensions, and their factorability. Jenna, Kevin, and Lucy also provided worksheets with guiding questions to help their students recognize key connections. For example, Kevin and Lucy both implemented a district-assigned concept lesson and provided the following questions in a hands on exploration of stacking cups:

1. *What does x represent? What does y represent?*
2. *Pick a point on the graph and explain what it means.*
3. *As you add one cup, how does the height of the stack change?*
4. *What pattern do you see in the table, how does it relate to the graph?*
5. *What is changing and what stays the same?*
6. *What pattern do you see in the table, how does it relate to the stack?*

At the same time, my student teachers also implemented guided discovery lessons using a set of carefully designed tasks that incorporated "progressive formalization" (Bransford, Brown, & Cocking, 1999, p. 125). In this process, students were encouraged to use their own informal representations before gradually incorporating more formal notations of mathematics. Ayesha, for example, designed a sequence of mathematical tasks that used this approach.

> "*I have decided to design a series of worksheets that will lead up to this goal. The worksheets break down the steps needed to write an equation. … Once students feel comfortable with the terms slope and y-intercept, I will introduce the mathematical symbols for these terms.*"

Similarly, Cindy also reflected that she methodically guided students over many weeks.

> "*The students have been slowly introduced to slope the whole semester. They began with proportional reasoning which gave them a foundation to understanding the slope of a line; after all, slope is the proportional value of the change in y over the change in x. Then they were introduced to the idea that the values in a table (of a linear equation) were the coordinate pairs on the graph. Furthermore the difference between the coordinate pairs was the slope. Most recently, they discovered y-intercept. It is important for the students to learn in a step-by-step manner.*"

A second key feature of the structured support is the way in which student teachers intentionally scaffolded learning and addressed differentiated instruction for students with different learning needs. There was a deliberate use of multiple representations (i.e., visual, vocabulary, symbols, etc.) to provide access to identified gaps. As Cindy stated, "What might not have been understood by definition through words could be understood by definition through pictures (tables and graphs)." At the same time, my four student teachers also incorporated group work as an explicit strategy for addressing the different learning needs of students. For the PTE, many other student teachers also implemented group work activities. But only Francis and Kevin identified it as part of their explicit strategy for providing support for English learners or students with special needs. In contrast, many other teachers provided superficial supports, such as the one provided by Olivia:

> "*Many of my students with IEPs have auditory processing difficulties, in order to provide these students with access to the curriculum I write every important item down under the document camera, which they in turn write down in the composition books. … Since the class is sheltered I give them extra wait time.*"

Similarly, Sandeep also had a naive understanding of what it meant to provide support:

> "*For the lone level-1 English Learner of my class, I will write one English language word with the meanings in simple language on the white board and also take extra care to explain some English Language words to her whenever I feel it is so required. I will explain to her, with the help of a diagram, that slope is when a road or a line is not parallel to the ground and its height goes on changing as we trace it from side to side. I will make her sit on the front desk with another student of same national origin by her side. This will also make it easy for me to monitor her better*."

In summary, student teachers in my class were intentional about their use of strategies to scaffold learning. They were attentive to the learning needs of their students and used their knowledge of students' prior learning and experiences to design activities that provided access to content. As Ayesha noted, we "really get to develop and design lessons that are specific to our students. … The traditional math system has failed them, and so trying new things and discovering what works for them, is the best way to keep them motivated and engaged in the content, ultimately preparing them for Algebra 1."

Opportunities to Engage

Student engagement is often confused with student participation. The PACT rubric explicitly makes the distinction between participation in learning tasks, such as following instructions, and intellectual *engagement*, which involve thinking, reasoning, or analyzing (Sato & Curis, 2005). Thus, it was relevant to examine the PTE lesson plans for strategies that were intentionally implemented to promote engagement. At the same time, the responsiveness of teachers to students' learning during instruction also provided insights into the opportunities that students were afforded for intellectual engagement.

In all six procedural-focus lessons, the candidates relied on verbal transmission of information as the primary strategy for engaging student learning. In each case, the candidates had little to say regarding the understanding that their students had of the content being taught. The lack of student discussion severely limited the teachers' ability to monitor student learning and therefore prevented them from discerning if their students were actually engaged. The comment from Pedro was typical of the reflections that these student teachers wrote:

> "*When I implemented the lesson what went well was the fact that the students had a chance to work on the proofs that they have seen in the notes*."

