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Exposing the Brilliant Facets of Pedagogical Content Knowledge: a Collective Case Study

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EXPOSING THE BRILLIANT FACETS OF PEDAGOGICAL CONTENT KNOWLEDGE:

A COLLECTIVE CASE STUDY

by

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ABSTRACT
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Under the Supervision of Professor Dr. Barbara Bales

A tremendous cultural richness exists throughout today's urban communities. From language, race, culture, ethnicity, religion, sexual orientation, and socioeconomic status, PK-12 pupils enter the classroom with a multitude of lived experiences and academic proficiencies. In particular, it is the range of academic proficiencies and the inadequate preparation of urban educators that perpetuates a visibly widening achievement gap between urban pupils and their suburban counterparts. Add to this a skeleton curriculum and endless high-stakes assessment exams, the future success of urban pupils becomes bleak. A deep foundation in pedagogical content knowledge (PCK), also known as the amalgam of rich content knowledge and pedagogical knowledge, becomes imperative for the successful preparation of future urban educators. Thus, this collective case study served as a vehicle to investigate how urban, pre-service teachers constructed and internalized an awareness of the complexities of teaching, learning, and PCK during a subject-specific pedagogy lab. These pedagogy labs focused on the subject areas of Political Science, Chemistry/Biochemistry, Environmental Science, and Mathematics, and acted as spaces where university students and faculty had

opportunities to confront, construct, and reinvent teaching practices imperative for PK-12 urban pupil success. Each pedagogy lab was constructed and facilitated by two university instructors; one instructor had experience with the particular content and the other instructor had experience with the particular pedagogy. During the five weeks of each lab, pre-service teachers engaged in a space of liminality where they participated in critical discourse surrounding the various dimensions of becoming a teacher. Three common themes of: making content relevant, inquiry-based teaching, and reflections of self as an educator emerged as the skills and traits necessary for today's developing educator. For individuals who were considering a profession in teaching, the participants of this study were advanced with their assertions of best teacher practice. The faculty and instructors who facilitated these pedagogy labs also experienced their own space of liminality as they participated in cross-disciplinary collaboration surrounding the dimensions of PCK. As such, a revision of the PCK framework emerged, which includes newly refined facets for the preparation of urban teachers. Those facets: *knowledge of self as an educator, knowledge of culturally responsive teaching, knowledge of inquiry teaching,* and *knowledge of content and student learning* realign to establish a brilliant skill set embodying content, pedagogy, and cultural responsiveness. As such, these facets fuse together to provide the opportunity to reemphasize a deeper development of culturally responsive pedagogical content knowledge (CRPCK), applicable for every urban classroom and the foundation for every burgeoning educator.

Pateicos mammai, papam, un Egilam par viņu mīlestību.

This dissertation is also for each of you who were told you could never do it.

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Introduction

The field of education and, within that, teacher development, continues to transform through evolving initiatives and reforms. Each new strategic change offers the hope of an opportunity to advance the learning of all students, regardless of their gender, class, race, culture, ethnicity, or abilities. Despite these new efforts, diverse students in predominantly urban areas[1] continue to face challenges such as large class sizes, an absence of rigorous content or academic expectations, inexperienced, ill-prepared, or uninspiring teachers, and a lack of appropriate learning materials or resources (Banks, 2010; Banks & Banks, 1995; Cross, 2003; Darling-Hammond, 2006; Freire, 1970; Hollins & Guzman, 2005; Haberman, 2005; Ladson-Billings, 1995a, 1995b; Milner, 2010; Miner, 2011; Sleeter, 2001, 2012). These challenges, coupled with the omnipresent high-stakes assessment demands for student achievement, contribute to the high number of teachers who leave these classrooms within three to five years of starting (Haberman, 2005; Ladson-Billings, 2000; Nieto, 2003; Marx, 2004). Such high attrition rates suggest that current methods of preparing teachers for today's city schools are inadequate and therefore reify the academic gaps between urban students and their suburban counterparts.

Since one core area of this gap centers on students' content knowledge (Ball Thames & Phelps, 2008), it makes sense that research focuses on how to better

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[1] The blanket terms of 'urban' and 'diverse' encompass a plethora of perceptions and realities, better known as cultural capital (Yosso, 2005), that serves to enrich the classroom and the lives of students and teachers. The reality has become that the majority of classrooms will have some level of diversity, with variances in ability, language, culture, race, religion, ethnicity, gender, socio-economic status, sexual orientation, and other lived experiences (Alba, Rumbaut, & Marotz, 2005; Ladson-Billings, 2000; Milner; 2010; Sleeter, 2001). In this study, 'urban' is defined as a densely-populated area made up of complex and contrasting perspectives of poverty and wealth, violence and transformation, social division and social activism, and finally, cultural wealth (Pratt-Adams et al., 2010). Within these areas, diverse students attending urban schools can experience a number of structural challenges because of the marginalizing policies addressing poverty, violence, hunger, and inadequate health care that affect learning.

understand pre-service teachers' ability to develop a rich awareness in the ways urban and diverse PK-12 students acquire and conceptualize content knowledge (Ball, Thames, & Phelps, 2008; Darling-Hammond, 2012; Grossman, Stodolsky, & Knapp, 2004; Phillips, Desimone, & Smith, 2011). This skill set—making content knowledge accessible to all students—is known as Pedagogical Content Knowledge (PCK). When PCK was first identified, it was viewed as a flat, one-dimensional set of teaching strategies (Shulman, 1986, 1987). Today, research reveals a more complex phenomenon (Ball, Thames, & Phelps, 2008; Grossman, 1990; Loughran et al., 2012; Nelson & Harper, 2006; Schneider & Plasman, 2011). Thus, one might conceptualize PCK as a crystal; it is a multifaceted, multidimensional knowledge base that includes a myriad of skills, attitudes, and behaviors that teachers need in order to foster learning in the classroom and, in doing so, promote academic gains among urban and diverse students. So how might these facets be exposed and rigorously developed in teacher preparation programs, particularly those programs designed to serve large urban and diverse communities? This is the problem that frames the following questions guiding this dissertation research.

Research Questions

The central research question of this dissertation proposal asks: how do urban pre-service[2] teachers construct an awareness of the complexities of teaching, learning, and pedagogical content knowledge (PCK) through the structure of a Pedagogy Lab? In addition are three attendant questions:

[2] The term 'pre-service teachers' is used throughout this study to include the various paths university student participants selected: education-curious and interested in various scopes of teaching; applied to a teacher education program; and/or formally accepted and enrolled in a teacher education program.

1. How does participation in a pedagogy lab shape urban pre-service teachers' understanding of pedagogical content knowledge as it relates to working in urban schools?
2. In what ways do urban pre-service teachers who participated in a pedagogy lab translate their developing PCK into learning opportunities for students attending urban schools?
3. In what ways do university faculty members expose and address urban pre-service teachers' misconceptions about teaching, learning, and the development of content-area knowledge for students attending urban schools?

Background of the Study

The demographic makeup of the United States' population grows ever more diverse over time, with the enrollment of racial minorities in today's schools projected to increase significantly in the future. Between 2007 and 2018, it is estimated that African-American student enrollment will increase by 26 percent, and Latino student enrollment is projected to increase by 38 percent (U.S. Department of Education, 2009). With this growing diversity in the classroom, it has become vital to address how well educators are prepared to lead students toward career and college readiness (CCSSI, 2010a, 2010b).

Research has long pointed out that those who enter the field of teaching are predominantly White, English-dominant, middle class females who have little experience outside their own homogeneous community (Haberman, 1991, 1995, 2005; Kincheloe, 2004; McKinney et al., 2008; Zeichner, 2003). To be more exact, in 2011 seventy-six percent of teachers in public schools were female; among both male and female teachers, eighty-three percent were White (Snyder & Dillow, 2012). This homogeneous pool of

educators necessarily carries various preconceived notions and cultural beliefs into the classroom. These beliefs and conflicting ideologies contribute to a mismatch between school and student and the teaching and learning relationships that occur therein. This incompatibility should be immediately addressed in teacher preparation programs to best prepare future educators, as when "cultural conflict exists between the student and the school, the inevitable occurs: miscommunication and confrontation between the student, the teacher, and the home; hostility; alienation; diminished self-esteem; and eventually school failure" (Irvine, 2003, p. 7).

To foster high-quality learning opportunities, this assemblage of pre-service teachers needs ample time and substantive practice to wrestle with strategies in teaching content while simultaneously participating in critical discussions about race and cultural diversity (Hollins & Guzman, 2005; Villegas & Lucas, 2002). The marrying of these two knowledge bases—content and cultural competence—within teacher preparation programs may help close the persistent achievement gap (Howard, 2010).

Most teacher education programs require the successful completion of numerous hours of coursework in both content and teaching methods. However, teacher preparation programs must remember that "pre-service teachers don't learn skills by reading a book in a methodology class. They hone these teaching skills by trial and error, by being in the thick of it, by reflecting on successes and analyzing failures" (Renard, 2003, p. 63). Furthermore, emerging pre-service teachers cannot learn the necessary pedagogy if they are isolated within the four walls of a university classroom (Cochran-Smith & Zeichner, 2010; Darling-Hammond, 2010; Shulman, 1986). Rather, these future educators need to experience teaching firsthand, engage in building relationships and

community with students and their families, learn to reflect on their professional practice, and observe and engage in discourse with master teachers so they understand the intricacies of learning to teach (Hollins & Guzman, 2005; Haberman, 1995; National Council for Accreditation of Teacher Education — Blue Ribbon Panel, 2010). This approach enables students of teaching to be afforded rich and extensive teaching opportunities that build their capacity to make connections between subject matter and how to successfully *teach* this knowledge to students. To that end, educators must develop a strong and rich understanding of the content and how to present it in a meaningful way. In addition, teachers must also have a cohesive culturally responsive pedagogy to ensure applicable learning opportunities for all students.

Importantly, teacher preparation programs should steer clear of the "container view of practice" where pre-service teachers develop in a way that is completely divorced from implementation (Dall'Alba & Sandberg, 2006, p. 385). Instead, pre-service teacher development must operate in both horizontal and vertical dimensions and be incorporated throughout a preparation program, so that "professional skill development entails a combination of skill progression and embodied understanding of practice" (Dall'Alba & Sandberg, 2006, p. 384). This necessary shift requires departing from the simple transference of knowledge toward developing a richer understanding of a "professional practice that has no end point" (Bales & Saffold, 2011, p. 10).

As one of the 11 sites funded by the Teachers for a New Era project (TNE), the University of Wisconsin-Milwaukee (UWM) explored ways to strengthen these connections to improve teacher preparation and, in turn, improve teacher quality in the PK-12 classroom. The notion of a pedagogy laboratory, an area that focuses on

conjoining disciplinary-based content knowledge and pedagogical knowledge to further support the concept of PCK, emerged from this UWM-TNE work.

Significance of the Study

This research examines how urban pre-service teachers construct an awareness of the complexities of teaching, learning, and PCK through the structure of a pedagogy lab. It also investigates how university faculty members develop their course content in a way that is appropriate specifically for pre-service urban teachers. To that end, the researcher utilizes the qualitative research methods of collective case study (Lightfoot, 1983; Merriam, 1988; Smulyan, 2000; Yin, 2003) to investigate how pre-service teachers explicitly bridge their knowledge and awareness of content with the necessary pedagogical knowledge and culturally responsive teaching to provide for successful learning opportunities in the PK-12 classroom.

This qualitative research is significant for a number of reasons. First, there is a limitless need for innovative and unique teaching and learning opportunities in the professional preparation of educators, especially in the initial years of a teacher's induction. Second, a gap exists between how pre-service teachers link pedagogical content knowledge and culturally responsive pedagogy. Third, it appears that an uncertainty remains when researchers attempt to concretely define Pedagogical Content Knowledge (Ball, Thames, & Phelps, 2008; Hashweh, 2005). Additionally, this study has the potential to uncover and impart additional recommendations for future teacher education programs as they relate to the development of PCK and CRP, and within that, how to further investigate and address misconceptions in pre-service teachers' knowledge of content and subject matter. Finally, there are opportunities to explore how university

faculty may anticipate and better inform the struggles developing teachers experience as they learn to meld these two areas together.

Chapter 1: Literature Review

This literature review examines the intersection of Pedagogical Content Knowledge (Ball, Thames, & Phelps, 2008; Grossman, Stodolsky, & Knapp, 2004; Shulman, 1986, 1987) and culturally-responsive teaching (Freire, 1970; Gay, 2000; Ladson-Billings, 1994; Mizialko, 2005; Sleeter, 2001), as well as the history of pedagogy labs. It considers numerous empirical and theoretical peer-reviewed articles and books in order to lay the foundation for this research project.

The Evolution of Pedagogical Content Knowledge

Shulman (1986, 1987) identified that developing educators need to embrace a sound knowledge of pedagogy, construct a foundation for content knowledge, and gain the additional knowledge of numerous educational contexts. In order to promote better learning within the classroom, the crossroads of these areas became the revolutionary domain of pedagogical content knowledge (PCK), otherwise known as the awareness of how to bridge together a rich understanding of subject matter and how to teach that content to students who have a variety of lived experiences. Considered "the subject matter *for teaching"* (Shulman, 1986, p. 9), this knowledge base may have the greatest influence on teacher education in developing best practices; it is suggested to be the 'missing paradigm' of teaching (Shulman, 1986). The notion of PCK also supports an understanding of why particular content-specific topics could be more or less challenging for students of different ages or grade levels to grasp: "the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning should be of those most frequently taught topics and lessons" (Shulman, 1986, p. 10).

Although the term pedagogical content knowledge originated in Shulman's work, there is some suggestion that this framework traces back to Dewey's (1916) notion that "teachers must learn to 'psychologize' their subject matter for teaching, to rethink disciplinary topics and concepts to make them more accessible to students" (Grossman, 1990, p.8). Grossman (1990) further elaborated on this notion, clarifying that pedagogical content knowledge also embodies one of the four "cornerstones of the professional knowledge for teaching" (p. 5): general pedagogical knowledge, subject matter knowledge, pedagogical content knowledge, and knowledge of context.

To analyze pedagogical content knowledge further, it is necessary to be knowledgeable of the following dimensions:

- Knowledge and understanding of teaching at different grade levels
- Awareness of students' understanding and misconceptions of subject matter topics
- Knowledge of current curriculum materials available for educators
- Awareness of curriculum and its vertical and horizontal trajectory
- Knowledge of diverse learners and how learning takes place in particular social contexts
- Knowledge of teaching strategies to make content applicable for students

(Darling-Hammond & Bransford, 2005; Grossman, 1990; Grossman, Stodolsky, Knapp, 2004). Each of these facets intersects and builds onto one another; therefore, it could be assumed that if one or several of these concepts are lacking or altogether missing from a teacher's development, it becomes difficult to compensate for. As each of these areas are significant to the whole of teaching, pedagogical content

knowledge has experienced a renewed interest in how the development of content-specific teaching occurs (Gess-Newsome, 2002; Southerland & Gess-Newsome, 1999), indicating the importance of identifying how pedagogical content knowledge has the capacity to continue to inform current and future teaching practice.

There are a number of categories that contribute to an overall consciousness of pedagogical content knowledge, including knowledge of the following: particular content areas and curriculum, specific assessments, needs of individual learners, and an explicit pedagogy (Morine-Dershimer & Kent, 1999). Effective teachers are those who know how to incorporate this amalgam of knowledge and present it in ways that are meaningful and relevant to their students. Yet the question remains: how do teachers develop and construct this necessary pedagogical content knowledge or 'pedagogical content knowing' (Cochran, DeRuitter, & King, 1993), and how does one concretely define this?

The first step may begin with each pre-service teacher's preparation and content knowledge development. Cochran-Smith (2003) identifies an obligation for students of teaching to confront their apprehensions when learning complex content. Pre-service teachers should take on an active role in questioning and addressing their perceptions—and more importantly, their misconceptions—in subject areas. For example, in the research by Bell & Gilbert (1994), some university students were found to maintain a naïve understanding of how plants and trees flourished due to gaps in their own education as elementary students. Role-playing with critical and effective questioning skills assists in confronting these common scientific misunderstandings.

A second noteworthy area identified by Cochran-Smith & Lytle (1999) is that of a continuous reflective practice. Pre-service teachers should actively explore an array of

methods and strategies, and then more importantly, reflect on the effectiveness of each approach. On many occasions, research uncovered tremendous discomfort and embarrassment among developing teachers when contradicting one other over traditional epistemological beliefs (Gallagher, 1991; Gallas, 1995). This combination of confronting trepidations and incorporating a genuine reflectivity could further influence a teacher's awareness of pedagogical content knowledge and expand his or her repertoire of effective practice.

Content knowledge among pre-service teachers is one of many necessary facets for quality teacher preparation (Ferguson & Womack, 1993), and there continues to be a positive link between the content knowledge of a teacher and overall teacher quality (Wilson, Floden, Ferrini-Mundy, 2001). However, a study conducted by Monk (1994) suggested that excessive undergraduate subject-matter coursework does not necessarily make one a better teacher. Rather, acquiring subject matter in the context of teaching and teaching practice to improve future achievement in the classroom is more appropriate (Goldhaber & Brewer, 2000; Shulman, 1986). Unfortunately, it appears that this does not occur regularly or at a rigorous level to advance pre-service teacher preparation for the diverse classroom (Ball & Forzani, 2010; Darling-Hammond & Sykes, 2003). To be more specific, future social studies teachers were found not to have adequate historical knowledge of the content they were hired to teach (Wilson & Wineburg, 1993). The same can be said in the field of mathematics, where methods courses could not, on their own, adequately bridge the gaps in future teachers' knowledge (Borko et al., 1992). Similarly, teachers continue to be ill-prepared for their science classrooms (Stoddart et al., 1993). Preparation programs should be the initial space where students of teaching may not only

experiment with and in turn expand their content knowledge, but also develop a pedagogy appropriate for diverse students. Precisely what this pedagogy is remains critical, as each content area and subject area are taught in very different ways (Ball, Thames, & Phelps, 2008). When overgeneralized, "pedagogical content knowledge begins to look as though it includes almost everything a teacher might know in teaching a particular topic, obscuring distinctions between teacher actions, reasoning, beliefs, and knowledge" (Ball, Thames, Phelps, 2008, p. 394).

To directly address the concern of 'overgeneralizing' pedagogical content knowledge, one must draw specific attention to the research conducted by Ball, Thames & Phelps (2008) on the teaching of mathematics. This research emphasized a need to further refine and elaborate on Shulman's (1986) initial concepts of Subject Matter Knowledge and Pedagogical Content Knowledge. The following graphic (Figure 1) demonstrates six distinct domains, encompassing these concepts' purpose as "a way to build bridges between the academic world of disciplinary knowledge and the practice world of teaching" (Ball, Thames, & Phelps, 2008, p. 398). The six proposed domains are:

1.) Common content knowledge;
2.) Horizon content knowledge;
3.) Specialized content knowledge;
4.) Knowledge of content and students;
5.) Knowledge of content and teaching; and
6.) Knowledge of content and curriculum (p. 403)

A Framework for Analysis:

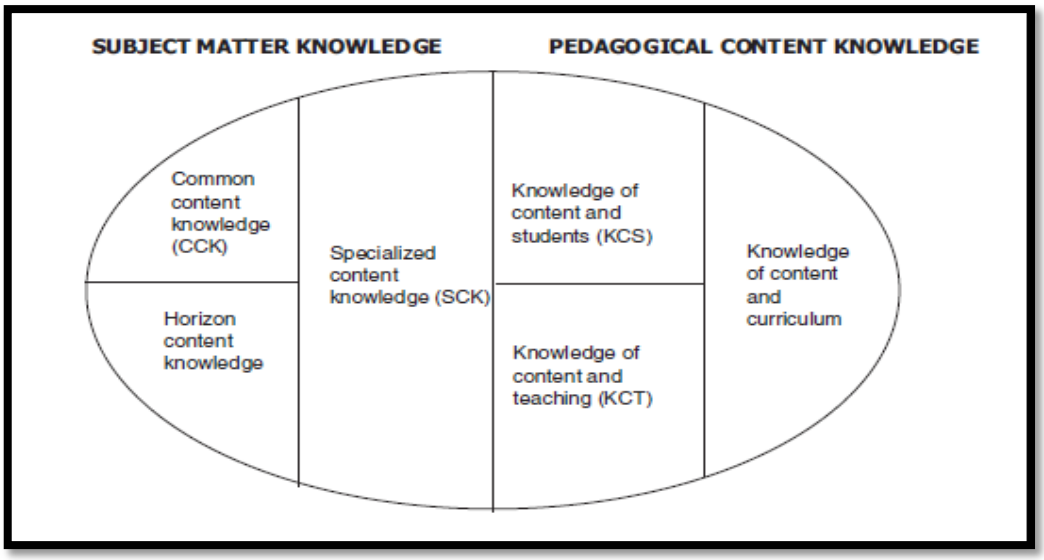

Figure 1. Subject Matter Knowledge and Pedagogical Content Knowledge (Ball, Thames, & Phelps, 2008, p. 403.)

Using this framework to analyze additional content areas allows for the possibility of uncovering insights about how teachers reason and making sense of their professional practice, along with the potential to make an impact on student learning.

This development of pedagogical content knowledge for teachers appears to be a key component that every preparation program should incorporate, as a sound foundation in content and pedagogy positively influences preparing teachers (Shulman, 1987). As identified by Wilson, Floden, & Ferrini-Mundy (2001), the concept of pedagogical preparation has many meanings across teacher preparation programs. More specifically, 'pedagogical preparation' is an umbrella term for courses in teaching of methods, theory, assessments, classroom management, and multicultural education. However, the emphasis of each of these courses differs from program to program depending on the focus of the university and the apparent needs of preparing teachers and students in the surrounding school districts. Therefore, urban teacher preparation programs should include a greater emphasis on pedagogical content knowledge and its relevant application

to diverse students.

The Evolution of Culturally Responsive Pedagogy

Urban students with diverse backgrounds are learning in classrooms typically instructed by White, middle class teachers. The National Center for Education Statistics (2011) has found that approximately 84% of public school teachers throughout the United States come from predominantly White, homogeneous upbringings, while almost 40% of the students in the classroom are children of color. Most of these diverse students will graduate from twelfth grade having been instructed mostly by White teachers (Irvine, 2003), with very few ethnically or racially diverse teachers. While it is not necessarily the *physical* whiteness of the teachers that causes alarm, the negative assumptions or perceptions these white teachers have of diverse student populations is a great concern. Many white pre-service teachers who enter the field of urban education have had few experiences beyond their own white, homogeneous communities. Therefore, the call to action is to address this notion of Whiteness and the hegemonic thinking (Sleeter, 2001, 2012).

Future, novice, and veteran educators should begin by building a clear understanding of self and concurrently analyze issues of prejudice, marginalization, and overt and/or covert stereotypes and how those beliefs have an impact within the classroom and the institution of school. To reiterate, Franzak's research (2002) suggested that, "teacher identity is continually being informed, formed, and reformed as individuals develop over time and through interaction with others" (p. 259). Therefore, a second step would be to apply that knowledge into their own teaching style and beliefs in the form of culturally responsive pedagogy or teaching strategies (Cross, 2003; Gay, 2000; Ladson-

Billings, 1995a).

Thus, pre-service teacher programs must incorporate multifaceted and multicultural opportunities to best prepare educators for their diverse classrooms (Cross, 2003; Gay, 2002; Haberman, 2005; Ingersoll, 2003; Sleeter, 2001). First, it is necessary to extrapolate the meaning of the terms—culturally relevant teaching, culturally relevant pedagogy, and culturally responsive teaching—as they relate to meeting the academic and social needs of culturally diverse students while actively questioning the norms of the dominant culture (Gay, 2000; Ladson-Billings, 1995b; Sleeter, 2001, 2012). To break down culturally relevant pedagogy further, we must focus on three areas of emphasis: (a) An expectation of academic excellence for all students, (b) Fostering cultural competence, and (c) Developing critical social consciousness (Scherff & Spector, 2011, p. 16).

The father of culturally relevant pedagogy, Paulo Freire (1970), attacked the notion of a "banking system" where the educator knows all (Mizialko, 2005) and the student is only a receptacle waiting to be filled. However, some pre-service teacher programs have not all embraced this notion that teachers should move beyond merely *meeting* the needs of the student to empowering students "intellectually, socially, emotionally, and politically" (Ladson-Billings, 1994, p. 17). To that end, Cross (2003) identifies that pre-service teachers need to first strengthen specific aspects of their preparedness, especially in respect to understanding and building an awareness of students' life experiences. She also suggests bridging a greater awareness between community and classroom and outwardly advocating for students. Still, many teacher candidates continue to have difficulty in implementing culturally relevant pedagogy from theory to field experience or classroom practice (Young, 2010). In the research design by

Young (2010), teachers and administrators were involved in constructing, assessing, and utilizing culturally relevant pedagogy. The results concluded that the newest teachers were the least likely to include culturally relevant pedagogy in their teaching due to the belief that the process took too much time to incorporate while facing other pressures in the classroom. Additionally, a second concern was that too few students of teaching have actually been exposed to the "appropriate conceptualization of teaching for students from groups marginalized and normalized" (Osborne, 1996, p. 286). With these issues in mind, both Haberman (2005) and Ladson-Billings (1994) posited that teachers should not continue making excuses about why they cannot include students' lived experiences into the classroom, but dynamically advocate for their students' learning.

Although many educators acknowledge the various backgrounds and lived experiences of students, it remains an arduous mission for all educators to appreciate and incorporate this wealth of knowledge into their everyday curriculum in an effective way (Milner, 2010). Thus, White pre-service teachers must engage in a more rigorous and in-depth understanding of social justice issues and diverse teaching styles throughout their teacher education program, then actively implement this knowledge base to create a culturally responsive pedagogy when teaching. Beyer (2001) explains that preparing teachers must include courses and experiences that include theoretical understandings, conceptual analyses, inquiry orientations and activities. Without this pre-service preparation, the road to failure for both for educators and students begins. Cross (2003) offers three suggestions for pre-service teacher programs:

1.) Modify field experiences to be much more than simply observation with in-depth interaction with students;

2.) Develop a greater awareness of race with a critical competence of multiculturalism; and
3.) Formulate a culturally relevant pedagogy.

Once in the classroom, educators must maintain their knowledge of culturally relevant pedagogies and remain vigilant in how they are implementing this in the classroom.

The Intersection of Culturally Responsive Pedagogy and Pedagogical Content Knowledge

Just as with other educational frameworks, certain areas cannot be divorced from each other, especially as we continue through the 21st century and the national and global communities become more diverse. To add to this vivid tapestry of educational frameworks (and acronyms), I include a vision for Culturally Responsive Pedagogical Content Knowledge (CRPCK). Consciously and deliberately bridging the concepts of culturally responsive pedagogy and pedagogical content knowledge together does not make one less important than the other; rather, it gives educators an abundant understanding of how to teach accurate content in both rigorous and culturally appropriate ways that are meaningful to every student, regardless of ability or grade level.

Although some may consider culturally responsive pedagogy as "muddy with the possibility of multiple snags" (Scherff & Spector, 2011, p. 2), when carefully taken apart and examined, the notion of culturally relevant pedagogy requires the distinction of the three terms: culture, relevance, and pedagogy (Scherff & Spector, 2011). When analyzed in this manner, the term becomes fairly transparent to understand. Therefore, preparation programs can offer a designated space for pre-service teachers to develop the CRPCK capacity to address the varied backgrounds and lived experiences of the urban students

they will work with.

The Pedagogy Laboratory as a Space to Develop Pre-service Teachers' CRPCK

The pedagogy laboratory, occasionally referenced as 'ped labs,' emerged from the Teachers for a New Era initiative. Funded by the Carnegie Corporation of New York, TNE projects emphasized collaboration between and across the different disciplines of science, mathematics, and the arts, as well as professional teacher preparation coursework. They offered an extensive clinical experience in order to improve and enhance teacher preparation programs across the United States (Carnegie Reporter, 2001).

At Urban University, the one-credit Pedagogy Labs offered pre-service teachers the unique opportunity to develop pedagogical content knowledge and gain a richer understanding of multicultural teaching. Targeting particular disciplinary-based content areas linked to education coursework, the Labs specifically linked pedagogical content knowledge with culturally responsive pedagogy. Appendix A presents the syllabus template referenced in the design of the 1-credit Ped Labs.

Research on the Labs drew together data collected through observation and interview, along with the pre- and post-assessment of PRAXIS scores. The essay responses of students participating in the School of Education's certification programs were also examined. Preliminary findings suggested that these students produced lessons with richer connections to the content areas and tended to be more enthusiastic about becoming urban educators. Research examining faculty participants' experiences with the Labs acknowledged a simultaneous professional development in their own practice while working with these future teachers (Bales & Saffold, 2011).

One particular Ped Lab focused on developing both PCK and CRP in pre-service

teachers. The Multicultural Pedagogy Labs implemented case-based instruction to examine and link culturally relevant teaching to the emerging pedagogy of pre-service teachers (Bales & Mueller, 2008; Bales & Saffold, 2011; Saffold & Bales, 2011). These labs specifically attempted to bridge content knowledge and methods courses with culturally relevant teaching practices. Within this "safe space", students of teaching could explore and question their beliefs, experiences, privileges, and struggles within the urban classroom. These pre-service teachers were required to "unpack their beliefs about children unlike themselves" (Saffold & Bales, 2011, p. 10) and make the critical connections between theory and practice. Through this intensive model, future teachers were provided with the tools to actively participate in constructing a foundation for pedagogical content knowledge; the future success of these pre-service teachers was richly identified through the teachers' School of Education application essays. The pedagogy lab model provides a structure for bridging the notions of culturally relevant pedagogy and pedagogical content knowledge to destabilize the beliefs of the traditional White, female, middle-class educator about teaching and learning.

This review makes visible several gaps in the literature regarding PCK and CRP. The first gap appears between the development of pedagogical content knowledge and culturally responsive pedagogy. A second gap appears to be the lack of research addressing a wider implementation of the unique pedagogy laboratories in teacher preparation programs. In fact, pedagogy labs have only been documented on one university campus (Bales & Mueller, 2008; Bales & Saffold, 2011; Saffold & Bales, 2011). These gaps point to the necessity of studying the research question presented in this proposal: how do urban pre-service teachers construct an awareness of the

complexities of teaching, learning, and PCK through the structure of a pedagogy lab? The review also highlights a need for research around the attendant questions:

1. How does participation in a pedagogy lab shape urban pre-service teachers' understanding of pedagogical content knowledge as it relates to working in urban schools?
2. In what ways do urban pre-service teachers, who participated in a pedagogy lab, translate their developing PCK into learning opportunities for students attending urban schools?
3. In what ways do university faculty members expose and address urban pre-service teachers' misconceptions about teaching, learning, and the development of content area knowledge for students attending urban schools?

The next chapter explores the theory of liminal space (Turner, 1987; Van Gennep, 1960) as a framework for understanding how pre-service teachers learn and develop CRPCK in a pedagogy lab structure.

Chapter 2: Theoretical Framework

The theory of liminal space addresses how one may transition through the different states of 'being' (Cook-Sather, 2006; Head, 1992; Nelson & Harper, 2006; Turner, 1987). Originally conceived by Arnold Van Gennep (1960) and later elaborated through the anthropologic work of Victor Turner, the concept of liminality was developed in the 1960s as an approach to understanding vast sociocultural systems (Cook-Sather, 2006; Jardine, 1994; Nelson & Harper, 2006; Turner, 1987). Based on ethnographic research which studied indigenous tribes and how certain members moved from one social stratosphere to the next, "liminality is used to refer simultaneously to one phase of the multi-step transition process effected through a rite of passage, the place within which the transition takes place, and the state of being experienced by the person making the transition" (Cook-Sather, 2006, p. 1). To explicate further, liminal space signifies "a social state in which participants are stripped of their usual status and authority across four phases: separation, transition, threshold or margin, and reaggregation" (Cook-Sather, 2006, p. 2; Nelson & Harper, 2006; Turner, 1987).

In the research conducted by Head (1992), liminality represents the middle stage or 'rites of passage' where, "the subject moves through a dimension of his life that has few of the characteristics of either his past or his coming state; thus he is literally betwixt and between" (p. 90). Head (1992) further delineates the following characteristics of the initiation rites:

- "you are neither one thing nor another, yet you are both at the same time"
- "it is viewed to grow as a person during the initiation process"
- "an initiate who is in total submission to an older member of the tribe"

- "monsters or tribesmen disguised in ceremonial masks appear to teach how to distinguish between different aspects of reality"
- "endurance of hardships are common"
- "a sense of community can occur" (p. 91).

In other words, liminal space becomes a chasm between two worlds—the previous world being one that is familiar, where one understands or is aware of the norms and expectations associated with that particular world, and the future world being unknown. This in-between space indicates that the "movement of a man through his lifetime is punctuated by a number of critical moments of transition" (Turner, 1987, p. 4) and additionally, that these "*rites de passage* are not restricted to movements between ascribed statuses. They also concern entry into a new achieved status, whether this be a political office or membership of an exclusive club or secret society" (p. 4). From this viewpoint, liminality could represent an unlimited array of possibilities, represented simply by someone or something who emerges from one state and shifts to an ambiguous place, where they may remain until they feel adequately prepared to enter into the larger, more dominant society and into a new societal sphere.

Throughout the space of teaching and learning, liminality or the action of "betwixt and between" can take place at any time, for anyone: students and young people in PK-12 grades, pre-service teachers at the university level, novice and veteran educators, administrators, and even faculty situated within higher education. Each group or individual may see themselves deliberately or inadvertently acting or remaining within a liminal space of: dominant groups, societal norms, popular culture, peers, behavior as a student and professional, and/or caught between different cultures.

Through the research conducted by Conroy and de Ruyter (2009) on liminality and specifically as it is understood in education, there are three forms: first, there is a space of liminality, for example the transition from childhood to adulthood; second, this notion can take the form as participating in a separate space removed from what is considered the societal 'norm', and third, teachers whose professional practice or beliefs are "operative within a state education sector, can nonetheless reflect a liminal position" (p. 6). Each of these areas highlights the notion of being in a space or place that is neither here nor there, which is more commonly described as "betwixt and between" two environments or worlds (Turner, 1987).

"Betwixt and Between"

Upon entering the liminal space or the separation from the person's current ideologies, one becomes "betwixt and between the positions assigned and arranged by law, custom, convention, and ceremonial" (Turner, 1974, p. 37 as cited by Nelson & Harper, 2006). This notion of 'betwixt and between' allows the individual to test out new experiences and in turn reflect on the situation and interaction within that new experience. The purpose of this is to question yourself and prior beliefs, with the hope to become "critically self-conscious" (Nelson & Harper, 2006, p. 11). This allows for deeper understanding and for transformative learning to occur (Nelson & Harper, 2006). Through the successful or active procession through these stages, transformative learning may take place. As defined by Nelson & Harper (2006), Figure 2 provides the necessary visual representation to understand the steps in learning new ideas or experiencing something previously unknown.

Theory of Liminal Space:

Aggregated State	Separation	Liminal Space	Reaggregated State
Learner may be: static bored ideological unreflective unaware of new possibilities	*Learner is:* Oriented toward reaching a new understanding Curious or challenged	*Learner may feel:* Challenged, chaotic, ambiguous, unclear, may want to retreat or quit *Learner has the opportunity to:* - Rethink and examine assumptions and beliefs - Engage in learning conversations	*Learning is deep & transformational:* Individual sees issues or events from a more complex/different perspective. Learner feels more comfortable in his/her own knowledge.

Figure 2: Nelson & Harper (2006), p. 12

The future world is unknown and unidentified, yet has the potential for tremendous progress, change, and evolution from previously lived experiences. This is observed through students in PK-12 classrooms as one continues from one grade level or stage in life, to the next, and further into their role as university student or career ready adult. In many professions, there are a variety of stages to obtain the epistemologies and foundational knowledge base, which requires scaffolding and building on concepts. Doctors, lawyers, and educators are such professions that must obtain the necessary discipline-specific knowledge to observe, replicate, and master various aptitudes, upon which, one demonstrate additional skill sets within a limitless continuum (Jardine, 1994).

This notion of liminality could also be observed in the case of evolving policies or teacher expectations and teaching standards. Therefore, the question remains, in what ways does this conceptual framework of liminality guide further understanding of the various stratospheres or positions as one moves through the various stages of education, especially as, “the educational sphere is revealed to be a liminal zone between past and

future, a gap between the private sphere of the home and the political sphere of the public realm" (Duarte, 2010, p. 495).

Liminal Space and the Stages of Teacher Preparation

The decision to become an educator, and the process of achieving this goal, is complex. Teachers are met with the thrill of the endless possibilities of where to teach, who to teach, and how to teach. For some, this becomes a "disorientating vertigo of being drawn out into this potent, ecstatic, swirl of difficulties that pertains to the community of teaching" (Jardine, 1994, p. 20). The concept of liminality becomes an appropriate tool for analyzing and understanding how pre-service teachers make sense of their experiences upon admittance to their school of education, yet prior to having the necessary skills to independently, confidently, and successfully instruct a classroom full of students.

One of the initial challenges pre-service teachers face is the shift from broad general knowledge of various disciplines to a narrow, more comprehensive understanding of specific content knowledge (Shulman, 1987). This shift has the potential to transform what they have previously learned and critically address their assumptions and/or preconceived notions. The transformation involves a 'rite of passage' as students leave behind their undergraduate, content-based experiences and move into their professional program with entirely different expectations and rules. Thus, the 'betwixt and between' space occurs as they learn how to become a professional and how they hope to present themselves in the grander scope situated within the profession of education. However, this liminal space may last longer than anticipated, especially if teacher candidates are not active in obtaining and applying the necessary pedagogy, or perhaps worse, if they inappropriately address preconceived notions or biases.

Almost instantly when a teacher candidate enters a classroom, whether for a short field experience or a semester long student teaching placement, this becomes an unknown space, removed from what was once customary and usual. This takes place as the student leaves their familiarity of the university to enter a classroom where they are seen as a newcomer, stranger, guest, or perhaps intruder (Pierce, 2007). Yet, this transformative period should be also seen as a time when "one becomes another" (Eliade, 1975, p. 165 as cited by Jardine, 1994). This becomes an excellent opportunity for pre-service teachers to determine and assert their developing professional role, and how it has the capacity to evolve further as one becomes more experienced.

One must also be aware of the period of seclusion, when transition occurs from one point to another. This separation and anxiety is experienced due to the transition from student to the increased demands of the various roles in formal teaching (Sinner, 2012). This period of uncertainty may be extended indefinitely, as it once again depends on a number of variables, such as the relationship with the cooperating teacher, whether adequate support is provided at the university level, or if the student teacher has ample critical reflection of their practice (Pierce, 2007; Sinner, 2012). This is visible through the ethnographic research conducted by Pierce (2007), as students of teaching must, "juggle simultaneously their students, responsive pedagogy, and curriculum content" (p. 40) or to be more frank, "experience professional puberty" (p. 43).

As a community of scholars who prepare future teachers it is imperative to be aware and understanding of this strange, yet exciting space of 'betwixt and between'. To promote success in these future educators, it is necessary to provide formal and informal feedback from observations and through assignments, support and scaffold the student of

teaching through their experience, encourage these novice educators to seek and engage in professional development and discourse or to become a member of a learning community (Pierce, 2007). This becomes critical as we enter the era of newly designed high stakes testing in higher education, such as the edTPA[3]. This national mandate requires future educators to complete a variety of subject-specific tasks and demonstrate those through classroom implementation of video and analysis. This new performance assessment brings both university faculty members and pre-service teachers into a new space that is unknown and perhaps foreboding with the implications it carries. Therefore, the call for awareness of liminal space is even more necessary.

Liminality throughout the Profession of Teaching

Teaching is considered an interpretive activity with multiple layers or stages, where each may provide the euphoric experience of starting over again, starting fresh, and anticipating the unknown. This could be viewed through teaching a new or different group of students, obtaining a different teaching position, advancing from teacher to administrator, shifting from paraprofessional to lead teacher, and the necessity to alter the content to meet the needs of new standards. Many of these exemplars are similar to what is experienced as a student in the classroom, during student teaching, and of course as novice teacher in the classroom; each position has the potential to encompass a liminal space prior to moving into an unknown stratosphere of teaching and learning.

As such, pre-service teachers must be provided opportunities to engage in their own pedagogical transformation. A powerful example can be drawn from the observations conducted by Carnes (2004) of a university classroom. During a role-play activity, the class "had become lost in some sort of no-man's land between past and

[3] edTPA is a standardized assessment pre-service teachers must pass to attain a teaching license.

present…A threshold region where the normal rules of society are suspended or subverted" (p. 4). This example of role-playing in the classroom becomes similar to actors on stage, and a space of liminality takes hold, as students embody a different entity or encompass a role that is not 'typical'. As Carnes (2004) indicated, this lesson became a "threshold region where the normal rules of society are suspended or subverted" (p. 23). This experience stimulated a tremendous sense of "uncertainty, emotional intensity, and imaginative expressiveness" (p. 23). Although the act of role-playing is not a new teaching method, the implementation of role-playing as a liminal space, encouraged university students to become something they were not entirely familiar with. Thus, these types of practices and learning opportunities must occur frequently in the development of pre-service educators. To participate in experiences that encourage uncertainty and encourage intense emotion, have the potential to draw out deeper levels of critical thinking, and thus critical examination of teaching practice.

The theoretical framework of liminality and the space 'betwixt and between' could actually be viewed as limitless, throughout all facets of life. Regardless, it is necessary to bring and maintain this concept to the forefront of education and teacher preparation. In particular, it is necessary for teacher educators to be both cognizant and understanding, and even compassionate of the experiences and stages pre-service teachers will undoubtedly progress through. The theory of liminal space also provides a framework to understand the ways university faculty members expose and address pre-service teachers' misconceptions about teaching, learning, and the development of content area knowledge for students attending urban schools. Thus, it is imperative that teacher educators and teacher preparation programs provide the necessary opportunities

and support systems for pre-service teachers to confidently and adventurously travel through the vast chasm of liminal space, or their pre-service teaching experience.

Please join me in reading Chapter 3, as it shares the methodological approach used to study how urban pre-service teachers construct an awareness of the complexities of teaching, learning, and pedagogical content knowledge (PCK) through the structure of a Pedagogy Lab as well as the three attendant questions framing this research study.

Chapter 3: Methodology

This study explores how urban teachers construct an awareness of the complexities of teaching, learning, and PCK through the structure of a pedagogy lab. In addition, it examines three attendant questions:

1. How does participation in a pedagogy lab shape urban pre-service teachers' understanding of pedagogical content knowledge as it relates to working in urban schools?
2. In what ways do urban pre-service teachers, who participated in a pedagogy lab, translate their developing PCK into learning opportunities for students attending urban schools?
3. In what ways do university faculty members expose and address urban pre-service teachers' misconceptions about teaching, learning, and the development of content area knowledge for students attending urban schools?

Such questions call for the use of qualitative research and resonate with the standards of the interpretivist paradigm. First and foremost, a concrete definition of qualitative research varies from researcher to researcher due to diverse visions and beliefs (Creswell, 2007; Hatch, 2002; Willis, 2007), which tend to cause tremendous "tensions, contradictions, and hesitations" (Denzin & Lincoln, 2005, p. xi). Among these contradictions, a core set of beliefs exist: qualitative research follows a line of inquiry situated within a natural setting to seek meaning and understanding of perspectives and/or behaviors regarding a particular problem (Creswell, 2007; Denzin & Lincoln, 2005; Hatch, 2002; Joseph, 2000). Therefore, with this understanding, a number of methods have been employed to further extrapolate the aforementioned research questions through

direct observation, interviews, and the analysis of collected materials (Denzin & Lincoln, 2005). The following sections further detail each of these methods and the intended methods for analysis.

The interpretivist paradigm lays the foundation for this research with the understanding that countless unique realities exist at any moment in time due to individual experiences (Hatch, 2002). Each experience provides for an opportunity to "gain an understanding of the constructions held by people in the context" (Mertens, 1998, p. 161). This context, the pedagogy labs, allows the researcher to closely investigate the social interactions and experiences between, across, and within the students, faculty, and content. As such, the use of collective case study is appropriate.

Collective Case Study

A case study involves exploring an area of interest through interpretive research by focusing on a person or a group found within a specific setting. Otherwise known as a bounded system, this method also emphasizes a thorough understanding of the theory surrounding what is to be studied (Creswell, 2007; Mertens, 1998, Stake, 2006; Yin, 2003). This collective case study ties together four distinct pedagogy labs. Each lab brings together the disciplinary content courses from the College of Letters and Science courses—Chemistry/Biochemistry, Environmental Science, Political Science, and Mathematics—and the pedagogical expectations for teaching in PK-12 classrooms. Due to the nature of these multiple labs taking place over an extended period of time, a multiple case-study or collective case-study approach has the potential to appropriately uncover the participants' perspectives across different subject areas and experiences (Creswell, 2007; Lightfoot, 1983; Merriam, 1988; Smulyan, 2000; Stake, 2006; Yin,

2003). Attention to pre-service teachers within these multiple cases may (a) provide the contexts and allow for comparisons of their multiple realities and (b) shed light on how they develop a professional practice across different disciplines. The use of collective case study research also allows me to explore how the university faculty members navigate the development and implementation of a pedagogy lab. Within this bounded system, I have the capacity to describe and analyze the content, activities, and outcomes of the pedagogy lab itself along with the experiences of the participating students and faculty.

The basic tenets of case study include an in-depth and longitudinal examination of what is to be studied, the use of numerous data sources, and the inclusion of a series of steps to form a sequence of activities (Creswell, 2012; Stake, 2006). Additionally, when implementing case study research, one goal was to explain the links that may be too complex for experimental strategies while also describing the real-life context in which problems are found. This is necessary, as there is no clear, single set of outcomes (Stake, 1995; Yin, 2003).

Site Selection

This study took place in a large public urban university located in a mid-sized Midwestern metropolitan area. This city has experienced a tumultuous history with its own ongoing lack of ability to provide equitable education opportunities for students of color and from diverse backgrounds (Miner, 2011). In a way that is different from many other urban areas, this city also continues to battle very severe patterns of segregation, limiting particular populations from living in areas and attending schools with equitable resources and opportunities (Dougherty, 2004; Jones, 2009; Miner, 2011). Therefore,

this qualitative research becomes even more significant when taking into consideration the city's history of segregation and marginalization and its effects on today's PK-12 schools.

This collective case study observes and documents the development of content, execution of activities, and student and faculty participation in each of the four one-credit pedagogy laboratories.

Selection of Participants

This research design is grounded in the interpretivist paradigm, which meant that participants became the "constructors of the knowledge" (Hatch, 2002, p. 49) during each of the pedagogy labs. This collective case study examined the bounded system of each Pedagogy Lab (Creswell, 2007; Yin, 2003), which included the various participants as well as the Pedagogy Lab course itself as units for analysis (Patton, 2002). The data collection focused primarily on the interactions of the participants during each 5-week Lab in addition to other events that unfolded during the individual course sessions. This design required the observation and documentation of multiple perspectives to obtain rich and extensive details regarding each participant as well as the environment they were situated in (Creswell, 2007). The two distinct sets of participants were the university students and the faculty or instructors who facilitated each lab.

The selection of participants for this dissertation on pedagogy labs was based on two typologies, maximum variation and snowball sampling (Creswell, 2007; Patton, 2002). First, maximum variation sampling allowed for "multiple perspectives of individuals to represent the complexity of our world" (Creswell, 2012, p. 207). This type of sampling is further identified as an inquiry into what is unique about particular

situations as well as what is common within these settings (Mertens, 1998). The Pedagogy Labs project required the recruitment of a variety of participants on different professional and developmental levels. To be more specific, the first set of participants is identified as the university students, who were recruited and enrolled into the Pedagogy Lab course for a variety of reasons and have a wide range of previously-lived experiences.

The second group is comprised of the university faculty members, who were also recruited to teach the different pedagogy labs. Each Lab had two faculty members facilitating the course: one from the College of Letters and Science and another from the School of Education. This combination of faculty instruction provided a bridge between content knowledge and pedagogical knowledge, and encouraged the university students to construct an understanding of teaching and learning in the PK-12 classroom. These two different traits, either knowledge of the content or knowledge of the pedagogy, were based on specific roles within the university. The two groups of participants provided various perspectives regarding participation in the pedagogy lab with the intent to shed light on the research questions guiding this inquiry.

Snowball sampling (Creswell, 2012) added another dimension to this research design, as those who facilitated each of the pedagogy labs had the capacity to recommend additional faculty for the following labs. This was significant, as faculty members provided inside information about other faculty members and their possible contributions to this area of inquiry.

Recruitment of participants

To delineate the participant selection process, active recruitment took place prior to the beginning of the pedagogy labs. First, faculty members were recruited to

participate as the instructors of the four labs. The faculty members were drawn from the prerequisite Letters and Science courses that university students enrolled in based on the details of their program acceptance and graduation requirements outlined by the School of Education. Upon the identification of these particular areas, the faculty members who taught these courses were recruited to participate. In addition, faculty members from the School of Education were also offered the same opportunity, after which the pairing of instructors took place. To be specific, if a Letters and Science faculty member instructed a course in political science, an appropriate pairing would be with a faculty member from the School of Education who has experience in social studies or political science.

The makeup of the pedagogy labs was contingent on the faculty and their own flexibility and availability to teach the additional course, as well as how each faculty member envisioned the presentation of pedagogical content knowledge. As this was a one-credit course, the individual labs were conducted for 5-6 consecutive weeks on average, and two hours per session. The university site for this research design had a number of nontraditional students. These demographics influenced the course offerings at the university. As courses are also available online through the university's online classroom and learning platform, Desire 2 Learn (D2L), the faculty members had the choice of designing their lab in an online format using the D2L platform or developing and facilitating it in a traditional, face-to-face classroom setting.

The faculty members who did participate were offered a small stipend upon implementation and execution of the pedagogy lab. Full disclosure of the purpose and framework of the lab was given to the participating faculty members, going so far to answer the questions suggested by Glesne (2011), such as: "for whom is this study

worthy and relevant? What knowledge will be gained through this research study? And finally, what are any positive and negative outcomes from this study?" (p.174). In addition, it was also necessary to be cognizant of other outcomes, as qualitative research often enters a space where "you are not fully aware of what you are looking for, among whom, or with what possible risk" (Glesne, 2011, p. 177).

The second group of participants was comprised of university students who were 'education–curious' or interested in education, or enrolled in education programs, thus labeled 'education-intended.' Similar to the recruitment of faculty members, it was important to disclose the purpose of the research and identify how participation in the pedagogy lab could affect the students. The strategy to recruit the student participants took place in three steps. First, the selected Letters and Science faculty members presented the opportunity to participate in a pedagogy lab course. This information was also presented through an informational advertisement I created. This included the course description, the number of credits, and those suggested to participate (see Appendix C). Some faculty experienced a challenge in recruiting students, thus to mediate this, I attended the course session and verbally shared the description and purpose of the pedagogy lab. Immediately following this informative session, students had another opportunity to register for the pedagogy lab. The third step was to send the necessary information via electronic mail. This provided one final strategy to enroll interested participants. Throughout these three approaches, full disclosure was shared with the participants regarding the lab was a graded course, students would participate on a variety of levels, and that this course was targeted particularly for students of teaching or education-intended students.

Inclusion/exclusion

As this course was made available through the university, students were required to follow the particular university enrollment policies. This means that if students were already enrolled in 18 credits, they could not participate in the study, due to the school's prohibition of an overload in credits. Other than this factor, there were no exclusionary criteria. If students were interested in participating in the lab, they could do so with no academic prerequisite. Likewise, faculty members also participated in the study based on their own interest and knowledge of the pedagogy and content.

Researcher interactions

As the researcher for this study, it was necessary to interact with participants on a variety of levels. Hatch (2002) identifies, the interpretivist researcher typically looks to interact with participants in a collaborative light; more importantly, "building a good working relationship is the responsibility of the researcher" (p. 51). Thus, in order to build and maintain a relationship with the participants, interaction took place first and foremost during the recruitment of both student participants and faculty members. Immediately following this phase, I identified the research description, purpose, data collection process, and expectations for participants prior to beginning the study (Hatch, 2002). Without this in-depth interaction, it would prove difficult to attract and pair faculty members together or to recruit ample university students. Third, within this collaborative relationship, I was prepared to guide faculty members or troubleshoot any technological questions about creating the online course or expediting the enrollment process of the interested students. Finally, I was also prepared to answer additional questions from faculty in regards to course content and/or student expectations.

Although the university faculty had experience teaching, I needed to anticipate some faculty having additional questions or concerns. The interpretivist researcher's responsibility calls for engagement in these discussions and the ability to remain cognizant when building a relationship with each set of participants (Hatch, 2002).

Obtaining Consent

The final and critical aspect of participant selection and involvement in any research design is that of obtaining consent. Participant consent or permission to participate must be obtained prior to beginning any research study. Therefore, it was necessary first to apply through the university's Institutional Review Board (IRB) for permission to study the university students and faculty who intended to participate in the pedagogy labs. Of course, as the review board may not have been familiar with my area of research, I provided an adequate explanation of the area of inquiry and the potential effects the research might have on participants and their well-being. Following the guidelines outlined by Creswell (2012) and Glesne (2011), I requested IRB approval for the study, developed a research protocol, and created two participant consent forms. For the IRB approval, I affirmed that participant consent was voluntary, indicated any possible effects to the participant, and noted that students or faculty could end their participation in the research at any time with no effect on their overall course grade. After reading this information, participants signed the study consent forms, which I obtained and locked in a secure cabinet in my office.

Protection of Human Subjects

The researcher may appear to hold a position of power as a primary collector of data in any qualitative study. With this awareness in mind, it is imperative that

researchers avoid the use of any and all stereotypes or identifiers that may expose the participants (Creswell, 2007, p. 44). This caution is essential to protecting the rights and safety of any and all participants involved throughout the entire research process (Mertens, 1998). It is especially critical when researchers ask participants to reveal the intricate details of their lives, learning, and overall thought processes (Hatch, 2002).