In addition, Rachel even equated student engagement with students quietly taking notes:

> "*I have my class in a routine when we do a lecture so that they know what they are to be doing, and understand that I will not tolerate anything other than the* [behavior] *standards that I have set forth for this time. The all are aware that I am teaching them something new, and this requires their full participation and their full attention*."

In contrast, students in Bae's class were afforded opportunities to discuss and challenge one another when multiple correct answers were given. Her questioning involved asking students to make choices. Similarly, Cindy's use of manipulatives (e.g., matching cards) and group work provided opportunities for construction of knowledge while reducing "paper and pencil anxieties." This put the focus on understanding the mathematical concepts, rather than on the mechanics of representing those concepts.

> "*I thought it was an effective activity because of the group collaboration. All students were able to express their processes when working with slopes and y-intercepts and then they could benefit from their peers input as well.*"

Further, as Francis noticed, "The more I asked students to explain and describe their process, the clearer their answers became and the more I saw the students were understanding the concepts." This suggests that students who incorporated strategies that intentionally promoted student thinking and discussion were much more able to recognize genuine student engagement.

As a final note, not all candidates who engaged students were able to articulate the level of student engagement. Dean, for example, frequently asked powerful questions to promote student thinking as a general practice. However, he failed to discuss that practice in his commentary. Similarly, Ayesha's worried so much about how her students would appear on videotape that she departed from her norm of group work to seat students individually. After the lesson, she reflected that she should have kept the students in groups.

> "*I would change the way I presented the lesson. I would have put students in groups and had them pair share and/or discuss the material they just learned after my brief lectures. I feel like the students needed more of a discussion about terms and concepts in between my presentation and their independent work.*"

However, it is also important to point out that even though some video clips appeared to show an engaging classroom where students actively responded to teachers' questions, there was actually little demonstration of the type of intellectual engagement described in the PACT rubric. For example, Natalie's scorer pointed out that the smoothness of her lesson was more likely due to the rapport that the she had with the students than with the substance of the lessons. The scorer observed, "Your questions to students elicit one-word answers that complete procedures, and you do not press for explanations or justifications. There is little opportunity for students to develop an understanding of why these procedures work, or why, for example, division wouldn't work." Like so many other student teachers, Natalie's primary strategy for engaging students was to simply to have them take notes. But because she *appeared* so engaging on video, I struggled to determine the degree of intellectual engagement based on the explicit strategies used that promoted student thinking and reasoning. And student thinking and reasoning could only be determined based on the teachers' reflections of what their students learned or did not learn.

Impact on the Teacher Educator

Just as teachers need specialized pedagogical content knowledge, teacher educators also need specialized knowledge in order to prepare teachers. This knowledge for teaching teachers goes beyond subject matter, history of education, and pedagogical theory. In fact, university faculty also need to engage in authentic classroom experiences in order to be closely connected to the realities faced by practitioners. However, a true understanding of the complexities of classroom teaching cannot be accomplished without being "immersed in the milieu" of the classroom (Craig, 2007). This is what led me to consider the need for university faculty to bridge the "abyss between theory and practice" (Levine, 2006, p. 39) through clinical research from the stance of a practitioner.

As a high school teacher I re-learned many important lessons about teaching. Even though I had National Board certification and over twenty years of secondary teaching experience prior joining the faculty at the university, I was surprised at how much I had forgotten about the countless subtle moves that I needed to make in the course of a lesson. As master

teacher, I gained insights into what it takes to help pre-service teachers translate their university coursework into classroom practice. And as a teacher educator, I learned that being good at teaching about teaching is *very* different than being good at teaching high school students. In this section I discuss the different roles that I took on and how they impacted me and my students.

Being a Teacher

For the past five years, I had been longing to return to the classroom and practice all of the strategies that I had been presenting to my pre-service students. However, my idealized vision of teaching in a high school classroom quickly vanished when I actually began working with students who could not focus on instructions for even two minutes. In some ways, I felt like a new teacher again, as I readjusted back to a set of routines and norms that I had only recently left behind. For example, one key learning (or readjustment) was realizing that I needed a default set of opening week activities that could "run themselves" while I got acquainted with the students and socialized them into the norms that I wanted for my class. This meant that *everything* from classroom policies to instructional activities had to be in place before the students walk in. It was not until my third semester back in a high school classroom that I felt like everything was in place for the first day of class.