Presently, there is little to no immediate and identifiable risk to those who participated in this research design. However, it is important to anticipate what risks may arise from the start of a study, such as possible embarrassment or discomfort at one's own perspective during class participation, a class assignment, or during the concluding interview process. To further ensure for autonomy, each participant selected their own pseudonym for the duration of the research project, which was used during the recording of the interview, in any field notes, and throughout the transcription of data and all research files. This ensured an additional layer of protection to safeguard the participant's responses and identity. The data obtained from the observations, interviews, and artifacts have been stored on a voice-recording device as well as on the researcher's laptop, both of which are password protected. The signed IRB forms and any additional documentation are stored in a locked file cabinet in the researcher's office. Finally, upon completion of the research study, all files such as transcriptions, field notes, and any other artifacts will be destroyed.

Selection of Methodological Tools

In light of the interpretivist paradigmatic view and collective case study procedure that shape this study, there are a number of methodological tools that had the capacity to obtain responses and rich, detailed data from the participants. As discussed previously, a

qualitative researcher is one who becomes an instrument for data collection (Hatch, 2002; Mertens, 1998), and due to this role as data collector, one must have various tools or methods identified and developed. These tools aid in the overall verification of the perspectives, experiences, and learning of both pre-service teachers and university faculty.

For this qualitative dissertation on the implementation of pedagogy labs, the following data collection methods have been implemented: observations, artifact collection and analysis, and interviews.

Observations

Upon the initial organization and implementation of the pedagogy labs, the virtual labs took place online through the university's Desire 2 Learn platform. The face-to-face Lab took place in a traditional university campus classroom. Due to the nature of the pedagogy labs and my role as researcher, my positionality existed on a continuum between passive participant, moderate participant, and active participant (Mertens, 1998) in both the online and face-to-face labs. Passive participation observation occurs when the researcher is present but does little to interact with the students and faculty of the pedagogy labs (Mertens, 1998). Moderate participation requires the researcher to maintain a balance between observing and participating throughout the pedagogy lab sessions. Finally, an active observational participant is one who is involved in the activities of the pedagogy lab, but does not "blend in completely" (Mertens, 1998, p. 318). The purpose for the continuum of three observation strategies was due to the preference of the participating faculty members instructing each Lab and the expectations they had in teaching this course. As researcher, I was cognizant to avoid becoming intrusive or overly removed from the research (Hatch, 2002). Additionally, due to a few

technological difficulties during the organization of the online classroom, I became further immersed in the research as I remedied the aforementioned challenges.

These further indicate why I needed to participate in some of the activities and interact with the participants. The strength of these observation strategies afforded me an opportunity to discover additional information which may not have been shared through the interview or artifact collection process (Patton, 2002), as the space of the pedagogy classroom, both virtual and face-to-face, allowed for both "less need to rely on prior conceptualizations" (Patton, 2002, p. 262) and firsthand experience of how the participants are interacted in the field (Hatch, 2002).

Artifact collection

Throughout each pedagogy lab, a great amount of artifacts were made available. Thus, it was necessary to compile and analyze all the available documents and artifacts including, but not limited to: the course syllabi, handouts, assignment descriptions, completed assignments, faculty feedback, video collection, student reflections and responses, and university student lesson plans. This set of unobtrusive data may provide additional depth to the research, which may be unavailable from either observations or interviews. Additionally, this prevented me from intruding on the teaching and learning taking place during the Pedagogy Lab course. Following the guidance of Hatch (2002), I often revisited the initial research question(s) so as to not drift too far away from the purpose of the inquiry. As three of the labs were held entirely online, and students were expected to complete various assignments, extensive artifact collection was required. An additional benefit of this data collection was that it provided the chance for artifacts to

'speak for themselves' (Hatch, 2002): they allowed for the voices and thoughts of the participants to be not only heard, but concretely seen as well.

Interview

The third methodological tool is used in the study was the process of participant interviews. Upon the conclusion of the Pedagogy Lab, the university students were interviewed either individually or in focus groups using a semi-structured interview protocol (see Appendix C for the Student Interview Protocol). The choice to follow a semi-structured interview process ensured that the imperative questions were included while allowing for greater flexibility to take place as additional insights and information emerged (Mertens, 1998). The allocation for both individual and focus group interviews was due to the various schedule conflicts that arose, as some of the university student participants were not available to come to campus for a set focus group time. To accommodate these participants, I conducted the individual interviews face-to-face or online through the video chat application Skype. Each interview session, regardless of whether it was face-to-face or online, was recorded with a designated recording device.

The faculty members were also interviewed (see Appendix B for the Faculty Interview Protocol) using a similar semi-structured interview protocol. Once again, anticipating any possible schedule conflicts, faculty had the option to conduct the interview with their Pedagogy Lab teaching partner or individually. The accommodations of being able to meet face-to-face or through video chat applications were also provided. Conducting these interviews became an additional strategy to draw out information and perspectives from the participants, which could not have been otherwise observed through the available artifacts.

I was prepared to address any challenges that arose during the interview process (Creswell, 2007). In some cases, interviews do not go as intended due to a technological issue with the recording device, participants may experience discomfort due to the interview questions, and/or participants may not understand the intended research question (Creswell, 2007). Therefore, as a researcher, it was critical to ensure proper technology, disclose to the participants that a pseudonym would be used to protect their identity, and encourage participants to share additional questions to clarify any miscommunication of the study and/or the interview .

Description, Analysis, and Interpretation of the Data

The act of analyzing and interpreting qualitative data is a continuous process, one where findings "emerge from the data through some type of mystical relationship between the researcher and the sources of data" (Mertens, 1998, p. 348). It is precisely this relationship that gave me the ability to transform the collected data into a rich and descriptive study. Implementing Wolcott's (1994) framework of description, analysis, and interpretation (D-A-I) brings a greater sense of clarity to those navigating through the data once it has been collected. First, Wolcott (1994) highlights the significance of descriptive data by urging researchers to stay "close to the data as originally recorded" (p. 10) or allowing the data to, in essence, "speak" (p. 10). The next step is to progress with careful analysis to determine which relationships emerged within the data. Finally, interpretation needs to take place to make sense of the data, or "reach out for understanding or explanation beyond the limits of what can be explained with degree of certainty" (p. 11). With this framework I genuinely transformed the abundance of collected data to create a substantial analysis.

To analyze the collected data, I first transcribed all interviews, observations, and collected artifacts. Then, with the use of the qualitative data software package NVivo 10, coding and more in-depth analysis for themes took place. As there are four individual cases, I analyzed each case independently, then again analyzed the data across the different cases (Stake, 1995, 2005; Yin, 2003). I must note the increased concern regarding the use of software for coding and analyzing data throughout the field. This concern stems from the possibility of losing the 'craft' of human interpretation of data and instead shifting toward hollow computer-generated data sets (James, 2012). In this study, the NVivo 10 data software provided a larger space and the capacity to organize a collection system where all obtained data was stored. Due to the extensive data this collective case study required, this computer system was useful in helping me look across the different pedagogy labs, as well as gain a broader view of the different university student and faculty participants. Just as James (2012) advocates, researchers must maintain their craft and need to be mindful of allowing for participants' experiences and voices to be heard.

Establishing Trustworthiness and Credibility in the Research

Establishing trust and credibility is a significant aspect of any qualitative research design. To determine whether the findings of this proposed research design are accurate, particular steps were taken to assure that the research is authentic and credible (Creswell, 2003). Credibility, as defined by Mertens (1998), requires "a correspondence between the way the respondents actually perceive social constructs and the way the researcher portrays their viewpoints" (p. 181). The goal is to implement a variety of strategies to assure for credibility and trustworthiness. For example, it was beneficial throughout the

development of this dissertation to have a peer debriefing and member checks (Creswell, 2003; Mertens, 1998) to review the sections of the research both formally and informally, pose the necessary questions and account for missing or ambiguous information.

Persistent observation or extended experience in the environment also assured for credibility during the research (Mertens, 1998; Willis, 2007). This was due to the manner in which the pedagogy labs were conducted, as the online and face-to-face design allowed for continuous and ongoing observation; in particular, the online pedagogy labs offered limitless exposure. Triangulation or crystallization (Richardson & St Pierre, 2008) assured for infinite means to share and "check" the experiences of the participants throughout the data. Rather than triangulation, which is a "rigid, two-dimensional object" (p. 963) and cannot feasibly take all the available data into consideration, crystallization allowed for the collected data to be looked over in endless ways to check and regroup it. This rich and thick description helped me to understand and convey the participants' experiences and the meaning therein from a detailed perspective.

As a final step in ensuring credibility, I also included all negative or discrepant information, as "real life is composed of different perspectives that do not always coalesce" (Creswell, 2003, p. 196). Sharing contrary findings within the data allowed me additional credibility as a researcher, and further supported the fact that there is no deception within the research.

Reflexivity in the Research

Prior to conducting any research or inquiry, one must identify and acknowledge the capacity of research scholarship and the various lived experiences, embedded assumptions of reality, and worldviews that exist. This requires recognition of how

epistemological beliefs are formed, which in turn drive the research and finally "shape how the researcher sees the world and acts in it" (Denzin & Lincoln, 2005, p. 22). With this in mind, I must take the necessary time and diligence to unpack assumptions (Creswell, 2007; Hatch, 2002; Mertens, 1998). However complex and challenging the examination process of these preconceived notions may be, it must take place to share the outcomes and results of this research design in an honest and transparent manner.

With this being said, readers should have a thorough awareness of how I came to find myself situated within this particular research context. As Berger (2013) posits, I must turn the research lens onto myself and be reflexive to identify how my experiences have affected the collection, analysis, and presentation of the data. Through this transparency, I reaffirm my ability to gather and analyze information, as I have a unique perspective to capture in sharing the stories the participants have shared with me.

Specifically, I must draw from experiences which date back to well before my entrance into any university classroom or teacher preparation program. Growing up as a bilingual student in a very homogeneous community, my PK-12 'schooling' presented a number of challenges and difficulties. At a young age, I became keenly aware of the significant differences that existed between me, my teachers, and my peers in the classroom. Few could relate to my cultural and linguistic background and some even dismissed it. In hindsight, these challenges drew me further into the world of education, where I now find myself embracing multiple roles pertaining to teacher development. Beginning with my pre-service preparation, I completed a traditional teacher certification program in a small liberal arts college located in the Midwest. For close to a decade, I taught social studies, English language arts, science, and reading to bilingual middle-

school students living in a diverse urban community. Throughout these years, I had the privilege to work with students who arrived at school every day with vivid imaginations, creativity, and questions about the world around them, which frequently included the inequalities they observed. During this time period I also became cognizant of particular teachers who struggled while others succeeded; I noticed how some teachers viewed their students as assets, while others could only see theirs through a deficit lens. I became aware of how teacher preparation varied from university to university, program to program, and student to student.

Presently, I am a teacher educator, graduate student, and student teacher supervisor at a large research university, where I continue to be fully immersed in the development of urban teachers and urban teacher education. As a teacher educator, I have a genuine opportunity to observe and facilitate the development of pre-service teachers across various stages of teacher development. As a graduate student, I work in a variety of research areas within education, affording me access to a wealth of current literature and critical conversation. Finally, as a student teacher supervisor, I observe and facilitate the development of teacher candidates in their urban elementary and middle school placements.

I share these roles in depth to present my experiences to date and how they shaped, and continue to shape, my positionality as a researcher. Additionally, these experiences highlight my ability to access and build relationships with the participants in this study. In juggling the roles of teacher, graduate student, and teacher educator, I found myself fully immersed in my research, to the point where the lines between participant and researcher blurred. I believe this allowed for additional opportunities to gather generous

data from both the faculty participants and student participants, as you will see in the next chapter.

Limitations of the Study

A few inherent limitations emerged at the conclusion of this research study. First, the pedagogy labs of this study took place at only one urban university, across only four subject disciplines. While pedagogical content knowledge (PCK) shares foundational similarities across subject areas, the inclusion of other disciplines, such as literature, composition or creative writing, history, and other sciences may have exposed additional facets of PCK, which could in turn further prepare pre-service teachers for urban schools.

Second, given limited time, funding, and resources, adapting this dissertation into a longitudinal study would be challenging. Specifically, I could not further explore and investigate if and how university students completed their university course work, applied to an academic program, or perhaps graduated and/or obtained employment. Specifically, this study could not follow the university students to determine if and how they implemented their pedagogical content knowledge during their first few years of teaching.

A third limitation is in relation to the number of university students who participated in the study. Specifically, the Chemistry/Biochemistry Pedagogy Lab and the Environmental Science Pedagogy Lab experienced lower enrollment rates. It remains unknown why fewer university students enrolled in either of these aforementioned labs. As a result, the research study was not as exhaustive as it would have been had a larger number of university student participants enrolled. Another study could be conducted with a greater number of university students who are, as mentioned previously, enrolled across additional subject-specific pedagogy labs.

Fourth, because this study was developed as a collective case study and observed human engagement, it is difficult to ascertain how these results could be reproduced with a different group of instructors or faculty members, university students, and/or a different university located in a different urban community.

Chapter 4: Pedagogy Lab Case Studies

In this chapter, I detail the accounts of the four pedagogy labs. For each of these individual cases, I present the voices and experiences of the university students, instructors, and the subsequent dialogue that took place during each individual pedagogy lab. Sharing this information allows me the opportunity to tell and retell the various experiences of the participants. This study also allows for a better understanding of how university students and faculty engaged in and grappled with the discovery of new knowledge and its intersection with each participant's lived experiences. As such, each case will look to answer the research question guiding this study:

How do urban pre-service teachers construct an awareness of the complexities of teaching, learning, and pedagogical content knowledge (PCK) through the structure of a pedagogy lab? In addition, the following cases will also look to answer the attendant research questions of:

1. How does participation in a pedagogy lab shape urban pre-service teachers' understanding of PCK as it relates to working in urban schools?
2. In what ways do urban pre-service teachers, who participated in a pedagogy lab, translate their developing PCK into learning opportunities for students attending urban schools?
3. In what ways do faculty instructing the pedagogy labs promote and provide opportunities for urban pre-service teachers to engage in the development of PCK as it relates to working in urban schools?

With these research questions in the forefront, there is an opportunity to "shed empirical light" (Yin, 2003, p. 40) on the pre-existing framework of pedagogical content

knowledge (Ball et al., 2008; Shulman, 1986, 1987), and culturally responsive pedagogy (Cross 2003; Gay, 2000; Ladson-Billings, 1995a, 1995b; Sleeter, 2012) within a liminal space and the multiphased process of pre-service teacher development (Cook-Sather, 2006). In doing so, this collective case study offers us opportunities to understand how teachers-in-training construct and internalize an awareness of teaching and learning in urban schools, while also grappling with the notion of pedagogical content knowledge and its impact on current and future teaching practices. The confluence of these contributing cases and this type of analysis may contribute new facets or dimensions to the existing six categories of PCK put forward by Ball et al. (2008).

Each of the cases is presented in a similar fashion. Each case begins with a short overview and description of the specific pedagogy lab and the participants, both university students[4] and instructors. As each lab was conducted in a specific content area and classroom medium, it is necessary to share the particular details that make each of the cases distinct. Following a brief introduction and overview of the pedagogy lab, I included an Entry Vignette to further draw the reader into a firsthand account of the participants' experiences. Finally, I chronicle how the lab unfolded, both for the instructor and the university students. The subsequent sections identify and highlight key themes that surfaced during the university students' experiences through the intersection of course work, discussion, instructor feedback, and the pre-existing conceptual ideologies. I close each case with a broad summary of the instructors' experiences and beliefs about learning to teach, as well as a summary of their experiences in the development of each pedagogy lab. This confluence of perspectives is intended to reveal

[4] In the description and analysis of each case study, I will use the term *university student* to refer to the participants within research study. The term *PK-12 pupils* will signify the students in grades Pre-Kindergarten through 12th grade.

the potential of these labs as spaces to foster individual and collective understandings of pedagogical content knowledge within the context of urban teaching and learning.

Please join me in interpreting these experiences through the eyes of the university students, and the faculty in their discovery and presentation of the various facets of pedagogical content knowledge, and considering the implications of these findings on the development of teachers.

Case #1: A Political Science Pedagogy Lab

The Political Science Pedagogy Lab linked together the content knowledge of political science, specifically state politics, with the consideration of teaching sensitive and controversial topics in PK-12 classrooms. The instructors who facilitated this course were Dr. White and Professor Schiller, both tenured male faculty members at Urban University. Dr. White has worked as an Assistant Professor for almost ten years in the Department of Political Science at the College of Letters and Science. Professor Schiller, with 20 years of experience at the university level, is a Senior Lecturer in the Department of Curriculum and Instruction at the School of Education. This particular Pedagogy Lab attracted a large number of participants: thirteen university students in total, including ten females and three males (see Table 1). To further detail this group of university student participants during the semester of the lab, I have also identified their age, gender, declared academic program as formally designated on their academic transcript in 2012, and semester grade point average (GPA) upon the conclusion of the Pedagogy Lab.

Finally, the university students whose names are highlighted indicate their declaration of any Education-intended major. [5]

University Student Demographics of the Spring Semester Political Science Lab

Name	*Gender*	*Age*	*Academic Program in 2012*	*Semester Grade Point Average*
Kendra	F	20	Exceptional Education (declared 4/2011)	3.5/4.0
Lisa	F	20	Education Intended: Middle Childhood Early Adolescence; Math and Social Studies Minors (declared 2/2012)	3.0/4.0
Lindsey	F	22	Early Childhood Education (declared 11/2010)	3.0/4.0
Matthew	M	31	Education - Middle Childhood Early Adolescence Social Studies & Natural Science Minors (declared 3/2012)	2.9/4.0
Jaimie	F	29	Education Intended – Early Childhood Education (declared 7/2012)	3.3/4.0
Natalie	F	22	Education Intended (declared 1/2010)	2.5/4.0
April	F	22	Education Intended – Broad Field Social Studies: History Major; Broad Field Social Studies Political Science/Geography Concentration (declared 1/2012)	1.2/4.0
Devin	M	19	Education Intended – Middle Childhood Early Adolescence: Natural Science and Social Studies Minors (declared 7/2012)	3.6/4.0
Laila	F	23	Broad Field Social Studies: Early Adolescence - Adolescence; History Major and Political Science/Psychology Concentration	3.3/4.0

[5] Urban University's School of Education has a variety of teacher preparation programs. Among the university students participating in this research design, the four most common programs were:

- Early Childhood Education (ECE) will grant a teaching certification for grades PK-3.
- Middle Childhood - Early Adolescence (MCEA) will grant a teaching certification for grades 1-8.
- Early Adolescence - Adolescence (EAA) will grant a teaching certification in a *specific content area* for grades 7-12.
- Exceptional Education will grant a special education teaching certification.

			(declared 4/2012)	
Eugene	M	30	Chemistry (declared 11/2011)	3.9/4.0
Porsche	F	20	Health Sciences: Athletic Training (declared 6/2011)	1.1/4.0
Pamela	F	21	School of Arts Undergraduate (declared 6/2010)	2.9/4.0
Morgan	F	21	Social Welfare Intended (declared 12/2011)	2.5/4.0

(Table 1)

The Political Science Pedagogy Lab specifically encouraged university students to critically analyze how and why controversial and complex social studies topics should be taught to pupils in the levels of 5th and 11th grade. Dr. White also elaborated on his belief in the benefit of exposing pre-service teachers to the notion of pedagogical knowledge: "…pedagogy is a tool for making judgment calls about content and what you're going to cover, what you aren't going to cover, what's going to keep students engaged. I know pedagogy is going to help filter the content so it's easily communicated to whatever audience you're teaching to" (Dr. White, Concluding Interview, 12 May 2012). These tenets are evident in Dr. White's Entry Vignette:

Just a word of welcome to all who have joined us for this PedLab. PedLabs are an attempt to collaborate between the School of Education and Letters and Science faculty. It's a chance for you to consider the material in your Political Science class from a different perspective. And for those of you who are considering a career in teaching, this PedLab will be a good chance to consider the relationship between your content knowledge and the craft of teaching. Please review the welcome and syllabus files under the "Content" section of the course. Assignments are located under the "Dropbox" section of the site. We will be doing a few "how would you teach this topic?" type scenarios in this PedLab. In other words, we will present you with a topic covered in POL SCI 105 and ask you to think about how you would teach this topic to students at

different grade levels. We are NOT going to post elaborate instructions for these exercises. Doing so would defeat the purpose of obtaining candid responses from you. In other words, we're not interested in telling you how to answer questions; we're more interested in seeing how you answer these questions (without a lot of guidance from us). There are no right or wrong answers for the "how would you teach this topic?" questions; however, there are some minimum quality standards we'd like you to observe. You should explain the logic/reasoning behind your answers. In other words, "yes" or "no" or "agree" or "disagree" responses without any explanation are not appropriate. This does not mean you need to write paragraphs of material for each answer. We're simply asking you to explain the thoughts/reasoning behind your answers). So welcome and we hope you will find this a rewarding experience (Dr. White, Introductory Welcome Post, Political Science Pedagogy Lab, 2 April 2012).

Inside a Political Science Pedagogy Lab

As the Entry Vignette described, the Political Science Pedagogy Lab required university students to submit work through individual online dropboxes situated within Urban University's Desire 2 Learn (D2L) course management system. This type of isolated assignment submission prevented some of the cross-dialogue that might have occurred if university students had commented on one another's responses and submissions. Dr. White did acknowledge this challenge during the concluding interview: "I actually did post a question in the discussion forum, and only one student responded. I got the sense that other students were just afraid to share their ideas with other students for maybe fear of being criticized or looking stupid." (Dr. White, Concluding Interview, 12 May 2012). The initial question and assignment asked university students: "Please

explain why you decided to enroll in this PedLab. You do not have to write anything really elaborate. We would simply like to get a better understanding of the motivations students have for enrolling in PedLabs" (Political Science Pedagogy Lab, Online Dropbox #1 Assignment Description, April 2012). The university students' answers varied both in understanding of pedagogy and their general motivation for participating in this additional voluntary course. One common response university students shared was an interest to become educators and to enter the various education programs offered in the School of Education at Urban University. "I have not yet been admitted to the Education Department and would like to have this PedLab look positive on my transcript" (Jaimie, Online Dropbox #1, 4 April 2012), and "I enrolled for this PedLab because I am a broad field secondary education social studies major. I thought this would kind of get my feet wet as far as developing curriculum" (Laila, Online Dropbox #1, 6 April 2012).

Another common response was the connection between real-life experiences to the subject matter presented in the political science course work, and how that may relate to teaching in the future:

> As a future educator, it is important to be aware of current events, of what is going on within our state, as well as, others and in the world. It will be a good way to get me to start thinking of different ways in which an educator might approach this subject and any other subject in general. I am also taking an exceptional education class this semester and I thought that it would be a good idea to take this class online in order to further expand my knowledge (Natalie, Online Dropbox #1, 3 April 2012).

University students of the PedLab were also eager for the opportunity for extra credit and how that might impact the overall course grade: "I'm going into the education field, and to me, this seemed like a good practice for my future! Also, the extra credit I will receive for Political Science didn't seem like a bad deal either. I could use a little boost" (Lindsey, Online Dropbox #1, 9 April 2012). Sarah shared similar sentiments. "To be able to get some experience in classroom teaching, with a class I am already taking. In addition, a financially free credit, with an assignment already as an extra credit opportunities for my political science class is just a bonus" (Sarah, Online Dropbox #1, 9 April 2012).

Three university students identified the potential of the Lab to address gaps or weaknesses in their own academic learning, and how that coupled with their developing teaching practice:

> I'm an MCEA[6] student who is anxious to get started on Education courses. I thought this would be a good opportunity to get my brain thinking in pedagogical terms before I start in the School of Ed next fall. My minor focus will be social studies (an area where my knowledge is a bit more limited). So, I thought that taking this course would help me to fill in a little bit of the gaps (Matthew, Online Dropbox #1, 9 April 2012).

Claire also exposed her own weakness in the political science content, expressing an optimistic desire to become the best educator possible for her future pupils:

> I want to be the best for my kids so any help I could get with bettering my skills I'll take. Also political science is not my strong suit so I was thinking it would

[6] Middle Childhood - Early Adolescence (MCEA), will grant a teaching certification for grades 1-8.

also help me understand the material better. I'm excited to get to use my creative skills by coming up with a curriculum (Claire, Online Dropbox #1, 9 April 2012).

Lindsey honestly identified her challenges with her political science content with respect to future teaching, "I decided to enroll in the PedLab because I thought it would be interesting to put my skills to the test on how to teach something that I find difficult myself" (Lindsey, Dropbox #1, 9 April 2012). It is significant to include these university student justifications for enrolling into this PedLab because they present information about each participant's state of mind as they continued through the various stages of the material.

Making Political Science Content Relevant

One theme in particular emerged throughout the university students' submitted responses during this Pedagogy Lab: that of making content relevant for pupils and pupil learning. The content of the pedagogy lab focused greatly on how to effectively teach the United States political systems and the process to amend Wisconsin's Constitution. Some of the pedagogy lab participants identified that this subject matter may be irrelevant and boring for young pupils. Matthew, who heavily emphasized the need for pupils in urban classrooms to be engaged on a much greater level, provided one such example: "Life in Urban City is hard for many of our students. This is a real bummer, but we do need to root their learning in the positive and in popular culture!" (Matthew, Concluding Group Interview, 18 May 2012). The indication that popular culture and content can be bridged together for meaningful and *positive* learning opportunities for urban pupils is significant, as many urban teachers are challenged in determining ways to connect with their diverse group of learners (Duncan-Andrade, 2004; Gee, 2004).

From the weekly discussion topics posted by both Dr. White and Professor Schiller, the questions required university students to imagine themselves as teachers in 5th and 11th grade classrooms. With this mindset, university students were asked to make recommendations of how they would teach particular political science topics. Each topic was intentionally sensitive or controversial to stimulate critical dialogue. During the third week of the Lab, the discussion question invited university students to address the question, "Suppose you're covering state constitutions in a civics course. How would you use a controversial issue to illustrate a point about state constitutions? In one case you're teaching 5th graders; in another, you're teaching 11th graders. Would your approach to teaching a controversial issue involving state constitutions differ by grade level?" (Political Science Pedagogy Lab Online Dropbox #3, Assignment Description, April 2012).

The university students' responses varied, with a common explanation that some controversial topics might be too sensitive to include in a 5th grade classroom. Another common response from the university students indicated that to teach controversial issues with the state constitution in mind, it would be best to bridge the pupils' lived experiences to the content presented, or in other words, make the content relevant.

The emphasis on the requisite need to teach social studies topics that are relevant to pupils' lives was highlighted in responses like "when the subject at hand relates back to and clicks with the student's brain, that's when they make segues [segue] into the teaching material and grasp that as well" (Lisa, Online Dropbox #3, 25 April 2012). Additionally, when these controversial issues are communicated in the classroom, this would actually help bridge complex content with real-life situations, especially those that

immediately translate to the learners in the classroom and, in turn, trigger a 'light bulb moment':

> I would mention during teaching how some people feel these controversial issues are taking away a right from them, and depriving them of happiness and love. I would then relate this back to the [pupils] by saying how much of them often feel their parents deprive them of things they feel they deserve or need and in a sense the same thing is happening with adults and these issues. I would also point out that if our state has the power to declare such things, then we should be paying attention to what is happening to [our state's] constitution more often I feel like this would also get the students to start caring about their state constitution, and even look at and analyze the small things that are happening. When I relate it back to them, and give the example of their parents being like an analogy for controversial issues, they will have that light bulb moment (Lisa, Online Dropbox #3, 25 April 2012).