One of the most challenging adjustments in returning to a high school was readjusting routines of practice. The pace of teaching in a high school is much faster, as a new lesson must be developed *each day*, rather than each week at the university. Also, the lessons must be much more carefully thought out because students need a highly structured format. Part of the challenge, then, was in designing lessons that were cognitively rich, yet easily accessible to all, and with a short turn around time to plan and grade the papers.

An important realization in designing lessons was that my best laid plans were often conceived with an ideal setting in mind, even though I was back in the classroom. At that point I experienced the same struggles new teachers experience when their reality does not match their ideal. I understood why, as a result, many teachers may become disillusioned and abandon the reform practices discussed in their university methods courses. As a teacher educator I had forgotten the pressures that a classroom teacher faced on a daily basis. The desperate need to feel successful tempted me into making compromises with students—compromises that included defining success by completion of procedural tasks. It was difficult to resist making a "treaty" with the students in which the teacher provides low demand tasks in exchange for student participation or good behavior (Sizer, 2004, p. 156). When all the theory about student learning had to be applied to real students with variety of learning issues, reform teaching suddenly seemed much, much more difficult than how I remembered them years ago.

Another ongoing struggle for me was in getting back into "the groove" of being a teacher. It took me five weeks in my first semester to *feel* like I was back in "the groove," where I was able to enact the moves of teaching without much conscious thought. And it wasn't until Week 12 that I truly felt at ease as a classroom teacher, when I was finally comfortable with the routines of the school and classroom. I felt comfortable with the students and was able to chide misbehaving students without fear. And it was not until I began teaching my third semester that I noticed how quickly I became comfortable in the high school classroom. For example, on the first day of class I was passing out their restroom passes (I give them a set number of printed passes for the entire semester). And immediately some of the kids said that they didn't get theirs. My student teacher was about to hand them another set before I stopped her. Of course the kids were just testing me and trying to get extra passes. A year ago I might have missed that

and just given them more passes—but now I feel like I am back in tune with the student mind. This is all part of the intuition— the sixth sense— that classroom teachers develop. And the fact that I did that without missing a beat made me feel encouraged that it was finally all coming back to me. Upon reflection, I am truly amazed at how much and how quickly I had forgotten the little things that teachers must do subconsciously every split second of every day.

Being a Master Teacher

Despite verbal agreement with principles of reform practice, student teachers often enter the classroom with the belief that students must master "the basics" before they could engage in higher order problems (Nathan & Petrosino, 2003). My student teachers were no different. And the fact that we did not use a textbook just made them even more apprehensive in teaching the school's lowest performing students. After working with four student teachers I began to realize that the gap between the expert teacher and a novice is often wide. What experts take for granted is often mysterious to novices. The same is especially true of student teachers, who may not possess the pedagogical content knowledge of seasoned teachers. Thus, I had to remind myself constantly that I should not assume everything was transparently clear to my student teachers. In fact, I realized that too much freedom to innovate may actually paralyze a novice teacher who may not deeply understand the connections between concepts and procedures.

One challenge my student teachers faced was the creation of curriculum. They did not have the experience or knowledge needed to develop the necessary scaffolds for the students. More important, they lacked insights into the design of *appropriate* scaffolds. For example, in their classroom presentations on fractions and combining like terms, the student teachers neglected to consider cases of problems as well as trajectories of thinking that might result from their choices of examples. They did not consider how using all positive coefficients for combining like terms would affect the learning trajectory of students, or how certain denominators would be more intuitively accessible for pupils. Further, their selection of problems did not take into account the current levels of understanding in their pupils. Thus, the potential for disengagement emerged, as pupils resigned from working through their difficulties.

Over time, however, the student teachers truly began to understand the process for designing worthwhile mathematical tasks. They developed tremendous growth in their understanding of how instructional tasks could be designed to foster conceptual understanding as well as procedural fluency. In the Spring 2008, Ayesha seemed to have gained confidence in the use of well designed tasks as a pedagogical strategy. Bae, on the other hand, was only able to create tasks with the same superficial features as those we had been rehearsing. However, her choices of examples or sequence of activities reflected a more novice understanding of how tasks could be used to guide learning. With regards to implementation of tasks, Bae was also less adept in her social interactions with students. While she was warm and friendly, her ability to maintain classroom discipline was much weaker than Ayesha's. Further, she was often not sure of the boundaries and often gave students too many "chances." In fact, Bae often resorted to individual instruction because students ignored her attempts at whole group instruction. As a result, valuable class time was lost as she went from group to group to re-teach what she had just presented.

In Fall 2008 both Cindy and Dean also began the practicum assignment with much apprehension about not having a textbook. Like Ayesha and Bae, both were accustomed to the familiar routine of learning mathematics based on a section-by-section coverage of a textbook. At the same time, Cindy thought there really was not much to learn about being a teacher. After

all, she had already been a substitute teacher. Dean was a math major and had been a tutor as well. According to Dean, "My whole thing before was purely lecture because that's all I've seen." Thus, my role as a master teacher placed me in the position of also having to demonstrate how reform based practices could be viable in a real classroom.

In additional to modeling teaching practices and designing effective lessons, I also had to coach the student teachers in developing their own identity. This meant helping them refine their practice without being judgmental. Student teachers needed the space to experiment and to fail, if necessary. It was my job to buffer them from the pressures of administrative accountability while maintaining a safe environment in which they could hone their practice. In my co-teaching with Cindy and Dean, they were provided that opportunity to explore and practice teaching strategies, much in the same way that their students were able to explore and practice mathematics.

One area of teaching that required extensive practice was in designing worthwhile tasks, which is often neglected in favor of pedagogical concerns such as classroom management. However, I realized that I just could not focus on everything in my mentoring relationship.

> But within the confines of a teacher education program, even one organized around contemporary educational reform principles, preservice teachers will not encounter every possible instructional scenario relevant to their teaching. Consequently, they will not proactively form pedagogical content knowledge about everything they teach. Preservice and practicing teachers can have only a limited set of experiences from which to induce effective principles of pedagogy. From these limited instances and from more general principles, they must make inferences about ways to facilitate learning in specific circumstances. (Nathan & Petrosino, 2003, p. 921)

Thus, I chose to focus my mentoring on lesson design because I felt that the other elements of teaching would eventually fall into place with experience. Lesson design, however, required much more intensive coaching and I knew that I wanted to focus on learning experiences for my student teachers that would have the greatest impact on pupil learning.

So despite initial reluctance on their part, little by little the student teachers began to gain an acute awareness into the nature of tasks and their design, as evidenced by their lesson activities and written commentaries. Of course much work remained to be done, including many aspects of questioning, classroom management, etc. However, the experience of co-teaching was transformational for Cindy and Dean. For example, at the beginning of the semester, Cindy admitted that she thought that group work was "a load of crap." However, because she experienced success with students working in groups, she became a vocal advocate of group work as a essential practice in supporting student learning. In fact, at the beginning of her second semester of student teaching, she appealed to me to transfer out of her new assignment because her new master teacher refused to let her implement group work.

Finally, my role as a master teacher focused on helping my student teachers reflect constantly for self improvement. It meant asking "why," and knowing when to ask "why," as well as asking the student teachers to explain their instructional decisions. As a result of these daily conversations, Cindy changed her perspectives on students as learners ("I used to think they were just stupid and lazy"), on how to teach ("I now understood how collaboration should be implemented"), and on being patient for results ("I don't need to rush; it's about quality, not quantity"). According the Cindy, "what changed my perspective is all this reflection you had us do." As a mentor, that was the single most powerful practice that I could have possibly passed on to my student teachers.

As a side note, teaching at the high school required five hours per week, for 20 weeks each semester. Mentoring, planning, and debriefing took as much as ten hours per week. Over two semesters, I invested over 600 hours in teaching and mentoring at the high school, including the additional time for preparing lessons and grading papers, attending faculty meetings and parent conferences, and even going on a couple of field trips.

Being a Teacher Educator

Taking on a high school class while carrying a full workload of a university professor has been an extremely disorienting experience. The types of preparation (and amount of preparation) required for each role differed dramatically. The familiar timetables for planning, writing, grading, even checking email were interrupted by the demands of handling discipline, attending 504 meetings, and preparing lesson materials on a daily basis. Further, there was the challenge of switching between roles constantly. However, the greatest benefit of occupying a dual role as a teacher and professor was that I was able to develop a knowledge for teaching teachers that could not be obtained any other way.