Matthew's response to the posted question also went into how to implement particular political science content in the classroom as it related to controversies specific to pupils' interests across various grade levels:

> In 5th grade, I don't know how comfortable your administrator would be with handling some of these topics, but I came up with a milder solution. If we consider the differences between several classrooms, we'll notice that different teachers have different ways of doing things. For instance Ms. Shuster may have assigned seating while Mr. Roller allows students to sit where they would like. How do these classrooms that sit in the same school come up with different

> policies? The [pupils], teachers, and materials in each classroom are different, so they necessitate different decisions. I can remember being a little bit upset that the neighboring 5th grade class seemed to be having more fun sitting next to their friends, so I think that 5th graders would understand this as a more controversial topic, and be able to see how individual classrooms could stand in for different states (Matthew, Online Dropbox #3, 25 April 2012).

The university students identified a benefit of this Lab: the experience to discover how to teach various subject areas to the specific pupil grade and age levels. As one student noted, "The biggest thing I learned is that how you teach really does change based on the grade level that you have. We can all have the same lesson that we need to teach, but we can all teach it extremely different, depending on our personality and the students in the room" (Jaimie, Concluding Interview, 15 May 2012). These university students are not in the final stages of their teacher preparation, or even enrolled in an education program. The responses suggest they are thinking about teaching practice in a more advanced way and making a link between sensitive content and how to, in their minds, "correctly" teach that to various groups of learners.

Other university students in this Pedagogy Lab had very strong beliefs about controversial topics and wanted to avoid teaching them altogether. This was primarily due to the presumed 5th grade students' reactions to the material surrounding same-sex marriage or the legalization of marijuana. One university student was firm in her refusal: "I would not touch a controversial topic with a 5th grade class. No matter what you choose, someone would be upset. At that age group there is no need to alienate the parents and no reason to look like you are trying to sway children on a subject" (Eugene,

Online Dropbox #3, 24 April 2012). Interestingly enough, Laila noted that teaching a controversial issue such as same-sex marriage would just make pupils laugh and would take away from the focus of the lesson: "I believe I would chose different issues depending on the grade; for the younger grades I would find some controversial issue that would not make them giggle. 5th graders laugh and get into very frenzied giggles, I believe that the gay marriage issue would just make them laugh" (Laila, Online Dropbox #3, 24 April 2012). These responses are a possible indication of the university students' own discomfort in teaching sensitive content and the perceived outcomes from parents and/or pupils.

Two other university students also shared their discomfort with teaching the identified controversial topics to younger grade levels. However, these university students presented a deeper understanding of how to include complex content in the classroom, as they offered alternative methods of teaching the constitution:

> As far as controversial issues, I wouldn't go into abortion or medicinal marijuana, I would stick to the developments of the Constitution, for example, women's role in government, slavery, bill of rights. I would feel it would be more appropriate to use a current controversial issue when it came to 11th graders (Natalie, Dropbox #3, 24 April 2012).

Lisa perceived a lacking maturity level and ability level of 5th grade pupils as an explanation to avoid controversial current events:

> 5th graders are not at the same maturity level as 11th graders, nor do they fully understand some of the more "hot-button" controversial issues that are at hand. So, for the 5th graders, I would probably take an issue such as gay marriage, and put

> it into simpler terms. Such as, some states makes laws saying that only boys and girls can live together once they are over the age of 18. I would still be hitting on the issue, but not straightforwardly exposing them to gay marriage and its issues at such a young age (Lisa, Dropbox #3, April 2012).

Responses from university students varied from absolute discomfort and avoidance to constructive attempts to grapple with the issues at hand. Such variance, particularly as it relates to those who constructively struggled with teaching controversial subjects, suggests that introducing these critical conversations early in a teacher's preparation allows for greater opportunity to consider and reflect on both individual preconceived ideas, as well as how to make content relevant to pupils of various ages and grade levels.

Inquiry-Based Teaching and Learning in Political Science

Inquiry-based teaching and learning was another interesting theme that emerged during this Political Science Pedagogy Lab. The university students had an image of a perfect classroom: one full of questions, conversation, and general curiosity. During the culminating group interview, Jonathan shared, "I think my classroom would be largely discussion-based, so that the students can really explore all the topics and kind of ask their own questions and not just go section-by-section, by the book. They can really explore the topics by their own volition" (Jonathan, Concluding Group Interview, 18 May 2012). This topic on inquiry continued when Pamela identified that she recently changed her major from Film to English, and hoped to soon apply to the English Secondary Teaching preparation program. She described her vision for a high school literature or writing class full of discussion and the development of questioning skills: "It would be

really nice if students were discussing the book and what happened and what they think things mean and just what they though about it. So this way, they're interacting with each other and not only me" (Pamela, Concluding Group Interview, 18 May 2012). During this same line of questioning, an interesting dichotomy occurred when Devin detailed his vision for a perfect classroom: "I prefer a classroom with not a lot of resources, so the kids are forced to come to me for questions, like I could control what the class is really focusing on, so the [pupils] don't get overwhelmed with too many different things at once" (Devin, Concluding Group Interview, 18 May 2012). This is an interesting statement for two reasons. First, these ideas are contradictory in the sense that Devin understood the need for pupils to ask questions and explore their areas of interests, but simultaneously wanted to remain the purveyor of knowledge. Devin's intention was for the classroom to be a space where the lack of resources forced PK-12 pupils to seek out their teacher for answers. Historically, these belief structures have a negative and limiting impact on PK-12 pupil learning (Haberman, 2005). If not properly addressed and examined, the long-term consequences can be devastating for pupil learning. Teachers cannot and should not consider themselves as the sole source of information in any learning environment. Perhaps if there is a collective effort to address these belief structures earlier in the education of teachers, these professionals can engage earlier in methods courses with a more open and unprejudiced perspective. This may build their capacity to prevent some of the traditional teacher-centered and misinformed beliefs.

Reflections of Self as an Educator in Political Science

One of the overarching goals of these four pedagogy labs was for university students to engage in a discourse of pedagogy and content knowledge. In addition, the

emphasis was on how both of these areas could be joined, and the impact this could have for future models of teaching and learning. To consider these implications, the university students exposed a great deal of reflective thinking, both as university students and, in some instances, as teachers. In other words, the university students imagined what happened when they 'put the teacher hat on':

> This [Ped Lab] has definitely helped me. It's really gotten me to think about teaching in a professional manner and have a teacher hat on and really think about okay, this is real life of what I'm going to have to do, situations that I'm going to have to deal with and how to handle them based on what I would do. The thing that I like is that it didn't have specific instructions, so I really had to think, like what would I do right now if I was in this classroom and I was really teaching this because I'm not going to have my boss next to me in a classroom telling me this is how I want you teach this lesson (Jaimie, Concluding Interview, 15 May 2012).

During this concluding interview, Jaimie identified that during the Lab, university students were provided multiple opportunities to address challenging situations that could take place in today's PK-12 schools. Rather than provide specific guidelines and detailed rubrics for the purpose to elicit 'correct answers,' Dr. White and Professor Schiller encouraged genuine and honest responses from each of the university students.

The final assignment for the Political Science Pedagogy Lab was the choice to either write a five-page term paper with a focus on reviewing a key debate in state politics (Political Science Term Paper Assignment, May 2012) or create a lesson plan for a specific grade level, focusing on a political science topic. Of the thirteen university students, only two chose to create a lesson plan; the remaining eleven university students

opted to complete a final term paper assignment. The two university students who created lesson plans, Matthew and Lindsey, appeared to embody a concrete understanding of how professional educators acknowledge crucial steps when planning and teaching particular content. Matthew's lesson plan, written for a fifth grade classroom, is titled *Classroom Constitution*. Through this lesson plan, Matthew took on a great deal of content in hopes of delivering it effectively and relevantly to the pupils in this fictional classroom. For example, the lesson's objectives were listed as such:

1.) Through the creation of their own 'classroom constitution,' students will gain understanding of the way our lives are connected to our state's constitution.
2.) Through discussion and debate, students will practice their speaking skills and work together to create a meaningful document.
3.) Upon completion of the 'classroom constitution,' students will learn the processes and reasons for amending the state constitution (Matthew, Lesson Plan Final Assignment, 16 May 2012).

A veteran teacher could see that the list of objectives was actually more than one lesson could successfully achieve. Yet, Matthew made the distinct link between the prior knowledge of 5th grade pupils to the complex content of the state's constitution. He accomplished this by creating a classroom constitution. The framework for Matthew's classroom constitution lesson included seven articles, such as:

> Article 5 Executive: Mr. Walter is the executive. What powers and/or limits should he have?
>
> Article 9 Eminent Domain: What are our rules regarding shared property (textbooks, supplies, classroom space, etc)?

Article 12 Amendments: How will we make changes if we have to?

(Matthew, Lesson Plan final assignment, 16 May 2012).

Matthew's discussion questions addressed the complexity of the classroom constitution while simultaneously empowering pupils by acknowledging how individuals have the capacity to contribute to, and participate in, the ownership of a classroom. A particularly interesting reaction emerged from the comments and feedback that both Dr. White and Professor Schiller shared with Matthew in their assessment of his final project. Dr. White paid close attention to the actual content of the lesson plan, "Wow! This is extremely impressive. I did not think [university] students would put this much effort into this assignment (i.e., actually consulting the state's constitution)" (Dr. White, Final Evaluation Feedback, 22 May 2012). Professor Schiller shared feedback focused specifically towards the pedagogy of the lesson. "I'm impressed. The lesson looks very good. My only comment is about time and time is a tough one without experience. This looks like a unit and would take several days" (Professor Schiller, Final Evaluation Feedback, 22 May 2012).

While this feedback is incredibly supportive of the thorough lesson plan Matthew created, there is an underlying tone of disbelief that an undergraduate university student planning to go into education could, or would, put together such a thorough lesson plan. Perhaps this indicates a common misconception that some faculty members may have of pre-service teachers; specifically, that these university students are far too inexperienced and lack the necessary knowledge base early in their preparation.

Lindsey's lesson plan was less conclusive and comprehensive in comparison to Matthew's plan. This indicates that each developing educator has particular strengths

and weaknesses in their ability levels. Lindsey's lesson plan, titled *Amending the State Constitution,* intended to meet the following objectives:

1. Have children understand how you can amend government documents and how the state's constitution is amended.
2. Have them be able to write up a proposal themselves.
3. Be able to state in their own words how the process takes place (Lindsey, Final Assignment, 9 May 2012).

These learning objectives presented a rather basic, or general, understanding of how to clearly and succinctly distinguish the goals or purpose of the lesson. Lindsey lacked a significant amount of information and content in this lesson plan, such as what grade this lesson was designed for, along with which particular academic standards were going to be met. Overall, her lesson plan was very vague. The culminating project of this lesson was described as some type of art project, but Lindsey did not identify the elements of the project, or how the project would tie in to the lesson regarding amending the constitution. Professor Schiller and Dr. White's feedback reiterated these similar observations. "I like what you have here. I do have a question and a comment. What grade were you teaching this to? And the comment is that I would like to know about the art project. So more detail would help" (Professor Schiller, 22 May 2012). Dr. White targeted his feedback in regards to the content. "As far as the real life and relevant examples, I agree examples could be useful learning tools. My only question would be can you find recent amendments simple enough to relate to a young audience?" (Dr. White, 22 May 2012).

The difference between Lindsey's and Matthew's lesson plans illustrated the various ability levels future educators have as they attempt to designate appropriate content and subject areas and explore how to teach those effectively. As such, this initial opportunity to engage in writing lesson plans may be helpful for Lindsey and Matthew's future professional development, especially as they enter designated preparation programs, where the expectations and demands increase twofold.

Faculty Reflections on the Political Science Pedagogy Lab

It is also necessary to present the reflections and experiences of Dr. White and Professor Schiller who facilitated this lab, as their beliefs and interpretations of pre-service teacher learning help inform teacher development. During the concluding interview, Dr. White said that he learned quite a bit in regard to his own teaching practice through the collaboration that took place between he and Professor Schiller, in addition to the actual implementation of this lab. Dr. White identified that after working with Professor Schiller, he became aware of his own teaching practice, realizing that:

> …effectively teaching a subject is maybe harder than I thought. This made me rethink a few things…to make the content more relatable to students, I need to think, okay, what can I do to make this more relatable? And Professor Schiller has taught me a little more about empathy and understanding (Dr. White interview, 20 June 2012).

This statement is especially telling, as the university students who participated in the Pedagogy Lab *also* identified the importance of making content and learning opportunities meaningful to PK-12 pupils in their future classrooms. This parallel between pre-service teachers and faculty members indicates that the process of teacher

development does not end, whether one is in a PK-12 classroom or in higher education (Bales & Mueller, 2008). The Pedagogy Lab appeared to encourage both faculty and university students to be cognizant of the individuals situated within the classroom, as well as to determine how to make learning relevant to those unique learners. Being able to master that task represents the professional role of teachers. Learning early through a pedagogy lab seems to be beneficial to that development.

Another significant line of thinking emerged during the concluding interview with Professor Schiller in regards to collaboration. Professional Schiller identified the need for constructive collaboration between the two schools of the College of Letters and Science and the School of Education. Pedagogy labs present opportunities to determine new ways of bridging together the critical areas of teacher preparation in content and methodology:

> Having this lab attached to an intro Political Science course was big; the Letters and Science family, for the most part, they think the School of Edu. are not considered quite equal to them in terms of research and mainly because they don't know what it is we do. And when you start kind of explaining to them, they go, "Oh my god, we need these relationships." So partly the value of this is just to establish relationships between L and S [Letters and Science] and education (Professor Schiller, Concluding Interview, 12 June 2012).

These collaborative relationships between various schools and departments within higher education become important in supporting the dimensions of teacher preparation; in part, they support content knowledge, and how that interacts with pedagogical knowledge. Additionally, as the public opinion of teacher preparation and teacher

aptitude shifts back and forth from vilifying to favorable, it is important that there be a united front between departments outside schools of education regarding the actual content preparation, the methods course work, and any implementation of policy within the schools of education. As indicated by Professor Schiller and Dr. White, this collaborative component has the capacity to strengthen the pedagogical content knowledge in future educators.

Reoccurring Themes

From this Political Science Pedagogy Lab, a number of key concepts emerged. First, there is an understanding that university students intending to go into education need to engage in critical or 'courageous' conversations (Singleton & Linton, 2006) earlier in their professional development. The earlier university students have opportunities to face their own misconceptions, biases, and discomfort, the greater the opportunity for growth and progressive thinking. Secondly, university students develop an awareness of how to integrate their interests and lived experiences into various learning opportunities. As highlighted by both the faculty instructing the Pedagogy Lab and the university student participants, it is clear that teachers need to continuously determine the interests of the individuals in the classroom and integrate these into teaching. Finally, the Pedagogy Lab appeared to create opportunities for pre-service teachers to engage in inquiry-based teaching practices, with the emphasis on providing opportunities for PK-12 pupils to explore and discover answers to their own questions through conversation.

Case #2: A Chemistry/Biochemistry Pedagogy Lab

The Chemistry/Biochemistry Pedagogy Lab at Urban University was constructed with the intention to bridge content from an introductory Chemistry/Biochemistry course with the pedagogy of how to teach specific chemistry topics to pupils in PK-12 grades. This Lab was offered both in the fall and spring semesters, and delivered entirely online through Urban University's Desire 2 Learn (D2L) course management system. The Lab was designed and taught by two female instructors, Dr. Kelly and Dr. Lindsey. Both are veteran faculty members in the Chemistry Department of the College of Letters and Science. Dr. Kelly is an associate lecturer and Dr. Lindsey is an assistant professor, and both have experience working with undergraduate degree university students, including university students considering a path to become educators.

Just as each Pedagogy Lab conducted at Urban University had unique features, the Chemistry/Biochemistry Pedagogy Lab is different, in that Dr. Kelly and Dr. Lindsey requested to offer the course twice—once in the spring semester, and then again in the fall semester of the same calendar year—because of the low enrollment. Three university students enrolled in the first Chemistry/Biochemistry Pedagogy Lab, offered in the spring semester (see Table 2). The second offering occurred in the following fall semester of the same calendar year. During this semester, eight university students initially enrolled, but for unknown reasons, five withdrew from the course, leaving only three female university students in the lab for the duration of five weeks (see Table 3).

I grouped these two offerings together for three reasons. First, both labs followed an identical syllabus and course expectations, with no deviation from the intended objectives. Second, during both the spring and fall semester, Dr. Kelly and Dr. Lindsey

concurrently taught the same three-credit introductory chemistry course intended for those interested in teaching and education. Third, both pedagogy labs had identical university student enrollments; three university students in spring semester (Table 2) and three university students in the fall semester (Table 2). The university students who declared an intended major of Education are highlighted. The gender, age, and grade point average (GPA) are also indicated to further detail the demographics of the university students participating in this Chemistry/Biochemistry Lab (see Tables 2 and 3).

University Student Demographics of the Spring Semester Chemistry/Biochemistry Pedagogy Lab

Name	*Gender*	*Age*	*Academic Program*	*Semester Grade Point Average*
Brendan	M	43	Education Intended; Science: MACSTEP Early Adolescence, Adolescence; Chemistry Minor (declared 2011)	4.0/4.0
Laura	F	22	Education Intended; Middle Childhood Early Adolescence; Natural Science and English/Language Arts Minors (declared 2010)	3.9/4.0
Joe	M		NO DATA AVAILABLE	

(Table 2)

University Student Demographics of the Fall Semester Chemistry/Biochemistry Pedagogy Lab

Name	*Gender*	*Age*	*Academic Program*	*Semester Grade Point Average*
Abbie	F	25	Letters and Science Undergraduate; English Intended	4.0/4.0
Larisa	F	20	Education Intended; MCEA: Natural Science and English Language Arts Minors (declared 9/2011)	3.5/4.0
Karissa	F	20	Nursing Intended (declared 5/2011)	2.8/4.0

(Table 3)

The overarching goal for this was Lab for university students to develop an understanding of "the teacher role in a science related classroom and to connect a specific chemistry content area to the pedagogical knowledge needed to teach successfully in a PK-12 classroom" (Chemistry/Biochemistry syllabus, 2012). Dr. Lindsey and Dr. Kelly both emphasized the significance in developing an awareness of how to teach complex content well, rather than focusing on PK-12 pupils simply having "fun," as this may contribute to misconceptions in the sciences:

> If you teach science in all levels, you can have fun experiments, but really make it fit what you want to teach. And in order to do this, teachers really need a good content knowledge and they really need a good understanding of how students learn and what the misconceptions are and they really have to work against those misconceptions. Don't let a science experiment just become an art project (Dr. Kelly, Concluding Interview, 21 May 2012).

This emphasis on content knowledge ran throughout the Chemistry/Biochemistry Lab. Dr. Lindsey and Dr. Kelly insisted that educators, both novice and veteran, must circumvent the desire to simply have "fun" in order to amend pupils' prior misconceptions and to teach the content well. Through the following Entry Vignette, one becomes acquainted with the teaching style and academic expectations of both Dr. Lindsey and Dr. Kelly:

Welcome to the pedagogy lab CURRINS 565. This is a 1 credit online lab that will investigate how the chemical content of chemical and physical changes can be successfully taught in a PK-12 classroom. To get more insight in this matter we will talk about the teacher role, different representations of the content matter and also student

misconceptions that need to be addressed. The course is divided up into 5 main one-week sessions. Each Monday the new material for the upcoming week will be posted. You will find instructions and all needed material or links under "content". You must submit assignments in the D2L dropbox. Please use a word processor file format that is compatible with Microsoft Word. Do not submit a pdf. Please make sure to submit your assignments on time (Chemistry/Biochemistry D2L Introduction, 8 October 2012).

Inside a Chemistry/Biochemistry Pedagogy Lab

Like the four other pedagogy labs of this collective case study, the instructors posted discussion questions and assignments through the online D2L classroom. University students submitted their assignments to individual and private online dropboxes, similar to those in the Political Science Pedagogy Lab. Once again, this restricted the amount of interaction among the university students. The instructors did attempt an initial dialogue by asking the university students to identify their understanding and definitions of pedagogy, content, and any intersection of the two: "What is more important, for a teacher: knowing content or knowing pedagogy? How is pedagogical content knowledge (PCK) a way to address this?" (Online Discussion Question #1, 7 October 2012). Thus, the notion of PCK was planted, requiring university students to become involved in the debate over content and pedagogy. Abbie shared a very rich description of PCK and its possible implications on teaching:

> Both content and pedagogy is essential for an effective teacher, though I think there is more focus on pedagogy in the earlier grades and more complicated content requires broader content knowledge. In my personal experience, I have had teachers who are very well-studied in the content of their subject yet cannot

> seem to get a classroom of students to grasp a concept or even bother to care. This is why pedagogical content knowledge is an extremely useful tool. Being aware of what makes specific content difficult to learn, an appropriate order to introduce concepts, and what approach best fits the concept being presented can make the learning process more successful for everyone involved (Abbie, Fall Pedagogy Lab, Online Discussion Response, 20 October 2012).

Larisa also presented a very thorough explanation of PCK and the need to combine particular areas of teacher preparation and teacher development in order for someone to become a *great teacher*:

> There is a Chinese proverb that says, 'Tell me and I will forget; show me and I may remember; involve me and I will understand.' A teacher that is able to combine his or her content knowledge with their curriculum in a way that their students will understand will have a classroom in which that quote will ring true. In order to be a good teacher an individual needs to understand all three, but to be a *great teacher* an individual needs to be able to combine all three (Larisa, Online Discussion Response, 3 November 2012).

This statement by Larisa is inherently true. For teachers to be great or excellent, they need to move past a simple understanding of PCK, and instead, implement a deep understanding of content knowledge and the curriculum (Ball et al., 2008), coupled with a deep knowledge of students' unique backgrounds and experiences.

Brendan, on the other hand, candidly identified his own uncertainty with PCK. In his online posting, he shared an initial understanding of this abstract concept:

> I am having difficulty with the term pedagogy and its definition. It would be nice

> to have a clear and concise definition that was in plain language. But in my mind pedagogical content knowledge would be a benefit to all involved - student, teacher, and even the parent. The teacher would be able to find a method to impart the knowledge to the student. The student would start building a foundation of knowledge, which concepts can build off of. The parent can even learn from the student (a good way to see if the student really understands the concepts). (Brendan, Spring Pedagogy Lab, Online Discussion Response, 9 April 2012).

Brendan's response was especially intriguing, because it appears to reinforce two misconceptions common among some pre-service teachers. The first misconception is that teachers are "imparting" information onto pupils to construct a foundation of knowledge. The second misconception is that this "imparted knowledge" will somehow benefit and teach parents. This is a particularly dangerous combination if not addressed and immediately clarified during the initial stages of a university student's teacher preparation.

Over the course of five weeks, the university students completed an in-depth analysis of how to incorporate rich content knowledge, and in turn, plan a lesson on a physical and/or chemical change (Chemistry/Biochemistry Lesson Assignment, 2012). Thus, the lab's goal for the university students was to spend a generous amount of time reinforcing their understanding of physical and chemical properties and chemical changes. Dr. Kelly and Dr. Lindsey used various article readings and online Power Point presentations to present this chemistry content. As the lab continued, the university students came face-to-face with the tremendous amount of chemistry content knowledge

needed to teach well. Both Dr. Lindsey and Dr. Kelly indicated this was somewhat intended: "While content and pedagogy go hand-in-hand, content has to come first. There is nothing more dangerous than an excellent teacher that doesn't know what they're talking about. I would rather have a teacher that can't communicate well, but knows the science than someone who is personable and doesn't know their content" (Dr. Kelly, Concluding Interview, 21 May 2012). As such, during the Chemistry/Biochemistry Lab, a tremendous emphasis was placed on acquiring the necessary content knowledge. Three themes emerged from the university participant's understanding of the chemistry content: *Making chemistry content relevant, inquiry-based learning, and reflection of self as an educator.* In turn, each influenced how university students thought about planning and teaching that content to pupils' particular grade levels.

Making Chemistry/Biochemistry Content Relevant

As previously identified, Dr. Kelly and Dr. Lindsey intended to infuse a foundational understanding of the content knowledge of both physical and chemical properties. Therefore, university students were required to determine how particular science standards, both local standards from Urban City School District and national science standards, integrated the topics of chemistry for learning opportunities among PK – 12th grade pupils. One of the initial Lab assignments was to interpret the standards and determine how they evolved from grade level to grade level, "Read the Science Standards (National and Urban City Public School District's Science Standards) and identify chemical content throughout the grade levels. Then identify different types of teacher knowledge that is necessary to teach any K5-12 content successfully"

(Chemistry/Biochemistry Assignment Description, 2012).

Unpacking academic standards is a rather daunting task, and is typically addressed during teacher preparation coursework after admission into a particular education program. Therefore, this was an excellent opportunity for the university students to begin developing or enhancing their awareness of how academic standards build in a horizontal and vertical knowledge base. Laura, a university student already admitted into a teacher preparation program, showed a deeper level of thinking about academic standards than others in the lab. She tied them directly to urban pupil learning and PCK:

> For this session, we were asked to examine the standards and read the article by Ball (2008). My understanding is that both the National standards and Urban City Public School's Science Standards are similar, for example grades 1-4 focused on concepts such as matter and physical properties and grades 5-8 some emphasis rests on chemical reaction. This is the first time I have heard of the term [PCK], so in my experience there is an emphasis on adapting instruction based on the learner. We need to get to know a student that is different in race, gender, class and socioeconomic status to learn about their funds of knowledge and how to use them in the classroom (Laura, Online Assignment Submission, 13 April 2012).

Since Laura was in the initial stages of her teacher preparation course work, she was clearly making a critical link between standards-based teaching and how an educator should address and incorporate the needs of *all* pupils to achieve those academic standards.

Just as notable within Laura's written response is a rather glaring recognition that

she had never heard of PCK in any of her previous education course work. While Laura did, in fact, make a clear connection between content, teaching, and student learning, there is still a requisite need for preparation programs to immerse pre-service teachers in the field's academic vocabulary, like pedagogical content knowledge.

Larisa reflected on her understanding of pedagogy, the content, and the specific academic standards in mind:

> In order for a child, especially a first grader to truly learn something they must be able to see it and experience it in their own life. The reason children have snow ball fights and not rock fights all have to do with the properties of two substances. To meet the standard of 'identify the properties of objects and materials', students could come and feel items that are hard, soft or squishy, sparkly, dull, wet, and dry. Children will not learn unless the lesson is accessible to their own life. Teachers need to provide information in lessons that touch the students' lives (Larisa, Online Assignment Submission, 12 October 2012).

Even in this segment of Larisa's written work, she clearly identified the significance of standards-based teaching and how they should relate to the students' interests and lives.

Joe, another student in the Biochemistry Lab, also made a connection between the academic standards and how they need to relate to student learning:

> Similar principles build off the concepts in each grade of the science standards. Thinking about that then, content knowledge, arguably is the most important type of knowledge. This suggests that the teacher must understand the subject and all of its "ins and outs", because if the teacher does not know for sure how can the student ever be expected to learn? Understanding your students and how the

> student learns, may help you as a teacher to frame how to present the curriculum (Joe, Online Assignment Submission #1, 13 April 2012).

Here, Joe illustrates an awareness of bridging together the content, standards, and knowledge of how students learn. This opportunity to analyze the science standards in conjunction with a concrete description as suggested by Ball et al. (2008) appears to solidify how content and pedagogy should be fused together during a teacher's preparation. Furthermore, from this assignment submission, Joe also identified the notion that learning opportunities should be created with an understanding of the distinct individuals in the classroom, and gave an acknowledgement of the significance of knowing the young learners in the classroom and providing a tailored education.

Inquiry-Based Teaching and Learning in Chemistry/Biochemistry

The notion of inquiry also appeared in both semesters of the Chemistry/Biochemistry Pedagogy Lab. Without explicit prompting from the lab's instructors, the university students identified a requisite need for learning to be foundational in inquiry-based opportunities. While some of the university students precisely stated this with the use of academic vocabulary such as "inquiry" and "inquiry-based learning," other students implied and alluded to their understanding of what inquiry teaching and learning entailed.

Laura was one of the university students who alluded to a classroom of inquiry. She took the notion one step further and shared how she sees herself implementing this complex teaching method in an urban classroom:

> So I think the teacher, is mostly the facilitator and the students pose the questions. But I think the children learn by, you know, watching their teacher and learn that

> they too can, facilitate conversations. This is especially important because what I've seen, kids in urban districts don't experience science enough. They don't. I mean, the kids in a classroom I observed 'saw' science once week. So by encouraging students to ask questions, that's how you engage…I mean, it's their world out there. You can go out and touch soil. You can go out and touch things. That is interesting to them instead of sitting in a desk with paper that they do every day. So, I think, in so many ways, science just hands itself as being fun while still learning. It just has to be done (Laura, Concluding Interview, 10 June 2012).

Laura's comments offer a number of key points that should be emphasized for the continuous development of both pre-service and veteran teachers. First, she identified the belief that teachers need to act as facilitators; while this is definitely not a groundbreaking discovery, there continue to be too many classrooms where pupils are simply expected to complete worksheets. Second, Laura used the word "fun" to describe the potential science has to engage learners. Recall that this notion of "fun" was highly criticized by both Dr. Kelly and Dr. Lindsey, who warned: "…don't let a science experiment just become an art project" (Dr. Kelly, Concluding Interview, 21 May 2012). However, in this instance, the word "fun" is not referring to mindless teaching activities void of actual teaching. In this case, Laura may not have the professional vocabulary to replace "fun" with terms like engaging, relevant, or rigorous. Thus, when pre-service teachers suggest that lessons should be "fun," faculty should follow up with additional questions to distinguish what "fun" *actually* means.

Finally, it is necessary to also highlight how Laura integrated the concept of making content accessible and relevant to PK-12 pupils. This theme mirrors the intention of the Pedagogy Lab, making chemistry content relevant. Teachers must determine ways to make learning opportunities relevant to the PK-12 pupils, "So by encouraging students to ask questions, that's how you engage…I mean, it's their world out there. You can go out and touch soil. You can go out and touch things" (Laura, Concluding Interview, 10 June 2012). If university students in the initial stages of their teacher preparation coursework can make these connections, we can expect in-service teachers to have the capacity to implement these practices in the classroom as well.

Karissa shared a very interesting description of how she perceived teachers might engage first grade pupils into the world of inquiry: "When it comes to science, a first grade teacher is typically the first person to feed their inquiry about the natural world. Because this is their first formal education in the realm of science it needs to be as basic as possible" (Karissa, Assignment #1, 12 October 2012). This is one more example of how pre-service teachers have very distinct, and on occasion, incorrect beliefs regarding students and student learning prior to entering a PK-12 classroom. In particular, Karissa's preconceived notion that a first-grade classroom will be the *"first* space" for pupils to experience inquiry is of great concern. As Dewey (1916) cites, pupils, regardless of age, are innately inquisitive and are constantly interacting with their environment. Further, the notion that the teaching of science should be as "*basic as possible"* because young children may not grasp complex concepts is another misconception that can negatively impact future PK-12 pupil learning and development, if not appropriately addressed. As Laura identified, science content is not regularly

implemented in some elementary classrooms, therefore rigorous teaching must be conducted to ensure that students develop the critical science skills that support career and college readiness.

Joe's experience in the lab highlighted the benefits of having PK-12 pupils control their own learning. He explained the importance of having teachers embrace a sense of flexibility when teaching in the classroom:

> There's got to be give-and-take. Obviously you have to let the students ask the questions, so maybe those questions push you onto a new thought of how you need to present the material because you haven't taken into account how students perceive things. You have to be ready to adapt to what comes up (Joe, Group Interview, 18 May 2012).

This statement is consistent with what Laura initially emphasized: it *is* the pupil's world, it *is* their environment, and it *is* crucial to provide pupils the opportunity to inquire about the surrounding environment. Both Lab students discussed the importance of providing PK-12 pupils a space where they, too, can inspire their teachers to new levels of thinking; this requires teachers to be flexible and to adapt to events as they take shape in the classroom. As such, future educators enrolled in today's teacher preparation programs need to diligently consider how PK-12 pupils learn, as well as what motivates their actions, in order to provide a stimulating atmosphere of inquiry.

Reflections of Self as an Educator in Chemistry/Biochemistry

The notion of thinking and reflecting like a teacher became evident as university students completed the lab's course assignments over the five-week time frame. The assignments built off one another, requiring university students to create a lesson plan

that was appropriately grounded in accurate chemistry content and had clearly identified objectives and goals. This structure, working on the lesson plan week by week, appeared to be extremely beneficial. Students first identified a grade level, then focused on the necessary standards, including activities and experiments, and finally developed an appropriate assessment. During the concluding interview, Joe said he was thankful for this Pedagogy Lab opportunity when constructing lessons, particularly because he did not have a teaching background: "…this was valuable because it was getting me to critically think about how I would make a lesson, rather than if I took a methods course, then it would just be like, 'Follow this outline and give me a lesson plan'. This actually got me thinking and talking about [the lesson] rather than regurgitate information" (Joe, Concluding Group Interview, 18 May 2012).

Joe's statement is intriguing because there is a perceived belief that once university students enter teacher preparation programs, unique thinking and creativity will disappear, with more prescribed expectations becoming the norm. Let's look at the lesson plan Joe created in the Lab for third graders discovering matter and molecules (Joe, Final Lesson Plan, 11 May 2012). Joe's lesson planning skills took shape to incorporate three activities. The first activity encouraged students to use their visual skills to question how rocks, ice cubes, and liquids have similar and different properties. The second activity engaged the pupils to stand close together, modeling how molecules can be tightly packed; he then had them move around to demonstrate how molecules are fluid, as in liquid substances. The third activity was for students to create their own silly putty substance and observe the characteristics of each student's putty (Joe, Final Lesson Plan, 11 May 2012). To reiterate, Joe is a university student who has not begun his teacher

preparation coursework. Therefore, Joe is thinking like a teacher in the sense that he wants the lesson to be grounded in content, while simultaneously, engaging, active, and supported by the appropriate academic standards. This is one more example of how university students' thinking has shifted from the traditional teacher-led and teacher-directed lessons, to having pupils take ownership of their learning.

Let's look at Abbie's lesson. She, too, is an individual who is not enrolled in any other education courses, but has made a very distinct connection between the complex content and how to teach that content so that students meet the targeted academic standards. Abbie crafted a very intricate lesson design to target chemical properties and how those properties transition into a new substance (Abbie, Final Lesson Plan, 14 November 2012). Her lesson plan required students to prepare and bake cookies. At first glance, this could be one of the lesson ideas that Dr. Kelly and Dr. Lindsey warned about, being "fun" with little to no content integration. However, Abbie explicitly addressed this concern within her lesson plan: "There may be confusion with this if it is a fun cooking activity or a learning activity. Therefore, throughout the activity, I would like to stop at checkpoints to let students identify the meaning of chemical properties and change and share the chemical equation of the substance" (Abbie, Final Lesson Plan, 14 November 2012). Abbie was keenly aware that this lesson could quickly become meaningless if the requisite chemistry content was not included throughout the various steps of the experiment. Throughout the lesson plan, Abbie considered each stage of pupil learning with a teacher's frame of mind: where pupils might become confused or lose interest, and included checkpoint questions to maintain a focus on the chemical properties and the objectives of the lesson.

Faculty Reflections on the Chemistry/Biochemistry Pedagogy Lab

As identified in the beginning of this case study, Dr. Kelly and Dr. Lindsey were explicit about having students develop and present correct content knowledge, then think about how to distinguish necessary academic standards, and finally develop an appropriate lesson. Dr. Kelly and Dr. Lindsey, upon the conclusion of this Pedagogy Lab, agreed that the introduction and focus on the academic standards were critical for every developing teacher:

> Well, I think we started out the right way, by going right to the standards and making sure that everyone understands that chemistry is an underlying theme [in the standards]. Then in that first week we also talked about the role of the teacher and we used the article on PCK [Ball et al., 2008]. But its important for university students to agree, 'All right, fine, I need to know chemistry, regardless of which grade I'm teaching' (Dr. Lindsey, Concluding Instructor Interview, 21 May 2012).

It is clear that the university students in this lab embraced an awareness of the scientific academic standards and could explain how they build off each other with common chemistry expectations. But while the academic standards and a thorough knowledge of the content were emphasized in the Lab, both Dr. Kelly and Dr. Lindsey shared a realization that the Lab lacked attention to pedagogy: "I know that we came at this Lab from the content perspective. It would be interesting to ask questions right away in the beginning, like how much time do you think it's going to take to prepare a lesson? What goes into getting ready to be in the classroom?" (Dr. Kelly, Concluding Instructor Interview, 21 May 2012).

As Dr. Kelly and Dr. Lindsey continued to reflect on the success of the Lab and the required assignments, they both initially insisted the experience did not change their understanding about teaching and learning. However, as they began to analyze specific experiences during the five-week Lab, they distinguished numerous opportunities when their own teaching and learning evolved, with Dr. Kelly noting, "I think this experience increased my knowledge about how those university students coming from different backgrounds might have more problems in one topic or another topic" (Dr. Kelly, Concluding Instructor Interview, 21 May 2012). Dr. Lindsey added to this thought:

> To be honest, this was the first time we had these pre-service teachers respond and write potential discussion questions and create assessments. It was very revealing to see what these university students considered important to test. While some of the assignments were not perfect, I think the students definitely got the idea of what goes into designing a lesson (Concluding Instructor Interview, 21 May 2012).

Dr. Lindsey also shared a glimmer of disappointment in the lack of content knowledge among the Pedagogy Lab participants: "We were looking at the final grades for the class. We noticed a lot of the content was over their heads, was it because they're not coming from a science background? I mean, they're all adults, they can read" (Dr. Lindsey, Concluding Instructor Interview, 21 May 2012). This comment, insinuating that because these university students are adults and "can read," reveals the instructors' own biases and preconceived notions of teaching and learning among university students. However, from the students' perspective, Laura specifically thought the Lab focused on using advanced content:

> I definitely struggled in the beginning [of this lab]. There was so much content that I didn't know, so I was actually learned much more about the content than I expected. There were so many times when I caught myself realizing, well, I guess I never really thought of that because it was too confusing. But one thing I did notice was there was much less focus on teaching diverse student populations. Here in Urban City we need to focus more on how the content knowledge can get kids in urban districts out from where they currently are, because they don't get the content many kids get in suburban districts do (Laura, Concluding Interview, 10 June 2012).

Thus, while this chemistry/biochemistry content was very challenging, it still appeared to benefit Laura, particularly because she developed a more advanced understanding of chemical properties and where they are located in the academic standards.

Laura also identified a distinct connection between a lack of accessible content in urban schools and what she needs to do professionally in order to provide equitable learning opportunities. Laura's statement alludes to the fact that urban educators need to embrace a deep understanding of content knowledge in order to provide rigorous learning opportunities for PK-12 pupils. Dr. Kelly shared, "[Laura] came a long way. She began this lab focusing on teaching from a Dr. Seuss book to specifically citing how different levels of knowledge require different levels of teaching which led to different levels of understanding" (Concluding Instructor Interview, 21 May 2012).

Brendan, who initially did not have a clear understanding of pedagogical content knowledge, highlighted his own development:

> This was empowering. I haven't entered the School of Education yet, so I haven't taken any methods courses yet. It's been really cool to just sort of think about how to teach something in the process of learning it. So in the process of learning – or relearning the content in some ways, I'm also now thinking about how I would teach that to kids. At first it was intimidating, because we didn't have someone saying, 'Here's what you should be going through.' It was more, my thinking through it. I feel like in methods courses, they're going to tell me exactly how to do it as opposed to coming up with what makes sense to me (Brendan, Concluding Interview, 11 May 2012).

Here, Brendan first asserts his own success in simultaneously learning content, one intended goal of the Pedagogy Lab, as stated by the Chemistry/Biochemistry syllabus. Second, Brendan also shares his concern of losing creativity or a sense of individuality, or becoming trapped in the requirements designated by the faculty members teaching the methods courses.

This notion of becoming restricted by the planning framework of faculty members was echoed by Joe. Joe expressed his fear of following restrictive lesson plan templates, "If I took a methods course, then it would just be like, 'Follow this outline and give me a lesson plan'. This actually got me thinking and talking about [the lesson] rather than regurgitate information" (Joe, Concluding Group Interview, 11 May 2012). This perceived shortcoming of methods coursework, reiterated twice by students in the Lab, is notable. Somehow students have preconceived ideas of what takes place during methods courses as they shift into the professional education coursework. This point is worthy of further exploration in another study.

Reoccurring Themes

The Chemistry/Biochemistry Pedagogy Lab highlighted how university students and faculty comprehend the act of teaching and learning when content and pedagogy are in the forefront. First, coupling a call for rigorous content knowledge with learning how to teach allows university students to learn (or re-learn) the explicit content while simultaneously building an awareness of how to teach that same content to the PK-12 pupils in today's classroom. While this Pedagogy Lab was considered by some students to be daunting because it addressed chemical and physical properties and change, it was precisely this rigorous content knowledge that fostered the participants' understanding of *how* to teach chemistry *well* to future PK-12 pupils.

Second, although this lab was a short, five-week opportunity, it appeared to help students develop a greater awareness of the intricate steps necessary when planning for various learning opportunities, including how chemistry subject matter visibly develops across all science standards from elementary through secondary grade levels. Specifically, this exemplifies horizontal content knowledge, (Ball et al., 2008) or how subject matter develops and builds from early grade levels through high school. Additionally, these university students did make the critical connection between the lives of PK-12 pupils and how teaching should directly relate to these particular young people. For university students, not yet admitted into an education program, this is an important realization to experience early in their professional preparation.

Finally, faculty members also had the potential to reflect on and discover new ways of teaching alongside their university students. It was exhilarating to see and hear how Dr. Kelly and Dr. Lindsey's thinking about teaching and learning evolved, and how

this evolution compelled them to integrate complex content with excellent pedagogical practice. Many of these experiences in the Chemistry/Biochemistry Lab mirror what Dr. White and Professor Schiller identified upon the conclusion of the Political Science Pedagogy Lab, in particular the emphasis on cross-collaboration. Once again, this suggests the importance of establishing a collaborative bridge between content classes in the College of Letters and Science and methods courses in the School of Education, both at Urban University and at other institutions in higher education.

Case #3: An Environmental Science Pedagogy Lab

The Environmental Science Pedagogy Lab was offered as a five-week summer course in the 2012 school year at Urban University and was facilitated by two female instructors, Instructor Holly and Instructor Hawthorn. In total, four students enrolled in the course, which was taught fully online through the University's Desire 2 Learn (D2L) course management system. The university students are listed in Table 4, along with additional information indicating gender, age, designated academic program, and semester grade point average upon conclusion of the lab.

This Environmental Science Lab was unique for a variety of reasons. One distinct factor was the demographic makeup of the university students who enrolled and engaged in this Lab (Table 4). Two of the participants, Frida and Melanie, were already in-service, experienced teachers, as well as graduate students in the Early Childhood Education (ECE) program. These two graduate students were completing this Pedagogy Lab as a final credit requirement to obtain a Master of Arts degree in Curriculum and Instruction at Urban University. Mara was a post-baccalaureate education student, or someone who had previously completed an undergraduate degree, and returned to Urban University to

earn a Middle Childhood-Early Adolescent (MCEA) teaching certification for grades 1- 8. The fourth university student, Laura, had previously participated in the Chemistry/Biochemistry Pedagogy Lab during the spring semester. In addition, out of the four university students, Laura was the only one who was considered a traditional university student[7].

University Student Demographics of the Environmental Science Lab

Name	*Gender*	*Age*	*Academic Program*	*Semester Grade Point Average*
Mara	F	31	Post Baccalaureate Student; Middle Childhood Early Adolescence Education; Science Minor	3.5/4.0
Laura	F	22	Education MCEA Natural Science and English/Language Arts Minors	3.6/4.0
Melanie	F	31	In-service Teacher – 1st Grade Master of Arts – Early Childhood Education	N/A
Frida	F	39	In-Service Bilingual Teacher – 3rd Grade Master of Arts – Early Childhood Education	N/A

Table 4

Another unique factor of this Pedagogy Lab was the non-traditional background of both Instructor Holly and Instructor Hawthorn. Unlike the prior pedagogy labs, which were taught by Urban University faculty, they were both doctoral students, concurrently teaching in PK-12 classrooms. Instructor Holly was teaching in an urban and diverse middle/high school with an emphasis on the sciences. Instructor Holly described her own middle/high school teaching situation as such:

> My students are at risk, predominantly Hispanic. Almost all of them are English-Language learners. Their parents speak Spanish, primarily, if not only. There is a presence of poverty; I think we're probably 95% free and reduced lunch. Oh and

[7] The designation, 'traditional', indicates that Laura had enrolled in Urban University immediately after high school, continued to be a full time undergraduate student, and follows the established track of completing a four-year bachelor's degree.

> there's the contingence of non-legal. It really puts in some interesting twists because I think the population that I serve kind of lives in their own subcultures who realizes that society is not welcoming them (Instructor Holly, Concluding Interview, 25 July 2012).

It is also significant to note that Instructor Holly consistently developed and implemented this school and its mission due to her unwavering commitment to provide equitable opportunities for all urban PK-12 pupils: "My students are very aware of the world that is around them and the concept of oppression and that they're not – they don't fit into mainstream society. And so then my school ties in a lot of social justice issues" (Instructor Holly, Concluding Interview, 25 July 2012). As such, these professional experiences made Instructor Holly a fitting instructor to facilitate this lab, with her knowledge of pedagogy, environmental science content, and culturally responsive teaching.

Instructor Hawthorn was also a high school science teacher who worked in a larger suburban school district with a "homogenous population that typically does what the adult tells you to do" (Instructor Hawthorn, Concluding Interview, 17 July 2012). Instructor Hawthorn instructed both advanced placement pupils and pupils in the general and remedial science education track. These experiences teaching a diverse group of high school pupils made Instructor Hawthorn an appropriate individual to teach this Pedagogy Lab. Furthermore, both instructors embraced the opportunity to instruct a university-level course for future and developing urban educators, with a central focus on environmental science.

Due to the obvious passion from both Instructor Holly and Instructor Hawthorn, this Pedagogy Lab emphasized real-life classroom application in the urban setting: "We imagined that the [lab] should have an urban focus, so we touched on critical populations of people, pedagogy, and social justice because we imagined that it would take more of an urban spin to it" (Instructor Holly, Concluding Interview, 25 July 2012). As such, Instructors Holly and Hawthorn incorporated several opportunities for the university students to engage in critical conversations around equity, social justice, and inquiry-based learning for diverse pupils:

> We kind of defined it as really emphasizing how to incorporate inquiry into the scientific teaching. So it was environmental science, but with a heavy emphasis on inquiry; in particular, different ways to approach it and also assess science. So kind of taking a different design model" (Instructor Holly, Concluding Interview, 25 July 2012).

This notion was exemplified by the assignments and various discussion topics, which encouraged the university students to explore various avenues of learning in the scope of environmental science with the intersection of pedagogy, content, social justice teaching, and service learning. The following Entry Vignette captures the ongoing discourse that took place throughout the five weeks of this Pedagogy Lab.

Instructor Holly and Instructor Hawthorn posted the initial discussion questions of, "Tell us a little bit about yourself. What are you passionate about? What is your background in environmental education? What are your expectations for the course? What do you hope to gain from this course?" The responses were submitted almost immediately at 10:49pm when Mara submits her post, "Hi! My name is Mara and I'm

currently enrolled as a post-bac student in the elementary education program as well as a graduate student in the School of Education. I hope to learn different ways to incorporate environmental science into my future teaching!"

The next student, Laura, shares her initial greeting, "Good afternoon…or is it night already? Where has my Sunday gone? I have been attending Urban University for 4 years. I love being outdoors and being active outside. I hope to have a stronger understanding of how social justice can be brought into the classroom and what ways I may foster social justice. I also hope to gain some insight on how I can connect environmental education, environmental justice, etc…with primary subjects such as English, math, and reading so that it may find its way into my classroom on a regular basis."

Melanie submits her post of, "Hi all, I am currently attending the university for my master's in education. My expectations for this course are to become aware of how to educate students on our environment and learn ideas on how to enhance my life science lessons in early childhood education."

Finally, the fourth student, Frida, is a latecomer to the online course. Her introduction begins, "My name is Frida. I am currently working on my Education Masters Degree. I am a 3rd grade bilingual teacher and enjoy teaching science and mathematics especially earth and space." Without prompting from either of the instructors, dialogue began among the students on topics of interests, academic experience, future professional goals, and what else they hope to achieve during this one-credit course.

Inside an Environmental Science Pedagogy Lab

As indicated in the introduction of this case study, teaching and classroom experience was rather extensive and varied among the four university students. Both Frida and Melanie were urban classroom teachers, with close to ten years of experience in kindergarten through third grade. Mara and Laura discovered that they were situated in the same professional stage of their teacher preparation at Urban University; both had close to one hundred accumulated hours of general classroom observations, small group instruction, and a broad awareness of the day-to-day procedures of various urban teachers.

Immediately in the first online session, a sense of camaraderie developed between the four university students. Frida and Melanie both expressed surprise that they needed to enroll in one additional credit to complete their graduate degree. Melanie said to Frida, "Surprise summer class for you too??? Well! At least this is a good one!" (Online Discussion Board: Module I, 10 June 2012). Mara stated, "I'm currently enrolled as a post-bac[8] MCEA student…and this is a change of career for me. One of my favorite subjects is science and I consider myself a lifelong learner!" (Online Discussion Board: Module I, 9 June 2012), to which Laura responded, "Mara…We are on the same track! Pretty sweet! I am also in the MCEA education program" (Online Discussion Board: Module I, 9 June 2012). Hence, the relationships observed among the university students developed in a way that could be reflective of how Instructor Holly and Hawthorn constructed and initiated the Environmental Science Pedagogy Lab. The instructors believed in encouraging the university students to be consumers and producers of their own knowledge, in order to develop a greater understanding of what it meant to be an

[8] Post-bac is an abbreviated term for post-baccalaureate.

educator, and more importantly, an excellent educator (Instructor Hawthorn, Concluding Interview, 17 July 2012).

Each of the Lab's modules, or weekly sessions, was developed in a way that would allow university students to continuously interact with one another and examine the notion of pedagogical content knowledge within the realm of urban teachers, urban communities, and environmental science. Beginning with the first required module, Module I explored the university students' understanding of pedagogical content knowledge, and what that may look like in and outside of the traditional PK-12 classroom. Instructors Holly and Hawthorn posted three reflective questions that they encouraged university students to respond to: 1.) Share how or what helped form the way they thought about the environment; 2.) What field trips would be appropriate for future students; and 3.) What environmental justice projects have taken place in the local community. These questions provided the university students with an opportunity to share and highlight their own experiences within environmental science content knowledge and pedagogical knowledge. Due to the multifaceted backgrounds of the university students, a range of experiences was shared through the online discussion board.

Laura started the discussion, stating that from an early age she was "blessed with a clean atmosphere with many green areas to explore," and that because of this, "I am more thoughtful and cognizant of keeping the environment clean so I and others can enjoy its beauty" (Online Discussion Board, 10 June 2012). Mara, too, shared an event from her childhood that helped shape her curiosity for the environment. "I remember a field trip to the Urban Nature Center when I was in probably 4th or 5th grade that stuck

with me. To this day, I still frequent the Center; it's calming to be in such a tranquil place to be one with nature and the environment that surrounds it" (Mara, Online Discussion Board, 10 June 2012). Melanie identified her awareness of environmental sustainability through a particular activity in her undergraduate program. "I remember going to Urban City cleanups and hearing them talk about why it was so important to help out, if only for 1 day" (Melanie, Online Discussion Board, 11 June 2012). This introductory module appeared to be a tool to encourage the sharing of the backgrounds and prior knowledge of the enrolled university students.

Due to the short-term nature of the Lab, it can be assumed that Instructors Holly and Hawthorn intended to immediately set the tone of the lab and engage learning. Furthermore, these introductory questions also appeared to present how both in-service and pre-service teachers commonly reflect on their identities as students, and perhaps how those experiences have influenced their current teaching practice. In addition to the activation of the university students' prior knowledge, Instructor Hawthorn shared a Power Point presentation of six slides with voice-overs to explicitly define these common yet abstract concepts of pedagogical knowledge, pedagogical content knowledge, and inquiry education. This amalgam of terms became the driving force for the duration of the lab as Instructor Hawthorn emphasized, "…inquiry education enhances PCK in the science classroom" (Instructor Hawthorn, Course Lecture, 10 June 2012). The subsequent Modules: II, III, IV, and V elaborated on the awareness of sustainability, the discovery and integration of resources available in urban communities, and the construction of an environmental science lesson plan. These core areas became the central focus of this Lab and the following themes of: *Making content relevant; inquiry-*

based teaching; and *reflecting as an educator* emerged from the various modules, discussion points, submitted assignments, and concluding interviews.

Making Environmental Science Content Relevant

In the environment of teacher preparation, this skill of making content relevant must be presented in a way that is not only applicable to the university students, but also able to be translated to the future learning and development of the PK-12 pupils. During the five weeks of this Environmental Science Pedagogy Lab, the notion of making content relevant emerged as a significant theme among the instructors and the university participants, with respect to teacher development as well as future PK-12 pupil learning.

As identified previously, the Environmental Science Pedagogy Lab was very unique when compared to the other case studies for a number of reasons. When analyzing the theme of making content relevant, the extensive and current PK-12 teaching experiences separated Instructors Holly and Hawthorn from the other faculty members who facilitated the previous pedagogy labs. Thus, it is significant to include how the instructors' PK-12 teaching experiences worked in tandem with the development of new knowledge among the university participants and how these experiences impacted the task of making content relevant for PK-12 pupil learning. Both Instructor Holly and Instructor Hawthorn embodied an acute awareness of how and why making content relevant was pivotal to the university students, with the intention to successfully engage their future PK-12 pupils:

> I would say that [Instructor Holly] and I tried to make the activities that the students were doing to be practical to their teaching experience; to kind of fit together big pictures. So for example, they did a field trip mid-way through where

> they visited some environmental locations. Somewhere that they could take their students on a field trip to. Then, they had to look at it from a teacher perspective in terms of how can this fit into curriculum and what would I teach before it and what would I teach after it (Instructor Hawthorn, Concluding Interview 17 July 2012).