The experience of being a teacher and professor has caused me to reexamine much of what I had been doing at the university. As a result, I have completely revised my syllabus to be much more practical and sensitive to the needs of classroom teachers. No longer did I ask my methods to read research; rather they *applied* the research principles. No longer did they just simulate grading student papers; they graded actual student work I brought from my morning class. No longer did we discuss classroom issues hypothetically; we worked together to find real solutions for my Period 4 class the following day. As a result, the students in my methods courses no longer saw the class yet another "hoop to jump through" in obtaining licensure. For example, one methods student reflected after spending several weeks analyzing tests and writing tests:

> "*I admit, most often I use a pre-formatted test or quiz because that is easier. I know that is not in the best interest of my students, and to be honest, creating this assessment didn't take that much longer than it would for me to recreate an existing test, or even just to go through the test formats I have and pick which one I want to use. This assignment has helped reinforce to me how it important it is to take the time to develop good activities and assessments based on clear objectives. I think as a first year teacher I just assume that book knows better than I do, I'll take any help I can get! But in reality, I know that is not the case; the book doesn't know my school, my students, or me. It can help give me a guideline on what an assessment for the material should cover, and look like, but it isn't the end all, be all.*"

In my methods class, I conclude each session with the reminder "Focus on getting through to the kids, not on getting through a book." And in the end, Cindy wrote, "I used to think they were just stupid and lazy. Now I see it as my responsibility to get through to them."

Discussion

In their critique of the National Mathematics Advisory Panel report, Borko and Whitcomb (2008) asserted that there was a lack of research on components of teacher education programs that foster teacher learning. My study, however, provides a unique glimpse into some key elements of what teacher education needs in order to close the gap between the theory and practice. While coherence within the pre-service program is essential, the connection to field

experience remains the primary gap between theory and practice. My work has accomplished two key things: coherence within coursework (methods and seminar) and coherence between coursework and practice.

At the same time, my analyses of the student teachers' lessons provided me with several important findings. First, the four student teachers who worked with me demonstrated that not only could they articulate a clear instructional focus for each lesson, but their lessons evolved in sophistication to include connections between concepts and procedures that focused on deep understandings of each concept. This was often not the case among other student teachers. Second, my explicit focus on making content accessible in methods led my student teachers to be attentive to the learning needs of their students. As a result, structured forms of scaffolding were thoughtfully incorporated to help pupils reach learning goals. Third, my student teachers developed a high degree of awareness of their students' understanding which was used to inform their instructional decisions and their self evaluations. As Cindy pointed out, "I never would have thought to look at the test to look for common errors. Why are they common errors? It's just so enlightening."

A key aspect of my work focused on helping the student teachers develop a greater understanding of what it meant to teach proficiently. Current literature describes three specific types of knowledge in which teachers need in order to be proficient: knowledge of content, knowledge of students, and knowledge of instructional practices. Together, they form what Lee Shulman (1987) describes as "pedagogical content knowledge," that is, the expert blending of specific pedagogical knowledge with content knowledge to generate student learning. To help them develop this knowledge, I engaged the student teachers in identifying the key mathematical concepts they needed to teach as well as the possible "trajectories" along which their students might develop (Kilpatrick, Swafford, & Findell, 2001, p. 370). Each day we met to plan the specific activities that we would implement the following day. For example, we worked together to identify a weakness in students' ability to graph linear equations. Based on thoughtful examinations of student work, we created activities that incorporated multiple representations, including the use of tables and intuitively accessible problem situations. As the student teachers thoughtfully developed these activities, they began to develop habits which affected their lesson planning and teaching practices.

Collaboration also afforded the student teachers daily opportunities to reflect upon shared experiences and common objects of focus (Tobin & Roth, 2005). It was through our daily discussions that the student teachers began to develop a greater understanding of their own teaching. This was how their learning became generative: it helped them improve their practice based on ongoing development of their pedagogical content knowledge (Carpenter & Franke, 1998). This led my student teachers to refine mathematical tasks that focused more and more on inquiry and connections rather than on procedures and algorithms. In particular, the student teachers came to recognize that their students struggled with algebra because it often seemed to be a collection of rules and formulas (California Department of Education, 2006). Thus, the teachers made an effort to show students patterns and generalizations as part of a system that "made sense." In other words, the teachers' response to their students' struggles was to provide ways for students to see the connections between concepts, representations, and procedures. As a result, the student teachers began to establish the practice of (1) using their students' existing knowledge to make the content make sense; (2) organizing information to bring out patterns that could help students generalize; (3) contextualizing abstract concepts using familiar situations; and (4) connecting concepts through multiple representations.