As in-service teachers and doctoral students, both Instructor Holly and Instructor Hawthorn indicated that for content and learning to be relevant for PK-12 pupils, the university students needed to actively participate in the learning experiences:

> I love the idea of having [the university students] experience what they're learning about. So they're learning about inquiry, have them experience it. Just structure it so that it's a worthwhile experience. I know it's worthwhile for them because of what they write and how they met the project objectives in the lesson plans (Instructor Hawthorn, Concluding Interview, 17 July 2012).

Since the university students who made up this Pedagogy Lab were both in-service and pre-service teachers, Instructor Holly and Instructor Hawthorn provided various opportunities to encourage exploration of how to make content relevant for both university students and their future PK-12 pupils.

One of the initial assignments of this Pedagogy Lab required the university students to create a community resource sheet, which listed community resources or assets in the local urban environment. The direct purpose of this assignment was to "expose environmental issues and/or issues of equity in different communities" (Environmental Science Syllabus, June 2012). This initial layer of the assignment became an important tool for the university students to bridge environmental science

content with local urban assets, making the content more meaningful and relevant not only for future PK-12 pupils, but also for the university students who participated in this Pedagogy Lab.

Melanie, one of the in-service teachers, used Microsoft Excel to create her asset form and took this assignment one step further by documenting the exact distance each community resource location was from the school she was employed with. Melanie's community asset form included information for a local park, Urban City's ecology center, an insect program at another local park, and Urban City's recycling center. From these resources, she compiled various activities for her third grade pupils, such as playing various games, hiking, community cleanups, learning about insects, and recycling. Instructor Holly shared thorough feedback, further encouraging what Melanie could do to easily get pupils to Urban City's ecology center:

> I am glad you included the recycling center, you were the first to explore that and students usually are amazed at how much gets recycled when I take them there. One thing to note, Urban City's Ecology Center includes transportation with the NEEP fee, so the $4000 covers 24 trips and bus. If you are interested, I could put you in touch with their lead educator there (Instructor Holly, Community Assets Feedback, 2 July 2012).

These insights further underlined Instructor Holly's ability to bridge content and real-life application, providing more detailed information to advance Melanie's professional practice, and in turn, the future learning of Melanie's third-grade pupils.

Instructor Holly's knowledge base was due to her own experiences as an urban classroom teacher and her awareness of how to successfully access local environmental

resources. Therefore, the content became relevant to Melanie, since the assignment encouraged her to actively explore the local urban community surrounding her school. Melanie shared her reflections and appeared to internalize a greater understanding of service-learning projects and how they could impact the local environment:

> From the field trip assignment, I actually took my son to the [nature center], where he was so amazed by the trails that go up those big hills. I have always shared the responsibility of planning field trips to take our learning out of the classroom, but never thought of the chance to do good for others too. When I read a post in this discussion about service learning, I couldn't stop thinking about what my next field trip would be. Not only would we have the chance to explore and learn outside of the class, but we could also accomplish an act of volunteering. I like the idea of pulling weeds, harvesting seeds, or collecting trash to make our city a better place. A service-learning event at [the nature center] would be our way of giving back to the area's land as a "thank you" for letting us play there (Melanie, Module IV Discussion Board, 17 June 2012).

In that passage, Melanie appears to have embraced a rich awareness of service learning, while simultaneously reflecting on her own teaching practice and learning how to assure that her pupils received a unique learning experience.

Similarly, Mara created her community asset form by including information on Urban City's State Forest, an Audubon center, a hydroponics garden, and Urban City's horticultural center. Once again, Instructor Holly provided rich feedback with additional facts about the State Forest:

> Thank you for this, it covered a lot of great assets in Urban City. I really like the State Forest and think it is an underused asset in the city. Did you know in the 40s it was taken over by the army and used to house German-Americans? Lots to talk about! I also look forward to hearing about your experiences at the hydroponics garden (Instructor Holly, Community Asset Feedback, 18 June 2012).

Even from this short response, Instructor Holly's passion and enthusiasm is apparent as she shares additional knowledge of the local environmental resources to further encourage Mara's exploration of Urban City.

Over the five weeks of this lab, something very unique took place. Instructor Holly and Instructor Hawthorn blended the interests of the university students with the discovery of inquiry and action research, with respect to future PK-12 pupil learning. First, the instructors asked the university students to physically explore areas they found interesting, rather than simply assigning locations or looking up information on the internet. Then, the university students were encouraged to use these resources as concrete tools to develop opportunities for PK-12 student learning. Frida reflects on her own experiences for this particular assignment:

> It saddens me when teachers dislike going on field trips. It is my opinion that field trips enhance learning by providing students multisensory experiences or opportunity to interact with the world around them and each other in a safe and secure manner. While I did not expect to go the zoo as an assignment, it was a great experience since it was the first time I visited the zoo without children. There were no worries about where is Pepito? Did everyone get a lunch? How much time do we have? On the other hand I have time to sit, relax and enjoy

> everything the zoo has to offer and also think about how I could use this in future [lessons] (Frida, Module IV Discussion Board, 9 July 2012).

Frida's comment about exploring a local and familiar community resource presents her own new experience in rediscovering the zoo without some of the distractions that take often take place when traveling with a group of pupils or children. Finally, during the concluding interview, Frida further elaborated on the notion of making content relevant to pupils:

> You have to think about what you know about the students, what you, as the teacher, know about the students and try to figure out what you teach and how that will relate to them. What is in their life and their culture that can be used to help them understand this concept (Frida, Concluding Interview, 29 July 2012).

From this statement, Frida showed her concern about how teachers will make content relevant, especially in regards to integrating it with the cultures and lived experiences of PK-12 pupils.

Rather than requiring the university students to simply read journal articles and watch Power Point presentations about environmental science content, Instructor Holly was aware that the learning experience had to be applicable or related to the university participants. Instructor Holly believed that the university students' exploration precipitated an increase in new awareness of social justice and environmental justice teaching. "Because we also did a lot of heavy work in the actually community, I think that a lot of [the university students] expressed that it was the first time that they went somewhere with a different lens of service learning and imagined their [pupils] exploring and helping" (Instructor Holly, Concluding Interview, 25 July 2012). With this unique

triad of instructor engagement, university student learning, and the consideration for PK-12 pupil development, the theme of making content relevant developed further than just hypothesizing what should or could be done in a classroom. The university students appeared to internalize these new experiences to improve their professional practice.

Inquiry-Based Teaching and Learning in Environmental Science

The theme of inquiry took shape both naturally and purposefully as Instructor Holly and Instructor Hawthorn wove inquiry education into this Environmental Science Pedagogy Lab. An interesting juxtaposition took place between the university students and their experiences in the classroom. As the Lab engaged both in-service and pre-service teachers, contrasting perspectives emerged, with notions of realistic versus idealistic expectations considered attainable for today's educator. As common throughout this Lab, the conversation and dialogue on inquiry education was prompted by discussion questions posted by Instructor Holly and Instructor Hawthorn for Module II: "What thoughts come to mind when you hear the term "inquiry?" and "Does inquiry teaching align with what you do/plan to do in the classroom? Explain" (Module II, Discussion Questions, June 2012).

Laura, a pre-service teacher, was the first to respond on the online discussion board with her understanding of inquiry and how young children are naturally situated within an environment of inquiry, "Inquiry is driven by curiosity. We have heard that children are naturally curious. I call my 5-year-old neighbor the 'question master' because he will, without fail, ask at least 3 questions a conversation" (Laura, Online Discussion Board, 18 June 2012). This statement suggests that Laura embraced how PK-12 pupils, regardless of age or experience, are inherently inquisitive and that an inquiry-

based classroom could be the most natural method to teach PK-12 pupils. Going even further of her support and enthusiasm for inquiry teaching, Laura emphasized the perception of confidence and security in oneself through well-developed questioning skills, "If a [pupil] has the capability of having confidence in discovering what he doesn't know he can work to solve any problem he/she may experience in the future" (Laura, Online Discussion Board, 18 June 2012). This last statement, in particular, established Laura's bold belief that the future success of PK-12 pupils is somewhat dependent on inquiry-based learning opportunities. Laura's choice of wording is particularly interesting as she bridges these notions of confidence, discovery, and problem solving, and suggests that these factors are what pupils need for future career and college readiness.

Mara, another pre-service teacher, was the next to post her response to Instructor Holly's and Instructor Hawthorn's Module II questions. Her response appears to weave together an understanding of inquiry along with a rather personal self-reflection:

> Honestly, the first thought that came to my mind when presented this question was 'inquiring minds want to know.' For me, it simply means curiosity; being curious about what it is that is sparking my interest; wanting to know what is happening with a given phenomenon. I think students perceive inquiry as a means to finding out what they want to know about a given subject, but that they might be nervous about actually using inquiry in their learning. I try to put myself in the shoes of the kids in the classroom, asking their other classmates questions. I think I would've been nervous; nervous to ask a question that someone else may have thought of as dumb (Mara, Online Discussion Board, 17 June 2012).

Mara's conception was interesting, as she expressed a concern for those learners who might experience discomfort or apprehension while participating in an inquiry-based classroom. In this instance, it seemed that perhaps Mara was projecting her own concerns or trepidation about inquiry-based teaching and learning, as she thought about the scenario with the mindset of a PK-12 pupil or in the "shoes of other kids in the classroom," or asking questions and being perceived as "dumb." This response demonstrates how university students, particularly pre-service teachers, may understand and construct awareness between some of their personal struggles experienced as a PK-12 pupils and how particular learning opportunities could better benefit future PK-12 pupils.

However, immediately following this statement, Mara had an evolution in her thinking. Her pattern of thought shifted towards the orientation of an educator as she shared a somewhat contradicting comment:

> On the other side are the brave kids; smart kids that are asking relevant questions because of the way they were taught; they are stimulated about learning, and it's so cool to watch! That's because of inquiry; having students lead the discussions, having the students be investigators, scientists (Mara, Online Discussion Board, 17 June 2012).

What was especially intriguing in this response is that it also echoed what Laura previously suggested. This notion that a classroom with an emphasis on inquiry-based learning provides students the opportunity to become "brave…smart kids asking relevant questions," (Mara, Online Discussion Board, 17 June 2012) and who have the "confidence in discovering what he doesn't know…to solve any problem he/she may

experience in the future" (Laura, Online Discussion Board, 18 June 2012). Both are powerful perceptions of the potential an inquiry-based classroom has in empowering PK-12 pupils to become critical, confident thinkers.

Instructor Holly also supported inquiry-based methods through her personal experiences in teaching, and the incredible gains her urban pupils experienced:

> I absolutely think that inquiry is the reason I don't have behavior and attitude problems in the urban classroom. Particularly when paired with community involvement. I deal with a lot of two language speakers who are brilliant, but who feel so defeated in front of a textbook with little motivation to push forward. Once they find something they want to learn about, they don't even realize they are reading the same amount of material! Where it gets really tricky is that students are not tested on inquiry skills, especially our DIFI[9] districts like Urban City Public Schools. So, to take time away from reading (even to get them interested in reading), is a tough sell to a lot of administrators whose primary goal is to improve test scores. How can we make this shift? (Instructor Holly, Online Discussion Board, 18 June 2012).

The final question Instructor Holly included with her online comment spurred a rather interesting conversation in regards to inquiry teaching. As a result, the tone of this discussion board shifted drastically as it became a space for Melanie and Frida to present the reality of their teaching situations. This reality was encompassed by external demands and pressures, which, in turn, reduced the frequency of inquiry teaching and the ability to facilitate general science education. Frida wrote candidly, "While I enjoy an inquiry-based classroom, due to time constraints, it is very hard to conduct any inquiry in

[9] DIFI is the acronym for District Identified for Improvement

the classroom. Currently I am allowed 30-minute time slots twice a week for science. Therefore I have to rely very conformational or structured inquiry" (Frida Online Discussion Board, 27 June 2012).

Melanie, another in-service teacher, also provided a rather bleak outlook:

> I also struggle with trying to find time to incorporate inquiry into science. With such high demands for reading, writing, and math, (and now interventions), where do we have time to let the students guide the learning with their curiosity? I heard rumor next year that [Urban City Public School] teachers are going to have to do interventions with math too. Yikes!! My principal suggested that we get some science work sheets for the rest of the kids to "do" while we worked with the bottom 20% for interventions. SCARY thought (Melanie, Online Discussion Board, 27 June 2012).

For Frida and Melanie, both experienced educators, the notion of inquiry teaching was a challenge, not because of implementation and planning, but because of the stringent requirements put upon them from administration and/or school policy.

Instructor Hawthorn responded to this discussion thread with a hopeful outlook on the positive impact the newly drafted science standards, the Next Generation Science Standards (NGSS, 2013), could have to encourage a richer teaching of the sciences and inquiry education:

> The Next Generation Science Standards will be coming out next year and will outline what is expected in science education at a national level - much like the Common Core standards for Math and English. Most states are adopting NGSS,

> which will allow for states to pool their resources for the creation of a test (Instructor Hawthorn, Online Discussion Board, 28 June 2012).

However, this statement appeared to simultaneously reinforce the belief that schools will only integrate and/or reintegrate content areas if they are explicitly attached to high-stakes assessment. Otherwise, if high-stakes assessments do not drive content areas, a serious concern arises that inquiry-based learning will continue to lack adequate public and administrative support. "The in-service teachers said they don't know how practical [inquiry-based learning] was, they said, because science was treated as an elective and the materials for science are in a box in the back of the room, but no one really gets to it" (Instructor Hawthorn, Concluding Interview, 17 July 2012).

The demands of these high-stakes tests appeared to shape, or perhaps more appropriately, restrict what takes place in Frida and Melanie's elementary classrooms. Just as Frida and Melanie, who are both in-service teachers, recognized, there is a lack of time and a lack of emphasis to implement inquiry lessons—even any science lessons—as the pressures of achieving and surpassing the expectations of high-stakes standardized testing continue to rise.

During this particular online discussion between Instructor Hawthorn, Frida, and Melanie, Mara passionately wrote:

> It's so unfortunate that [Urban City Public School District] has such a hard time incorporating science learning into their classrooms. I understand the push for reading, writing, and testing but without science, we have nothing! Everything around us involves something with regard to science, and I think its mandatory for us as future teachers to be able to incorporate science learning into other core

> subject areas. Integration of various subject matters is how to get this done, and will be how I teach! (Mara, Online Discussion Board, 28 June 2012).

It is apparent that Mara embraced a powerful awareness of the injustice PK-12 pupils face when limited to instruction exclusively based on high-stakes test preparation. The solution she considered beneficial for PK-12 pupils was an emphasis on cross-curricular education, with particular attention to the science content area. From the understanding that Mara shared through her online response, an excellent educator has the ability to integrate content areas in order to meet the high-stakes demands, while, perhaps even more importantly, providing PK-12 pupils with diverse learning opportunities. Mara believed that this seamless integration of content areas is a requisite skill and should be in the forefront of every teacher's practice.

Instructor Holly very much agreed with Mara's beliefs, providing additional prompting questions:

> Great discussion points. I agree, that Urban City Public Schools is really missing out on a great opportunity to get students interested in math and English through science, rather than treating it like some other foreign topic. When I worked for the Environmental Center, I would meet with principals of schools to encourage them to participate in our programs. One actually referred to science as a "special" that was not really taught anymore. Like art and music. I left feeling so sad knowing that many of the subjects the students were interested in were removed so they could focus on the subjects they are failing at. Who enjoys doing things we are bad at? It sure makes it tough to stay motivated. I often hear a lot of resistance of integrating environmental and sustainability topics into anything but

> science courses. Do you think it is easier for elementary school teachers to integrate these topics? (Instructor Holly, Online Discussion Board, 28 June 2012).

These experiences provided a personal glimpse into Instructor Holly's professional practice, which further asserted the aforementioned injustice urban PK-12 pupils face in many of today's urban public schools. Worse yet, the devaluation of sciences and other academic areas, such as art and music, appears to be more commonplace then a well-rounded learning experience.

Instructor Holly's line of questioning engaged, and perhaps incensed, Mara to present a negative assumption of classroom teacher inadequacies:

> I truly think that we can integrate environmental science topics into several other curricular areas, I just think some teachers are (I hate to say this) lazy in incorporating multiple curricular areas at once. It does take more planning, but once you have the lessons you want to teach, you teach them and tweak them in the future if needed. I also have heard science referred to as a "special" and I think it's horrible. Why was it that when I was a young student, I was able to be taught EVERY subject, AND had time for art, music, and gym, EVERY DAY! Now it's unheard of...it's just wrong. We need to come together as future educators to make sure these very important subjects are not lost :((Mara, Online Discussion Board, 28 June 2012).

Mara's commentary caught the attention of Frida, an in-service teacher, who responded to the discussion thread and pointed out two very significant points, "It is not just that [teachers] are lazy, some teachers unfortunately lack the content knowledge necessary to teach science and the ones that have the knowledge need help incorporating

it into other areas" (Frida, Online Discussion Board, 29 June 2012). Frida's response to Mara was insightful, as it pointed out the particular dilemma today's educator faces, regardless of what grade level they might be teaching. Educators do need both pedagogy and content in order to meet the challenging and rigorous demands of teaching.

Instructor Hawthorn reiterated a similar concern for the ongoing preparation and development of today's PK-12 educator:

> There are few teachers out there, I think, who truly know how to embrace good pedagogy. I think it's easy, especially when teachers are judged on state assessments to go the content route, and I think it's, you know, it's easy to lecture and come up with a lab that the kids just have to follow. What should be more valued are the teachers thinking outside the box, trying something new (Instructor Hawthorn, Concluding Interview, 17 July 2012).

Once again, Instructor Hawthorn reiterated the concern of state assessments and the impact those have on the planning and lesson implementation that takes place in PK-12 classrooms. The greater concern identified here is the depreciation of creativity by tying teachers to assessments. As Instructor Hawthorn suggested, some teachers are purely providing pupils with labs or other learning experiences they "just have to follow."

The preceding dialogue is especially critical to highlight and recognize, as there appears to be a disconnect between the information presented in teacher preparation course work and the reality and limitations that exist in many PK-12 classrooms. Both of the in-service teachers, Frida and Melanie, acknowledged that time is severely restricted in their school day, with few opportunities to implement genuine inquiry-based learning opportunities within the scope of teaching science. Mara, in contrast, asserted that

"teachers are lazy," and that, as educators, "we need to make sure these very important subjects are not lost" (Mara, Online Discussion Board, 29 June 2012). Mara's obvious passion and concern for urban pupil learning is inspiring, as she emphasized that teachers should work harder to integrate content areas with inquiry and assure that they are not forgotten in light of high-stakes testing demands.

Reflections of Self as an Educator in Environmental Science

Due to the interactive nature of this Pedagogy Lab, along with the diverse professional backgrounds of the university students, an interesting confluence of ongoing professional reflection emerged during the five-week course. Throughout the two previous themes of *making content relevant* and *inquiry education,* the university students presented their experiences of reflecting on their teaching practice, and in some instances, showed awareness about how to improve and/or evolve their pedagogy. For the pre-service teachers, 'putting on the teacher hat' is both exciting and perhaps a bit more challenging, as they have to first imagine themselves as educators in a fictional classroom, and then imagine how their teaching methods may have an impact on the fictitious pupils. Both Mara and Laura had had some classroom experience, yet had not taught independently nor had the opportunity to foster relationships with an entire classroom of pupils.

On the opposite side of the spectrum, the in-service teachers had the opportunity to reflect on their own professional practice from the recently concluded school year and indicate how they might alter their teaching to best suit their future pupils. It proved interesting to observe the different perspectives and areas of reflection that each of these

four university students shared across the various discussion questions and upon the conclusion of the Lab.

Mara, a pre-service teacher who so passionately demanded equitable learning opportunities in the previous theme of *inquiry*, presented a vivid description of how she intended to facilitate her future classroom:

> Personally, I had very few classes when I was in grade school/middle/high in which the teachers taught using inquiry, I wish I had. To be taught using this method, I think, is so useful for the students to think outside the box. It forces the students to be completely engaged in their learning, rather than sitting at a desk, in their rows, listening to the teacher talk. Again, I look back at my learning, and quite frankly it was boring! No wonder kids don't like school! When I am a teacher, I am going to strive for inquiry based teaching, because I think it allows the student to actually learn! Learning about this inquiry method is eye opening, having students lead discussions at such a young age is a refreshing thought. It shows you that they are learning way more than what can be learned in a book. Being actively engaged and getting them so involved in their learning is awesome (Mara, Environmental Science Online Posting, 17 June 2012).

Mara compared her own schooling experiences to what she hopes to provide for future pupils. In her awareness of teaching practice, inquiry-based education has the capacity to significantly improve pupil learning, especially when compared to the traditional classroom of rows and teacher-led instruction.

While it is exciting to observe this level of enthusiasm through the eyes and mind of Mara's pre-service teacher attitude, she does not include the additional information

necessary to specify *how* she intends to facilitate this inquiry-based practice with her future pupils. It is important that pre-service teachers also have the knowledge base of the requisite steps to use when fostering this type of classroom teaching practice. Inquiry-based learning lends itself to a complex learning environment; therefore the teacher needs to be well versed in the *how,* along with the *why*. For example, both in-service teachers, Frida and Melanie, reflected on their teaching practices and identified specific areas in need of improvement. Frida shared a realization for implementing environmental science practices in conjunction with service learning and inquiry with young pupils:

> Originally, I thought if we walk around the school and pick up the garbage, that would be enough. I never really thought about going the extra mile in having the student research a problem; having to figure out ways to fix the problem through [service learning]. This [lab] gave me something to think about. I never thought about any of this. I never thought about service learning, I just thought about community service. In realizing that it's more than just going and doing something. They [PK-12 pupils] need to know *why* they're doing something (Frida, Concluding Interview, 29 July 2012).

From a one credit, five-week Lab, the awareness and professional reflection Frida presented signifies the potential this Pedagogy Lab had on her ongoing development as an in-service teacher. For example, Frida's initial perception indicated that the act of assigning a cleanup or a general community service project would be enough for pupils. However, upon reflection, she realized she had never thought about either action research or service learning as a better method of simultaneously engaging PK-12 pupil interests,

meeting the curriculum requirements, and working to help the community. Through action research or service learning, pupils can explore the concerns they have regarding their community and determine methods to alleviate those issues, instead of having a teacher simply delegate a task.

Melanie also reflected on her current teaching practice, along with a desire for additional professional development to improve her teaching of inquiry:

> I admit I need more help with doing inquiry in the classroom. Only in the past couple of years have I started to plan for it. I am gaining the confidence as a teacher to allow the students to question the things I put in front of them (Melanie, Online Discussion Board, 20 June 2012).

This initial segment of Melanie's reflection illustrates a perceived uncertainty to be able to successfully implement a method of inquiry. I suggest 'perceived' because immediately following this statement, Melanie draws a rich example of a unit she designed on the topic of magnets and the impact this self-constructed unit had on pupil learning:

> I prepared one of my science units on magnets a bit differently then usual. Instead of reading from the text, looking at the pictures, and doing the investigations [the textbook] planned for us, I created a science journal. It was mostly empty with a couple of headings on the pages that were the vocabulary words for the lessons. Students were able to explore the magnets to determine poles, what poles did, what were they used for and anything else that came to their minds about poles. Then the students had to pair with someone and think about what they learned. They could either write or draw and label the things

> they did in class, in their journal on the pole page. Then they had to share with another person what they explored in class for the day. I did this with magnetic force and strength of magnets, magnets around the class and home and we learned a ton of things about magnets. The students also had many unanswered questions, like where do magnets come from? Do magnets ever lose their strength? What is the strongest magnet? And so on. They couldn't stop asking me about magnets! The students eventually asked other teachers and then made their way to our library where they looked for magnet books. They even asked their families to help them on the computer. I was excited to know that I was doing inquiry and scared to learn how I could assess them to make sure they were learning (Melanie, Online Discussion Board, 20 June 2012).

In this unit description, Melanie confidently identified the steps she took to include inquiry in her science classroom; thus, it appears there may be a discrepancy between a teacher's confidence level and the actual planning and teaching that occurs.

The third element of a teacher's success is also the assessments, which was also part of Melanie's trepidation. This appeared to be a justifiable concern:

> I examined their journals and I gave them the completely unrelated unit test from the curriculum. Most were proficient on the test, but some were not. I found out that planning for inquiry would be harder than just planning for direct instruction. One of my goals for last year was to create more units to study using inquiry. That's a work in progress (Melanie, Online Discussion Board, 20 June 2012).

While Melanie is aware of her success, she did indicate that by implementing an

unrelated assessment, some pupils did not achieve a level of proficiency, and that the planning for these units is more difficult. Thus, it is necessary to extract two points from Melanie's' online entry. First, that teachers do need to take necessary yet calculated risks to engage PK-12 pupil learning and *reflect* and *discuss* the outcomes. Precisely through this Lab's discussion question, Melanie had the opportunity to identify a new way of teaching a topic on magnets, while also honestly reflecting on and challenging her own professional practice, suggesting that it is "a work in progress."

Second, it is also important to recognize that as exciting as it is to implement new theories, strategies, and methods in the PK-12 classroom, educators do need to have the appropriate understanding of the layers of these teaching practices for PK-12 pupils to attain ultimate success. Conceivably, this indicates the type of professional development teachers should be offered, rather than what is typically employed by school and district administration. It suggests that perhaps classroom teachers need to participate in their own action research to determine areas of need and further professional development (Burbank & Kauchak, 2003).

Finally, throughout the five-week Lab, Laura continued to reflect on her professional development through each during of her online posts and assignments, as well as in the concluding interview. Laura frequently referred to her interest in finding a teaching position in Urban City School District and what a good opportunity it would be:

> Well at this point I intend on teaching here in Urban City, in an urban-based school. I want to move to a suburban area when I get married one day and raise a family, but as of now, I think it would be a good experience [to teach in an urban school] (Laura interview, 12 June 2012).

It is important to note Laura's desire to begin her teaching career in an urban classroom. As research reveals, there are many occasions when white, female pre-service teachers maintain prior, and, on occasion, negative beliefs of and experiences with diverse populations, and often that is due to their own monocultural backgrounds (Haberman, 2005; Ladson-Billings, 1995a). Interestingly enough, Laura notes that she has a passion for urban teaching because of her childhood experiences living and growing up in a diverse community:

> I grew up in a very diverse area and I've learned so much about people and just how being accepting of other races can broaden how you view people, places and I just met so many people that are very closed minded in that regard and it's shocking to me because they're missing out on so much, hence why I intended to teach here in Urban City (Laura interview, 12 June 2012).

During both the Environmental Science Pedagogy Lab and the Chemistry/Biochemistry Pedagogy Lab, Laura frequently shared her passion and appreciation in working with diverse PK-12 pupil populations. Upon the conclusion of the Lab, she summed up her understanding of inquiry within the scope of teaching in Urban City and making teaching relevant to her future pupils:

> From all my [field experiences] in Urban City's School District I am aware now how connecting students cultures through inquiry could fit well into the UCS district. The diverse cultures would benefit with such an instruction. From this [lab] experience, I also learned that inquiry lessons can and should include a variety of subjects. This can be done and should be done. The engagement of the students could end the negative attitudes toward school some student's

> experiences (Laura, Concluding Interview, 12 July 2012).

Mara, the other pre-service teacher, also indicated a genuine interest and sincere consideration of bridging the various lived experiences that future pupils will bring into the classroom:

> Overall, I've learned so much about so many different groups of people and their individual qualities and what they bring to a classroom. I feel like [this lab] was perfect. My role as a future teacher in action research is to gather all the pieces of information from my own teaching of students, to better enhance the ways in which I teach the information to my students, and to enhance the overall learning of the students in my classroom. This will allow me to actively reflect on my own teaching practices and make modifications if necessary to better the learning outcomes for my students (Mara, Module III Discussion Board, 1 July 2012).

Both Mara and Laura's reflections on the Lab and its impact are significant, as they indicate that although this learning opportunity took place over a short five-week time span and was conducted solely online, both pre-service teachers appeared to have constructed a more solid foundation of a developing professional practice.

Through the various discussion topics and the required projects assigned by Instructor Holly and Instructor Hawthorn, the events of this Environmental Science Pedagogy Lab naturally became representative of how content can be made relevant for a diverse group of developing educators within the scope of inquiry and environmental science, along with service learning. The unification of these areas appeared to be successful, in large part because of Instructor Holly and Instructor Hawthorn's own pedagogical content knowledge in the teaching of environmental science, coupled with

their graduate student experiences. In the following section, Instructors Holly and Hawthorn share their own reflections and insights of the events that unfolded during this Lab.

Faculty Reflections on the Environmental Science Pedagogy Lab

This Pedagogy Lab purposefully exposed the university students to various modes of teaching and learning throughout the content area of environmental science within the scope of inquiry education. Due to the instructors' own interests in environmental science, coupled with their experience of teaching sciences at the PK-12 grade levels, an interesting demonstration of pedagogical content knowledge took place. As presented in the beginning of this case study, the background of these two instructors was unique, as both Instructor Holly and Instructor Hawthorn were doctoral students and middle- and high-school teachers when they conceived and implemented this Lab. The primary intent was to bridge together their classroom pedagogy skills and science content knowledge and their academic research interests, in order to implement what they perceived as best practices for teacher development. Through the various modes of learning during this Pedagogy Lab, such as online videos, PowerPoint presentations[10] with accompanying audio, research of the urban community, analysis of journal articles, and engagement through online discussion questions, Instructors Holly and Hawthorn envisioned guiding the university students through a multidimensional process to develop a foundation for inquiry teaching, environmental science content, and service learning within the local community of Urban City. This multidimensional teaching method evidenced an awareness of various modes of pupil learning along with a tremendous flexibility in

[10] Instructor Holly and Instructor Hawthorn created PowerPoint presentations with each slide including a discussion of the term and topics. Typically the voice shared more information than presented on the visual slide.

teaching. This supports the significance of Instructor Holly and Instructor Hawthorn's pedagogical practice, especially in light of the various goals and objectives accomplished in this short five-week Lab.

The instructors' deep pedagogical content knowledge could be attributed to the overlap between their own professional experience as skilled educators in the PK-12 classroom, coupled with their ongoing academic preparation in doctoral studies, which in turn presented what Shulman (1986) identified as a true 'wisdom of practice'.

Instructors Holly and Instructor Hawthorn were cognizant that it was central for the university students to experience various stages of development throughout the Lab in order to participate in the actual *construction* of new knowledge:

> I think one of the keys is building relationships, so I think connecting with the students, starting out with introductions and putting ourselves out there as a person rather than just an instructor helps. I think that allows for the students to feel more comfortable to ask more questions, which, to me, that's that kind of trust that's necessary in order for students to really not just be focused on the product, but learning. So I think opening up, and then also providing time for students to talk about their lives and their passions, to set a foundation, and kind of tie that in with mini lectures that are kind of like the hip trends that you should probably know about with the sustainability education and environmental education, and give [the university students] the opportunity to explore their own interests instead of just the content *I* think they should be learning about (Instructor Holly, Concluding Interview, 25 July 2012).

Instructor Holly recognized that instructional practices in higher education should not rely solely on teacher-led instruction, where facts and figures are ambiguously transmitted to university students. Rather, Instructor Holly perceived relationship building as an imperative first step in any learning environment, before any new knowledge could be introduced. More importantly, it is significant to identify that not only was this a belief, but also something that took place in practice during the Lab.

The university students appeared comfortable engaging in the new knowledge and asking the necessary questions to further their professional development. As such, the Lab appeared to become a safe space of dialogue and courageous conversations (Singleton & Linton, 2006) surrounding the issues of social justice, environmental science, and teaching in Urban City public schools. This notion of building relationships with the university students is a specific example of how Instructor Holly connected her own PK-12 pedagogical skills to university pedagogical skills. Instructor Holly felt so strongly about building relationships with university students that she suggested future pedagogy labs should be offered face-to-face:

> I think meeting [the class] would be good, even if it's anywhere, you know. And then each week, whatever, it is, it could be tied in differently. But I think that a face-to-face meeting is important to really form those relationships, it just helps motivate students to do a little bit better when they think that you're a real person who cares about 'em (Instructor Holly, Concluding Interview, 25 July 2012).

The notion of constructing relationships permeated throughout Instructor Holly's concluding interview, further indicating her genuine care and concern for student learning at both the PK-12 and university level well past the conclusion of the Lab. This supports

her professional belief that regardless of age or academic level, students need to feel that their teachers, educators, or instructors "care about 'em," in order to achieve the desired goals and outcomes. Without this sense of caring, Instructor Holly perhaps could not have achieved the desired goals and objects as intended for the successful completion of the Lab.

For both Instructor Holly and Instructor Hawthorn, the experience of teaching and facilitating this Lab provided them with various new professional experiences and a new way of thinking about how university students learn. In particular, this teaching experience appeared to envelop Instructor Holly into a space of liminality (Cook-Sather, 2006), where her thinking and practice shifted from that of a classroom teacher and doctoral student toward that of a university instructor:

> First, as an online class, I felt like it was challenging for me because I worked hard trying to fit in a great deal of interaction. But I think the D2L setup is really neat because the students had the chance to do it when they had the time. So I think the online lab has the benefits and flexibility, but it was a challenge my first time leading a whole online course. It's just a different way to build relationships compared to talking with someone face to face (Instructor Holly Interview, 25 July 2012).

Through this experience, Instructor Holly was able to expand her own PK-12 pedagogical practice to that of teaching within a virtual space, as she implemented methods that are typically successful in an online university classroom.

The notion of building relationships appeared again when Instructor Holly expressed concern that, because of the Lab's online component, she may have lacked the

necessary and positive rapport between herself and the other university students. Due to the high level of university student engagement, Instructor Holly critically reflected on this experience and on her own professional practice, becoming aware that "[teaching] was exciting because I think it let us know that we definitely are a lot more grounded than maybe either one of us thought in our pedagogy" (Instructor Holly, Concluding Interview, 25 July 2012). This statement indicates a sense of professional modesty while simultaneously noting that her pedagogical practices are much stronger than she previously believed, further reinforcing her own success as an educator. Although Instructor Holly has taught various educational disciplines, this Lab was her first university teaching position, as well as her first online teaching experience, providing her with a new opportunity to work with adult learners and expand her own professional practice.

Instructor Hawthorn reaffirmed similar sentiments as she described her experience of participating in this opportunity to instruct university students:

> I think the experience teaching college students was eye opening, because they're very similar to my high school seniors. I realized that you have to be very thorough in what you say, what you document in your syllabus and, I always thought twice before replying to a student, because it could be interpreted in multiple ways (Instructor Hawthorn, Concluding Interview, 17 July 2012).

During Instructor Hawthorn's concluding interview, it appeared that she had a preconceived notion of university students and their learning styles prior to facilitating this Lab. From this comparison of university student to high school pupil, Instructor Hawthorn presented a new awareness that regardless of academic standing or age, every

learner deserves to receive instruction and feedback with explicit details. This does not indicate a negative perception that university students are not capable learners; rather, this statement signifies that just as high school pupils require thorough instruction, so do university students. Instructor Hawthorn's revelation also implies that her future university teaching practice has evolved, as she may be better prepared for the needs of future students.

Instructor Holly also provided insights of her general expectations of the university students and the role these developing educators should embody during the Lab:

> This [lab] made the [university students] really think about themselves a little bit more and what they would actually do instead of just being a student. It kind of forced them to imagine themselves as a teacher if they weren't. And if they were, imagine them being a little bit different type of teacher, I think. So I think it pushed their boundaries a little bit on that (Instructor Holly, Concluding Interview, 25 July 2012).

For Instructor Holly, the intention of completing this Lab was for the university students, either pre-service and in-service educators, to think about teaching and the practice of inquiry through a different and perhaps more complex lens. For the pre-service teachers, Instructor Holly encouraged them to embody the notion of thinking like a teacher rather than a university student. For the in-service teachers, she strongly encouraged a greater understanding of how to implement inquiry education throughout various subject areas. Instructor Holly also identified a concern for those preparing to enter the field of

education, as they may not be provided with ample and rigorous learning opportunities to challenge their own content knowledge:

> We're training a lot of teachers who have really good intentions and are getting straight A's in their content material, but they have no idea how to disseminate it. And I think that is one the issues. Educators typically go into things they're good at. And so if you're really good at something, you never really learn - you never think about how you learned it 'cause you didn't have to go to a tutor, you didn't have to figure it out. It just comes to you. Which can be problematic because they aren't thinking about why the kids aren't getting it (Professor Holly, Concluding Interview, 25 July 2012).

As a result, Instructor Holly engaged with these university students more as colleagues and professionals than as naïve university students or inexperienced educators. This Lab became a reciprocal space where the university students learned from each other's distinct experiences, as well as from the instructors, while the instructors also learned from the experiences of the university students.

Similarly to the previous pedagogy labs, the collaborative aspect of shaping this Lab also emerged as a significant turning point in the professional development of Instructors Holly and Hawthorn:

> I think that maybe I inspired [Instructor Hawthorn] to trust herself a little bit more maybe. Maybe like relax a little bit more. Because, I think I really made her have to relax. For example, I took a little bit longer for grading, so she had to be a little more laid back waiting for some of my grades. And so I think that provided both of us with really great insight on just how other people learn and teach. Which

> will only help in the long run, I think, for both of us as teachers (Instructor Holly, Concluding Interview, 25 July 2012).

Throughout the themes identified in this case study, it is apparent that the collaboration and team-teaching that took place was a benefit for the university students enrolled in this Pedagogy Lab. Additionally, this was the first experience for both Instructor Holly and Instructor Hawthorn to facilitate a university course. By having the opportunity to team-teach this course, they could fuse together their individual expertise to best engage the university students. As inquiry learning was a strong aspect of Instructor Holly's pedagogy, Instructor Hawthorn shared how this influenced her professional practice:

> I know [Instructor Holly] has done an awesome job with inquiry and letting her [pupils] explore their learning and environment. Now I'm moving to a school next year that has very high expectations. This made me more aware of how I want to restructure my new high school classroom to be more pedagogy or at least I want to change it so that it's scaffolding, it's more learner centered than teacher centered (Instructor Hawthorn, Concluding Interview, 17 July 2012).

Therefore, for Instructor Holly and Instructor Hawthorn, both had the capacity to positively influence one another's pedagogy and future teaching practice.

Reoccurring Themes

Upon the conclusion of this Environmental Science Pedagogy Lab, there are significant aspects that further support the vivid tapestry of pedagogical content knowledge. The following four concepts garnered from the Environmental Science Pedagogy Lab highlight these experiences. First, the university students who participated

in this Lab came from various backgrounds, with the most noteworthy being that two of the university students were in-service teachers and two were pre-service teachers. This became a unique opportunity for pre-service and in-service teachers to learn side-by-side and participate in a common dialogue, which proved to be incredibly beneficial to the success of the Lab.

However, by placing both pre-service and in-service teachers together, a disconnect became apparent between what is taught in teacher preparation programs versus what is realistically implemented in the PK-12 classroom. As presented by both the pre-service teachers, Laura and Mara indicated how they imagine integrating various subjects and content with inquiry-based teaching strategies. The two in-service teachers, Frida and Melanie, were very forthright in stating that time and various professional pressures often make inquiry teaching a challenge to implement in the elementary classroom. Although this divergence did arise, the Lab afforded these developing teachers an opportunity to engage in the dialogue of why inquiry-based teaching is empowering for pupil learning, especially in the urban setting.

Second, the content and expectations of this Lab required the university students to move outside of their own comfort level and explore the various environmental resources found in Urban City. As such, the university students participated in creating their own inquiry-based lesson that included appropriate Urban City resources, which became tailored to the interests and experiences of each university student. The university students did not simply learn terminology and read hypothetical situations of inquiry-based teaching. Instead, the university students had the ability to construct their own knowledge based on real experiences.

A third important development in this Environmental Science Pedagogy Lab was the emphasis on fostering relationships in a learning environment, whether within a university classroom or with PK-12 pupils. Through this virtual classroom experience, a positive learning environment was established and could be attributed to a variety of influences. First, there was the coincidence of two university students who were both in-service teachers working in similar elementary grade levels in the Urban City public school district. Another coincidence occurred when Laura and Mara realized they were in the same stage of their teacher preparation program, only in different cohorts. Another influence could be attributed to Instructor Holly's dedication in stimulating a supportive learning environment that emphasized building relationships. Due to these factors, the university students appeared to build positive relationships among themselves and with the instructors. This further encouraged dialogue about the various discussion topics. From this experience, it appeared that the university students identified with the need in making content relevant to pupils, which is based on first building healthy and compassionate relationships in the classroom. This online Lab genuinely became a safe space for critical discourse and courageous conversations regarding urban teaching and environmental science content.

Finally, it is also important to note the professional and collaborative relationship that developed between Instructor Holly and Instructor Hawthorn, and how this experience appeared to enrich the professional practice of both instructors. As doctoral students and PK-12 teachers, facilitating this Lab provided them with new experiences that expanded their own professional development. Based on their shared reflections, Instructor Holly and Instructor Hawthorn acknowledged that they had a greater

understanding of one's own pedagogical practice, at the PK-12 level as well as at the university level. Instructor Hawthorn recognized the need for a greater level of inquiry-based teaching in her own high school classroom. Instructor Holly appeared to have gained more confidence in her ability to foster relationships with university students, especially through this virtual experience.

Perhaps the success of this Lab can be attributed, in part, to the incredibly positive and supportive environment that was created, which is due to both instructors and university students learning together.

Case #4: A Mathematics Pedagogy Lab

The fourth and final case study was the Mathematics Pedagogy Lab, which enrolled the largest number of university student participants, with a total of nineteen university students (Table 5). Similarly to the previous labs, the Mathematics Pedagogy Lab met for five consecutive weeks. This Lab, however, was very distinct, as it met face-to-face in a traditional university classroom[11] for two and a half hours, 5:00pm to 7:30pm, during the fall 2012 semester. Two male faculty members, Dr. Rugts and Instructor Cooper, facilitated this course. Both had extensive expertise in mathematics and the teaching of mathematics to university students, pre-service teachers, and in-service teachers. Dr. Rugts is an associate professor in the Department of Mathematical Sciences at Urban University. He has been at Urban University for twenty-seven years and continues to be an active member of the University community through various research projects. Instructor Cooper was originally a high school mathematics teacher for thirty-two years, and has since retired. He began working at Urban University as a senior

[11] "Traditional" denotes that this is a classroom large enough to hold 25 students and has various modes of technology used for instructions: computer, screen, document camera, and projector.

lecturer in the Department of Mathematical Sciences, specifically teaching the coursework intended for teacher preparation. Both Dr. Rugts and Instructor Cooper previously worked together on a research grant to improve the teaching of mathematics for Urban City School District; as such, they had an established working relationship prior to the initial stages of planning and facilitating this Pedagogy Lab.

While the recruitment process for this Mathematics Pedagogy Lab was similar to the recruitment of previous labs, it is important to delineate the variances that may have encouraged a larger number of university students to enroll in this Lab. Recruitment and information sessions about the Lab took place in the first week of the fall semester. In addition, the Lab started within the first three weeks of the fall semester. Thus, the great level of interest could indicate that the university students did not feel the amounting pressures of the new semester, and were eager to expand their pre-service teacher development or receive extra university credit. This scheduling consideration may have implications for future labs and how to recruit future university students.

This Lab was comprised of fourteen females and five males, all of whom were undergraduate university students at various stages of their undergraduate coursework and teacher preparation, as designated on the transcripts provided by Urban University (Table 5). Four of the university students enrolled in the lab were considered 'undecided' or had applied to a different academic program outside of the School of Education at Urban University (Table 5). The majority of the university students (15) declared majors as Education-intended, as noted on their official Urban University transcript. The Education-intended students are highlighted in Table 5.

University Student Demographics of the Fall Mathematics Lab

Name	*Gender*	*Age*	*Academic Program*	*Semester Grade Point Average*
Jace	M	19	Education – Intended (declared 4/2012)	3.9/4.0
Danya	F	19	Education – Intended; MCEA (declared 4/2011)	3.9/4.0
Paige	F	20	Education – Intended (declared 4/2010)	3.8/4.0
Mallory	F	22	Education – Intended (declared 1/2011)	3.6/4.0
Peter	M	49	Education – Intended (declared 2/2010)	3.6/4.0
Patrick	M	18	Education – Intended (declared 6/2012)	3.5/4.0
Jeanna	F	18	Education – Intended (declared 8/2012)	3.4/4.0
Johanna	F	19	Exceptional Education - Intended (declared 7/2012)	3.2/4.0
Sarah	F	21	Education – Intended (declared 4/2009)	3.1/4.0
Carl	M	21	Education – Intended (declared 4/2010)	2.9/4.0
Karen	F	19	Education – Intended (declared 6/2012)	2.8/4.0
Grace	F	18	Education – Intended (declared 4/2012)	2.6/4.0
Dana	F	21	Education – Intended (declared 4/2009)	2.5/4.0
Salam	F	22	Education – Intended (declared 5/2008)	2.4/4.0
Laurie	F	26	Education – Intended (declared 2/2011)	2.1/4.0
Emily	F	21	Letters and Science Undergraduate	3.8/4.0
Penny	F	20	Health Sciences Undergraduate (declared 3/2012)	3.1/4.0
Katrina	F	20	Health Sciences Undergraduate (declared 7/2010)	2.6/4.0
Ming	F	20	Undecided (declared 4/2010)	2.4/4.0

(Table 5)

The purpose of this Mathematics Pedagogy Lab was to specifically examine the teaching of specialized mathematics knowledge (Ball et al., 2008). As noted in the syllabus: "This

course explores the connections between the content material of School of Education mathematics courses and K-12 pedagogical practices, specifically as they relate to the complexities of the urban environment in light of the Common Core State Standards for Mathematics" (Mathematics Pedagogy Lab syllabus, 2012). To reiterate, a unique factor of this lab included the opportunity for the instructors and university students to meet face-to-face, and Dr. Rugts and Instructor Cooper deliberately planned this experience:

> When we were designing this course initially, we felt that face-to-face interaction was necessary. I know that people claim to be doing wonderful things with online classes these days. But I still just feel that these [university students] are going to be teachers in classrooms. What they need, is practice on being a teacher in an actual classroom (Dr. Rugts, Concluding Interview, 29 October 2012).

Due to this face-to-face design, the university students had opportunities to plan and physically *teach* a mathematics micro-lesson based on sound understanding of the various Common Core Standards. According to Dr. Rugts and Instructor Cooper:

> We talked about how Common Core standards are affecting the [university] students. I'm a big fan of Common Core because I think it defines structure as to what should be done at certain levels. What we attempted to do in the lab is have the [university] students recognize, as let's say a seventh-grade teacher, needs to know what a 2nd and 3rd grade teacher is doing so that kids get the learning they need. I could give you an example - Teaching high school geometry, teachers think that students don't know what, let's say a rhombus is. But kindergarten and first grade, that's one of the objectives and they start recognizing and being able to name those things. So, students need to recognize how this progression goes

> through the curriculum. That's what we did within the lab (Instructor Cooper, Concluding Interview, 27 November 2012).

As such, university students simultaneously engaged in the discovery of pedagogical practices in teaching mathematics, while also learning how to plan for and implement those practices with respect to particular content standards. The final expectation of the Lab required those university students who did not present lessons to provide constructive feedback of what was observed during each of the microteaching segments, which further emphasized a professional community of learning and development.

The confluence of these experiences offered the university students a purposeful triad of opportunities for pre-service teacher preparation. The first point of this triad included information about the intricacies in teaching mathematics to various ability and grade levels. Both Dr. Rugts and Dr. Cooper presented a personal story or experience to make the teaching applicable and realistic for these university students. The second point of the Lab required university students to plan and implement authentic thirty-minute mathematics micro-lessons to their pedagogy lab peers. The final point of this triad required the university students to observe and reflect on the various modes of lesson planning and the implemented pedagogy as it related to accurate mathematics content, per Common Core State Standards (2010). The experience of providing feedback to the presenting groups further encouraged a community effort in developing an excellent teaching practice. Throughout these experiences, the university students were encouraged to think about both the pedagogy and the content of mathematics for PK-12 pupils.

Instructor Cooper recognized that every developing teacher should embrace the

intricacies of a well-developed pedagogy, which he stressed often:

> My goal was to instill in those [university] students an understanding of pedagogy and how it is the art of teaching, if you want to call it art, or science of teaching. Encouraging students to question, how will you go about and think about your classroom environment. How do you see it functioning? How do you want to deal with kids? How are you going to deal with the art of teaching in your own classroom? (Instructor Cooper, Concluding Interview, 27 November 2012).

Through Instructor Cooper's eyes, a teacher should guide and ensure the success of pupil learning through various levels of encouragement, inquiry, and reflection.

Dr. Rugts presented an alternative view of what the university students and pre-service teachers should strive toward. He believed:

> Teachers should have a really deep knowledge of appropriate content. If the teacher doesn't know the content they can't teach it. Period. And that for me is number one, far ahead, really, of anything else. There are certainly aspects of knowing [pupils] and understanding how people learn, impediments, and differentiation. But none of that matters if the teacher doesn't basically know the material to start with (Dr. Rugts, Concluding Interview, 29 October 2012).

In his professional opinion, teachers need to first develop a foundation of exceptional content knowledge in order to become outstanding educators. Dr. Rugts also insinuated that only after the development of a deep level of content knowledge do pedagogical practices follow. Once again, the debate of pedagogy versus content knowledge in teacher education is precisely what drove this particular case study. These contrasting instructor perspectives were critical, as they shed light on how to bridge past content

knowledge and pedagogy with present pedagogical content knowledge. Although these two views somewhat contrasted one another, together they guided the overall outcomes and success of this Lab.

It is also important to note the various instructional methods Dr. Rugts and Instructor Cooper employed during the instructional aspects of the Lab. Dr. Rugts confessed:

> I'm finding it just psychologically very hard to leave the lecturing mode. I sort of feel that I can't really dive in and start problem solving with [university] students until I've summarized what it was they should have read. And there's half the class gone towards lecture (Dr. Rugts, Concluding Interview, 29 October 2012).

While these labs were not solely based on a tremendous amount of lecture or teacher-led instruction, it is important to once again highlight the contrast between Dr. Rugts' teaching practices to Instructor Cooper's. As a high school teacher for thirty-two years, Instructor Cooper frequently recounted personal stories during each of the five Lab sessions, including professional challenges and successes experienced as an urban educator. This method provided university students insights on what might unfold in a PK-12 classroom. This prompted multiple opportunities for both discussion and reflection on their future teaching practices.

The following Entry Vignette captures a glimpse of Instructor Cooper's pedagogical practice during the Lab and his efforts to instill an atmosphere of mutual respect and real-life teaching experiences throughout the Lab:

When teaching fractions, you share how common denominators have common relationships, and it is not as complicated as some teachers make it out to be. I had this

girl in an introductory [high school algebra] class and we were doing a problem on fractions. And she was sitting in a way that she just didn't want to be there, while everyone was working on the problem. So I ask her, 'What's going on? What's happening with this problem?" Her comment to me was, "I don't do fractions." So I respond to her and say, "In this class we do do fractions." But previous to this class, she was so turned off by fractions and it was a difficult task for her. So we are trying to build an understanding of different teaching methods. The trouble is when teachers see common denominators in standards for fractions that's all they do, they multiply the bottom and the top and that's all that they do. For some teachers it's a fetish to know only how to find the lowest denominator. But there are so many other ways to think about fractions, that we don't want to limit the information to our students. You always need to keep in mind the trillions of ways [pupils] will solve math problems (Instructor Cooper and Introductory Session, 11 September 2012).

Inside a Mathematics Pedagogy Lab

Both Dr. Rugts and Instructor Cooper identified the predominant goal of the Pedagogy Lab, which was to establish a concrete definition of pedagogy and examine how it intersects with mathematics content knowledge with respect to the Common Core State Standards for Mathematics. During the introduction of the first Lab session, Instructor Cooper purposefully and directly asked the university students, "You guys signed up for a Pedagogy Lab, ok so what's pedagogy? What does this even mean?" (Instructor Cooper, Concluding Interview, 27 November 2012). He was initially met with a great deal of silence, but his intention was to immediately present the purpose of the Lab and begin crafting a genuine understanding of pedagogy.

Each of the five Lab sessions focused on particular grade levels between 3rd and 8th grade and the correlating Common Core State Standards for Mathematics. As shared previously, during each of the weekly sessions, small groups of three university students would present a planned micro-lesson (Cruickshank & Metcalf, 1993), with adequate class time set aside to receive feedback from peers and the two instructors. Prior to the university students' micro-lesson presentations, Instructor Cooper and Dr. Rugts required the university students to organize a collaborative group meeting, which included an appointment with the instructors to further discuss and identify predicted outcomes of the planned micro-lesson:

> We developed the lab in a way for one-on-one contact. We assigned the [university] students their [mathematics] standard, and I wanted them to set an appointment with us so that we would meet on campus, and it was casual. It was just open. We talked about other things, and I said, "Oh, we'll get back to the lesson a little bit, too," but that was part of the model that I thought really worked quite nicely (Instructor Cooper, Concluding Interview, 27 November 2012).

Instructor Cooper intended to build a collaborative environment while simultaneously fostering a sense of community among the university students, himself and Dr. Rugts.

Instructor Cooper was acutely aware of the Lab's limited time frame and how the university students needed ample experiences to engage with both the mathematics curriculum and the experience of planning mathematics lessons. These meetings also promoted a greater sense of confidence among the university students, where they had opportunities to share their lesson ideas prior to the presentation date and address any glaring errors or misconceptions:

> It was comforting for the [university] students to think, "Oh, at least we got a little bit of a check beforehand, before we go up there and make the mistakes in class." There were some groups that had it pretty well laid out and we tweaked it a little bit, but there were other ones, I said, "That's not what this objective is saying. This is not where we're going." They kind of went, "Whoa. We just were planning and our planning was wrong." I just let them know, well, too bad. Just get over it. We have to meet this and this objective (Instructor Cooper, Concluding Interview, 27 November 2012).

Every small group presented lessons on math standards, with an exclusive focus on the subject matter of geometry and fractions, because "Those are two topics that generally grade school teachers don't like and they are areas that many teachers have trouble with or avoid altogether" (Instructor Cooper, Concluding Interview, 27 November 2012). Dr. Rugts shared similar sentiments and asserted:

> I'm always very frustrated by the fact that so much time gets put in number and operations that we never spend any time working on geometry. Especially because most pre-service teachers seem to be much weaker in geometry, on average they're much weaker on geometry than they are in number and operations. We latched onto fractions and geometry pretty quickly, so those were our focus (Dr. Rugts, Concluding Interview, 29 October 2012).