Enacting reform practices is often difficult for pre-service teachers (Clift & Brody, 2005). My role as a co-teacher and mentor, however, provided me the opportunity to support these teachers in shifting their beliefs from that of transmission of knowledge to the facilitation of learning. I was able to accomplish this by bringing coherence to the student teaching experience. Specifically, I was able to align my work in the high school classroom with the principles and practices that I tried to communicate in my methods class. At the same time, the co-teaching experience allowed me to engage in co-generative dialogues (Tobin & Roth, 2005) with the student teachers. These conversations helped the student teachers reflect on their own practice, their students' progress, and their instructional choices. As my student teachers learned how to engage in authentic applications of theory, they were then able to develop the pedagogical content knowledge they needed for real classroom teaching.

The important lesson learned is that effective teacher education cannot not merely focus on pre-service students' *acquisition* of information, but the *application* of new knowledge and understandings. This means teacher educators must provide numerous opportunities for their students to engage in authentic teaching practices as well as support them in honing those practices. Furthermore, those learning experiences must be *transformative* and *generative*. This means teacher educators must work on *changing* beliefs and practices as well as *empowering* pre-teachers in the implementation of those new practices. However, transformative learning is a difficult and painful process because it requires critical self-reflection. As the learner seeks to reconcile new ideas with past assumptions, there may be as much to unlearn as there is to learn (Ball, 1996; Cohen, 1990). Thus, if pre-service learning is to be transformative, student teachers need a safe and secure environment in which they can re-examine their assumptions. This is accomplished when pre-service teachers are provided abundant opportunities to discuss, reflect, develop, and *try out* their ideas. As pre-service teachers become aware of their own understanding of how learning takes place and what their goals of instruction are, they then become better prepared to select appropriate teaching strategies, adapt instructional materials, and understand their students' thinking.

The implication for methods instructors is that course assignments should focus on opportunities to rehearse the key practices which real teachers engage in: planning, instructing, assessing, and reflecting. Candidates should be given opportunities to learn *specific* ways to apply research rather than address education theory in general ways. For example, a course assignment might ask students to design an activity that must actually be presented to pupils based on a specific strategy, such as comparing and contrasting, which has been identified as one that produces significant learning gains (Marzano, Pickering, & Pollack, 2001). Such an approach to course assignments is drastically different from many methods courses that merely ask students to reflect on the research and write about how they *might* enact reform practices. In fact, the textbook assigned in my methods classes is a teacher's edition of an actual algebra textbook, rather than a typical methods book. My students use this book to design their lessons and write their tests. Thus, they are able to closely approximate what real teachers must do on a regular basis. The key distinction in my class, however, is that the students are guided in developing lessons and assessments that are based on research-based best practices and reform principles. As a result, they experience what is needed in order to apply theory to the classroom environments that they are likely to encounter.

At the same time, a key recommendation for the master teacher is that, within the parameters of school and district policies, student teachers must be provided opportunities to enact the teaching practices that they have rehearsed in their methods classes. Too often, the

disconnect between the university and the classroom occurs when a master teacher is unwilling to allow the student teacher to try out new strategies that the master teacher has not experienced herself. Master teachers need to realize that learning takes time, for the student teacher as well as for the pupils in the classroom. Simply covering a number of discrete procedures to keep up with a pacing plan does not provide a solid understanding of difficult mathematical concepts. What would better serve the pupils and the student teacher is to identify and focus on the key skills and concepts required for the course, and then *integrate* those skills and concepts in sets of intellectually challenging lessons. Doing this, however, is by no means an easy task and will require the collective knowledge of the master teacher and the student teacher. Master teachers will need to collaborate with the student teacher in developing lessons and in implementing reform practices. Only then will there be coherence between what is taught at the university and what is experienced in the actual classroom. The benefit, however, is that everyone learns and grows—the student teacher, the master teacher, and the pupils.

My experience in "crossing the boundary" between the university and the classroom allowed me to "practice what I preach" and to model what a teacher needs to do when a lesson doesn't work. However, it was also an experience that was fraught with risks (Hoge & Jenks, 2000). As Chazan (2000) points out, teachers are dependent on their students in order for a lesson to succeed. Thus, when students did not engage as planned, I became particularly vulnerable to criticism. Worse, I could inadvertently cause my pre-service teachers to dismiss the reform practices that I was attempting to demonstrate. However, reimmersing myself in the same classroom where my student teachers were placed afforded me the opportunity to engage in sustained inquiry in a laboratory setting as well as in a community of practice. Grossman & McDonald (2008) argue that teacher education must focus on the clinical aspects of teaching in order to develop a robust knowledge base for teaching teachers. What I have been able to provide is research on the work of teachers in context (Flores, 2006). More important, this study is an example of research that spans boundaries between circles of knowledge and can hopefully help close the gap between theory and practice.

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