With its emphasis on geometry and fractions, the Lab was used as a space to address and encourage critical conversations surrounding the more challenging and complex mathematics subject areas. These areas, as Dr. Rugts noted, are often neglected or avoided due to a possible aversion or discomfort of how to teach these complicated

mathematical concepts. Dr. Rugts and Instructor Cooper also emphasized the significance of the Common Core State Standards for Mathematics (2010b) as a tool to understand how learning is scaffolded across the various grade levels:

> We wanted the [university] students to at least study one or two of the content standards in some depth to see, perhaps from their own presentations and others how those standards were scaffolded and how they built from grade to grade, at least in a couple of the strands. We wanted them to learn and present some material, but we really wanted them to try and get them to learn to present it as the Common Core is suggesting it should be. It should be learned, taught, and presented (Dr. Rugts, Concluding Interview, 29 October 2012).

Due to the challenging aspects of fractions and geometry, Instructor Cooper was cognizant to always present information in nonthreatening ways. In doing so, university students could continuously engage throughout the Lab and ask the necessary clarifying questions. He noted:

> What I tried to do in that [university] classroom was model what I did as a [PK-12] teacher. I want an open, non-threatening type of atmosphere and I think in that short period of time, we accomplished that because I thought the students were very open with their responses and getting into [the content]. I gave the [university] students one of my favorite examples when I was teaching. A kid said something, and the class would chuckle because it's wrong. I'd say, "That's the best wrong answer we had today. Think about it. How many of you are thinking in that direction? That's great analysis of a problem. It doesn't happen to be right, but it helps us to get to the correct answer. I go back and I tell kids about

> Thomas Edison. When [Edison] was doing the light bulb, his assistant was complaining. He said, "This doesn't work." He said, "Well, that's wonderful. We've eliminated 1,000 things that don't work, so now we can continue to work to find the right things (Instructor Cooper, Concluding Interview, 27 November 2012).

From his experience as a high school classroom teacher, Instructor Cooper had firsthand knowledge about the complexity of mathematics and how it could become a struggle for PK-12 pupils and university students alike. It was clear that Instructor Cooper embodied the belief and teaching practice of care and consideration throughout the duration of the Lab. In turn, this disposition appeared to positively influence the climate of the learning environment, which encouraged university student engagement and constructive peer feedback.

Each of the five Lab sessions began with opening remarks from Dr. Rugts and Instructor Cooper, which included a brief summary of the session's standards and content. After these comments, the assigned university students taught the planned micro-lesson. Every lesson involved some level of peer interaction, either in pairs or small groups. Upon the conclusion of each lesson, there was ample time for class discussion, reflection, and peer feedback. The following themes are representative of both university student and faculty experiences learned through this structure of the Mathematics Pedagogy Lab.

Making Mathematics Content Relevant

From the start, Dr. Rugts and Instructor Cooper emphasized the significance in making content relevant by carefully blending awareness and knowledge of the following: a.) pupils and pupil learning, b.) accurate and deep mathematics content

knowledge, c.) the progression of academic standards, and d.) how these together had the capacity to engage and advance pupil learning. The Lab included various pedagogical practices, used with the intention of making complex mathematics content relevant and accessible for pupils in the classroom:

> We're looking for multiple strategies in solving a problem because I've had [pupils] come to me and say, "Well, I went to my teacher and they explained something in class and I went to see him afterwards and they did it exactly the same way they did it in class." Just by repetition, no one got it. So you've got to have multiple strategies. If a [pupil] comes in, you say, "Okay. You didn't get that. Let's look at it in this direction. Maybe this will make more sense," and then, tie those things that are relevant for the [pupils] together. This is hard though (Instructor Cooper, Session 1, 19 September 2012).

Like the instructors of the Chemistry/Biochemistry Pedagogy Lab, both Dr. Rugts and Instructor Cooper acknowledged a common misconception that to make mathematics content relevant, the lessons need to be "fun" for the pupils. "It doesn't have to be fun. The [university] students always say, "I want this to be fun." Well, it doesn't have to be fun, the learning has to go on," shared Dr. Rugts and Instructor Cooper (Session 1, 11 September 2012). Like the Chemistry/Biochemistry lab, this statement also makes an important distinction between a lesson that is "fun" and one that encourages rigorous content and challenging problem solving.

To make this distinction explicit, Dr. Rugts and Instructor Cooper required the university students to microteach segments that determined how to relate the subject matter to future pupils, as well as to the university students participating in the Lab. That

experience in planning and teaching a standards-based lesson encouraged the university students to move past their comfort levels, try various mathematical strategies, and correctly present the identified content. During these lessons, this awareness of how to make content relevant was embraced by some of the university students, while others had difficulty knowing when to pause the lesson and engage in conversations regarding the other university students' questions or misunderstandings. Instructor Cooper shares how he saw this learning unfold in the Lab:

> Some of the [university] little hesitant because these are their peers they have to teach. It's hard for them to say, "Hey, what are you doing here?" But some of the more outgoing students, I might describe it as, would go around and they really did a nice job of talking with the [university] students. Perhaps they saw Dr. Rugts and I, the lead that we were going around, but for them to pick up on that, that's not an easy thing for them to do; to help fellow students (Instructor Cooper, Concluding Interview, 27 November 2012).

Instructor Cooper was cognizant that some pre-service teachers were not confident in their understanding of mathematics, which, in turn, had the potential to bleed into one's teaching practice, and worse, negatively affect PK-12 pupil learning. He offered the following observation:

> The [university] students are either fearful of math or they don't like math. We have to break down those barriers because I would tell them, "If you walk into a classroom, those [pupils] are going to sense right away that you don't like this. You have to fool them, even if you don't like it, you have to fool them. But the question is, how do you get across mathematical ideas in a way that's

> understandable for [pupils]? (Instructor Cooper, Concluding Interview, 27 November 2012)

Thus, participating in this Mathematics Pedagogy Lab provided a unique experience for university students to face and address their own discomfort with the subject matter and develop a greater appreciation for the complexity of the mathematics content.

During the various Lab sessions, Instructor Cooper reminded the university students to always consider the following question: "How do you get across mathematical ideas in a way that's understandable for pupils?" (Instructor Cooper, Session 2, 18 September 2012). Instructor Cooper often attempted to address his own question by presenting various examples based on his professional experiences in the classroom. One such story focused on the skills teachers need to be tuned into pupil misunderstandings and periods of disengagement:

> When the [pupil] sits there and screws up his eyes and his nose, I'm thinking to myself and maybe even out loud, "Well, maybe I should do that one again", because if I can come at that question from different directions, I will. When you're teaching, rather than being that sage on the stage, you need to walk around and look at what students are doing. You'll know whether they got it or not (Instructor Cooper, Concluding Interview, 27 November 2012).

In this statement, Instructor Cooper presents two very important pedagogical practices for developing teachers. First, every teacher needs to conduct immediate professional reflection during the teaching of various lessons, which also includes the development of a hypersensitivity to various pupil behaviors and non-verbal cues. The second important concept is the emphasis for educators to not act as a 'sage on stage,' but to frequently

examine pupils' levels of understanding and progress. In essence, keeping these practices in mind will assure that content is accessible and relevant to pupils.

Another concrete example of making content relevant took place when Dr. Rugts and Instructor Cooper facilitated a whole class discussion regarding the various levels of counting and addition skills pupils may have. To demonstrate this, Instructor Cooper and Dr. Rugts asked the university students to determine how a PK-12 pupil might go about solving a specific addition problem. Instructor Cooper began by asking university students to rewrite the problem with a partner so that it better drew on the pupils' interests. Instructor Cooper shared the following example:

> You buy something for 45 cents, and you give them three 25-cent pieces. We want to count up from 45 to 75. Here's a nickel and then a dime another dime and so on to finally get 'em to 75 cents. What grade level is this for? Third grade. And do you think they would have seen in a store, counting change up? And that they might be aware of that when they give a cashier a dollar? (Instructor Cooper, Session 2, 18 September 2012).

The entire group of university students replied in unison, "Yeah!"

Instructor Cooper pushed the university students further in asking, "So what might we start with instead of quarters? What are some other ways that students can show you how to count up?" (Instructor Cooper, Session 2, 18 September 2012). One of the university students, Laurie replied, "Then you can actually use fake money in the classroom, right, to make it more realistic?" Instructor Cooper agreed and stated, "We always want to share multiple strategies, and in turn, understand the student work and what [pupils] are trying to tell us" (Instructor Cooper, Session 2, 18 September 2012).

This statement reiterates the complexity of teaching, along with making the content relevant and accessible to the pupils in the classroom, whether that is with various classroom tools or problem solving strategies. This conversation emphasized that teaching is not a one-dimensional act. Rather, an educator must be sensitive to the endless methods in which pupils develop knowledge, then how those are exhibited in the classroom, and finally, how those skills transfer to the next unit of learning or next grade level. Together, the university students collectively constructed an understanding of making content relevant and accessible to future PK-12 pupils.

However, when the university students were required to teach the micro-lessons themselves, there were a few incidents when content was often glossed over. This left the university students without the necessary skills needed to reinforce and review the missed information. One group in particular struggled more than others at making the content relevant to either future PK-12 pupils or the university students participating in the microteaching segment.

The group, comprised of Karen, Grace, and Dana, was assigned the targeted standard "3.NF.2 - Develop understanding of fractions as numbers. Understand a fraction as a number on the number line; represent fractions on a number line diagram" (Mathematics Pedagogy Lab Syllabus, Fall 2012). Although this is a third-grade standard, the lesson's introduction lacked any relevance to the pupils and their learning, beginning with "Umm, so we are basically learning about fractions and number lines. Does everyone know what a number line is?" (Dana, Session 3, 25 September 2012). This was the only reference to content, as Karen became more focused on the participation reward; she exclaimed during the opening, "We are gonna need a lot of volunteers, so smart kids

get smarties! You get candy every time you answer a question!" (Grace, Session 3, 25 September 2012). Materials were handed out and general directions shared. "Everybody take your orange strip of paper. Take this one and this will be your number line. Draw one big line and uhhh, then draw smaller lines. Ok, let's just go to the second. Everybody understand?" (Dana, Session 3, 25 September). Then Karen interjected, "Does everyone have number line that looks like this? Ummmm, ok, well…is that a YES?! Does everyone have their number line? Does everyone understand?" (Karen, Session 3, 25 September 2012). It soon became apparent that both Karen and Dana became frustrated with the low volume of activity and the high level of uncertainty visible from the university students as they tried to follow the ambiguous directions.

This lesson progressed with the folding of four other slips of colored paper in various ways to present the fractions of half, thirds, fourths, eighths, and sixteenths. There was additional confusion when Karen asked for equivalent fractions based on how the various fraction strips had been constructed. The group never related these fractions to real-life examples, the university students' experiences, or even hypothetical pupil experiences.

While the initial strategy of folding various papers had potential to be an interactive way of discovering fractions, key pieces of the lesson distracted the group from learning the necessary content. When the lesson concluded, the university students had an opportunity to share constructive criticism about participating in the micro-lesson. Emily stated, "I realized that when I was labeling my number line, I totally missed a line and a fraction. I can imagine that a third grader might do something similar and then they learn the order of fractions incorrectly" (Emily, Session 3, 25 September 2012). She then

offered, “We were so confused with the directions and what to do at certain points. In particular, with joining the line to show a bigger half. First you said draw it like this and then you pointed to the line on the board and it was something completely different” (Jeanna, Session 3, 25 September 2012). Peter chimed in, “Maybe, kinda ummm, put some separation between asking us to draw on the board and having us draw on our individual slips. It was distracting to see it already on the board and thinking well why do I have to write it down?” (Peter, Session 3, 25 September 2012).

These micro-lessons were truly an initial teaching experience for most, if not all, of the university students participating in this Pedagogy Lab. Thus, the instances presented here are not an implication of failure among the group of pre-service teachers. Rather, it offered a significant way for the collective group to pinpoint target areas where PK-12 pupils might have misperceptions or misunderstandings about fractions and how a teacher might tackle those concerns.

The notion of making content relevant is a complex practice that involves an intricate understanding of pupils and pupil learning, while also requiring deep knowledge of the content and an ability to present it through multiple teaching opportunities; in other words, teachers must embody pedagogical content knowledge. As Dr. Rugts pointed out, “Without that kind of in-depth knowledge, I think the [PK-12] class becomes scripted, the teacher has one way of doing it and that's how it has to go for the 47 minutes, or whatever it is. And the class, therefore, really can't become active or really participate” (Dr. Rugts, Concluding Interview, 29 October 2012). This vast area of teaching in relevant ways naturally becomes a component of PCK and has the capacity to encompass the multitude of culturally responsive teaching practices, as well as the inclusion of pupil

interests, goals, backgrounds, and popular culture references to improve motivation, confidence, and attention (Irvine, 2011).

The notion of relevant teaching became evident as university students considered the relationships between the various mathematical teaching methods and the understanding of how content standards progress in order to successfully equip pupils for the multiple levels of their mathematics learning. One such tool to encourage relevant teaching is inquiry-based learning, as presented in the next theme.

Inquiry-Based Teaching and Learning in Mathematics

The notion of inquiry emerged rather organically during the Mathematics Pedagogy Lab. This was due, in part, to the various microteaching lessons and conversations orchestrated during whole class discussion. I describe this observation as natural or organic because unlike the Environmental Science Pedagogy Lab, the act of inquiry was not a deliberately planned objective or goal included within the course syllabus. However, due to both the microteaching presentations and the questioning that took place during and after each micro-lesson, the natural event of inquiry-based teaching and learning took shape. This experience of presenting and participating in various mathematical lessons engaged the university students in an active discovery of both becoming mathematics teachers, as well as discovering new methods to solve traditional mathematical problems. I observed one example of this natural inquiry during one of the initial group presentations on the third-grade mathematics standard of "3.MD.5 Geometric measurement: understand concepts of area and relate area to multiplication and to addition" (Mathematics Pedagogy Lab Syllabus, 2012). Salam, Patrick, and Emily developed a micro- lesson to foster an understanding of area without using of any

previously memorized formulas.[12] In essence, they needed to develop a lesson that was appropriate for a third-grade pupil. With some suggestions and guidance from Dr. Rugts and Instructor Cooper, this group implemented a lesson that incorporated the use of geoboards[13] and rubber bands as hands-on manipulatives in an attempt to instruct the university students while fulfilling the required standard of finding area.

Right after the lesson began, the university students who were presenting were visibly nervous and uncomfortable in front of the larger class. Although this initial discomfort was evident, it did not deter the class from actively participating in the lesson. There was enough engagement to encourage Salam, Patrick, and Emily to gain the necessary confidence to move away from the podium and individually monitor and interact with the various university student groups. This level of participation was noteworthy because it demonstrates the innate curiosity among these university students as they discovered the purpose of geoboards and how to find area without using their background knowledge of formulas.

Instructor Cooper also noticed this buzz of activity and interjected with the question, "With a quick show of hands, how many of you have never seen a geoboard or actually used one?" (Instructor Cooper, Session 2, 18 September 2012). All but two students indicated they had never used this kind of manipulative. Although this lesson was constructed to meet the required standards for third-grade pupils, the university students' lack of experience with the geoboards challenged the group to explore and construct an understanding of finding area of particular shapes.

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[12] Throughout the lab, the emphasis was for the university students to personify the conceptual thinking and understanding of PK-12 pupils; or in essence, become pupils at the designated grade level.

[13] A geoboard is a manipulative used to support the learning of various mathematical subject areas, such as area and perimeter.

The progression of this lesson initially focused on discovering the area of basic shapes, such as squares and rectangles. The lesson quickly shifted to the more challenging problem of finding the area for triangles. As the problems became more difficult, Patrick initiated a whole-class conversation, asking "Is anyone ready to share? Is anyone feeling brave enough to come up here to share their answer?" (Patrick, Session 2, 18 September 2012). Before presenting the university students' responses to Patrick's question, it is important to note that he was using the term "brave enough" to encourage classroom participation and inquiry. Recall that during the Environmental Science Pedagogy Lab, Mara also stated that students who participated in an inquiry classroom were "brave…smart kids asking relevant questions" (Mara, Environmental Online Discussion Board, 17 June 2012). Even with Patrick's attempt to encourage participation, the class was enveloped by a few moments of silence.

Finally, Danya volunteered the strategy she used to find the area of a triangle. Patrick shared his astonishment that Danya presented a completely different method than his own for solving the problem, "Wow, I was actually looking for a simpler answer!" (Patrick, Session 2, 18 September 2012). Patrick's response could be indicative of what some teachers perceive their pupils to know, or rather not know, when discovering and exploring new subject areas. In this particular scenario, it appeared that although Patrick and his group members planned the lesson, Patrick did not have an advanced understanding of the multiple methods pupils might use to determine the area of different shapes. So although finding the area of particular shapes was familiar to the university students, the manipulation of the geoboards challenged the group. This awkward silence suggests that adequate scaffolding needs to take place when introducing new tools or any

new content during a lesson. When introducing new tools, manipulatives, and/or any new content during a lesson, adequate scaffolding must occur in order to further build on students' confidence and comprehension. Otherwise, great leaps between content may lead students to develop gaps in learning, which appeared to occur in this lab.

In any discipline, whether it is mathematics, sciences, literature, or any other content area, educators need the content knowledge and skills to both plan lessons and anticipate the intricate veins of students' thinking and areas of interest or inquiry. This knowledge base allows one to be more strategic in their lesson planning and its execution. For these university students, the lesson about finding area became an opportunity to learn how gaps in a teacher's knowledge can affect the learning potential of an entire class.

When the lesson concluded, Dr. Rugts and Instructor Cooper shared rather positive feedback, "Really nice. That was really well done" (Instructor Cooper & Dr. Rugts, Session 2, 18 September). However, during the subsequent lab meeting, both Instructor Cooper and Dr. Rugts provided additional insights on the connections between facilitating engaging lessons and how to address possible misconceptions pupils may have. First, Instructor Cooper addressed the importance of flexibility of crafting lessons that stimulate learning and curiosity:

> Teaching should always be about dynamic lessons. When something all of a sudden comes up that's spurred by students questions or interest, then you can run with that and not have a prescribed plan for the day, but have the ability to adapt on your feet and meet the needs of your students" (Instructor Cooper, Session 3, 25 September 2012).

His statement offered two important facets of inquiry-based learning. First, teachers ought to have a road map or guide outlining the lesson plan. Second, this road map should consider various questions and misconceptions students might have that can shift the trajectory of a lesson, thereby providing new opportunities for learning (Maab & Doorman, 2013).

Dr. Rugts followed up after Instructor Cooper's feedback and shared his perspective of what may or may not happen in a classroom if teachers do not keep the next stage of learning in the forefront of their planning:

> The geoboard might be the place to start with a concrete experience. That is a teaching decision. Do you leave the lesson at the geoboard though? If there is not any further intentional thinking, then very likely, the kids will stay with the geoboard, and not move past this stage. Always be thinking about what the next stage is and where you will go, especially when we see 6th graders and 8th graders still struggle with basic subtraction, and are counting on their fingers. It is intentional instruction to move these kids to the next level, even if you are not teaching 6th and 8th grade students, you have to think about what they need to know" (Dr. Rugts, Session 3, 25 September 2012).

Although inquiry-based learning was not an explicitly stated goal of this Mathematics Pedagogy Lab, it did offer ample opportunity to discover how a lack in content knowledge makes some teachers hesitant or resistant about digressing from the preplanned lesson. Dr. Rugts explained:

> As I said before, if you don't have the content knowledge you can't teach it, period. The problem is when the teacher doesn't have enough content knowledge to feel

> really secure. And good enough teachers should know more than the students do, because they can read the textbook and understand the textbook. But the moment anything goes the slightest way off track, the teacher is lost. So without that kind of in-depth knowledge, I think the class becomes scripted, the teacher has one way of doing it and that's how it has to go for the 47 minutes. And the class, therefore, really can't become active in learning (Dr. Rugts, Concluding Interview, 29 October 2012).

If teachers struggle with providing opportunities for exploration and natural inquiry, the end result is a classroom of disengaged students. Once again, the confluence of content and pedagogy underscores the fundamental development for any teacher.

Reflections of Self as an Educator in Mathematics

Through the unique experience of participating in a face-to-face Pedagogy Lab, the university students had an opportunity to teach a particular lesson and immediately reflect on and receive feedback from their peers and the instructors. This critical dialogue encouraged the university students to reflect in the lessons both as "teacher" and "student." Walking the line between these professional and academic realms was important, because it allowed university students opportunities to imagine and embody the dispositions of a teacher. In many ways, this Lab provided a space of liminality (Cook-Sather, 2006), where the university students shifted back and forth from teacher to student and confronted experiences that helped form or reform best practices for their future teaching experiences.

These types of reflections and professional growth were repeated at the conclusion of a lesson on "6.G.1 Solve real-world and mathematical problems involving

area, surface area, and volume" (Mathematics Pedagogy Lab Syllabus), where Jace shared:

> In high school and middle school I remember bad experiences all the way into college in math classes. You say an answer you think is right and the teacher says, 'Oh no that's not the right answer, can someone give the right answer?' And it's really easy to say that. But instead the teacher should say, 'let's explore what you are thinking and see where you are coming from. If we don't do that, we discourage people from raising their hands and participating. This is such a big deal (Jace, Session 4, 2 October 2012).

During Jace's statement, many university students nodded their heads in agreement, suggesting that they, too, believed that teachers had the capacity to discourage students and their learning. Seizing the opportunity to continue the momentum of this observation, Instructor Cooper added, "It is so important for a teacher to follow up with a statement like, 'That's a neat idea, I really need to think about that,' especially if it is not the correct answer" (Instructor Cooper, Session 4, 2 October 2012). Drawing on his personal experiences, he provided the following example of how teachers should use pupils' questions as opportunities to enrich a lesson:

> In the typical math classroom, kids will come and say, "Hey. I don't know how to do problem number 13." The teacher will go up there to the board and write away, with the response, "Now you just do it." Boom! The [pupils] never see teachers making mistakes. That's not the way math is done. Math is, "Oh, that didn't work. Scratch that off. Start over." So, we have to let kids know that that's okay. So instead – and this is part of the pedagogy - I would say to the high school class,

> "Hey. I don't know how to do that" Then, if you say that, the kids work like crazy because they want to show that they can do a problem that you had struggled with. You know how to do it, but you give them that impression. But you can't do that too often or [the pupils] will think you don't know anything," but occasionally, say, "Hmmm. I don't know how to get that done. I'll get back to you tomorrow. We'll come back to this." Sometimes maybe you don't actually know the answer so then you can do a good bluff there and do a little research after (Instructor Cooper, Session #4, 2 October 2012).

Instructor Cooper's commentary on the significance of content, how to teach that content, and how to engage PK-12 pupils in that content drew on his teaching and pedagogical expertise. More importantly, by sharing this example, Instructor Cooper simultaneously demonstrated how the university students, as educators, have the capacity to encourage pupil participation.

Throughout this lab, the university students had various opportunities to vocalize their reflections on the teaching and planning of mathematics. Among others, two important statements need to be shared. First, university students reflected on and acknowledged the need to plan lessons better. Second, they acknowledged the importance of having a comprehensive understanding of the content that needed to be taught. Johanna illustrated these two tenets, admitting, "I know that I have to plan lessons better and probably know the material better" (Johanna, Session 5, 9 October 2012). Dana also acknowledged a requisite need to improve her pedagogy for younger students: "I'm going into early childhood. I know that I need to improve my teaching skills" (Dana, Session 4, 25 September 2012). One of Penny's reflections shared the

experience she had as a pupil: "If I had learned math this way when I was in grade school, I might have liked [math] better then and now" (Penny, Session 4, 25 September 2012). These reflections acknowledge a personal expectation to expand their content knowledge and "knowing the material better" (Johanna, Session 5, 9 October 2012), in tandem with knowing how to teach that content to particular PK-12 pupils.

These reflections are important because during and after some of the teaching presentations, the lack of content knowledge and absence of pedagogical skills became very evident, as in the lesson Karen and Dana implemented. Although the Lab concentrated on teaching mathematics to third through eighth graders, many of the university students struggled to answer the group's questions about the lessons. In some instances, clarifying questions were asked of the presenting group, and in some instances looks of confusion washed over the presenting university students' faces as they stood silently trying to figure out how to answer the question.

Another such instance took place during the lesson on "6.G.1 Solve real-world and mathematical problems involving area, surface area and volume" (Mathematics Pedagogy Lab Syllabus, 2012). In this lesson, Paige asked, "My question is when looking at a triangle, why can't you just take half the base times half the height and come up with an answer? It just got kinda confusing the way you presented the information," (Paige, Session 4, 2 October 2012). Before the presenting group could respond, Instructor Cooper added, "You might see a sixth grader ask that question, and what are you going to do? You might think to yourself, don't ask me that question!" (Instructor Cooper, Session 4, 2 October 2012). The group simply did not respond. This might have been due to a lack of content knowledge, a lack of pedagogy, or a combination of both.

Regardless, their silence indicated their discomfort in teaching this sixth- grade content or knowing how to answer the question clearly.

Instructor Cooper pushed the class, "What other things were you guys uncomfortable with? That you would recognize a sixth grader being uncomfortable with during that demonstration?" (Instructor Cooper, Session 4, 2 October 2012). This line of questioning was important because it encouraged the university students to immediately reflect on what might take place during a lesson, and the importance of being prepared for events that may unfold in a PK-12 classroom. To an outsider, Instructor Cooper's question might have been perceived as discourteous, but the carefully established classroom community encouraged the giving of constructive feedback to the presenting group. This community was established because the group was taught to reflect on the lesson and offer constructive commentary to collaboratively improve each other's professional practice. He explained:

> This, the purpose of providing feedback really is to, not just to say, what a great job everybody did, but to point out ways in which this could be improved. Whether when the presenters actually teach this topic in a classroom, would they do it better than they did it this time. And as the lab went on they just got more comfortable and perhaps more of them had received criticism from their peers so they were ready to give back (Instructor Cooper, Concluding Interview, 27 November 2012).

It is important to note that all of these university students were in the beginning stages of their teacher preparation (Table 5), and in some cases, had only begun thinking about entering the teaching profession. Therefore, while some of the university students

had apparent content knowledge gaps in their micro-lessons, each learned a different way of thinking about how to plan and implement challenging content for the future. Although Dr. Rugts identified areas of weakness in the micro-lesson, he emphasized the overall benefit of this initial teaching experience:

> "During one of the presentations, a student came up with another strategy and the group wasn't ready for it. So they learned they have to be ready for the different ways students share answers. So I would like to say that perhaps this [experience] they do have a better appreciation for the depth of content knowledge that they need" (Dr. Rugts, Concluding Interview, 29 October 2012).

While some of the university students lacked the content knowledge and genuine understanding of the intricacies of lesson planning, this Lab became a space for university students to reflect on the various aspects that were successful, in addition to acknowledging the areas needing immediate improvement. If this reflection and responsiveness did not occur, Instructor Cooper stressed the negative long-term effect this could have on an educator's professional practice:

> Yeah, it's kind of like, "I'm going to turn off because I know what you are telling me" or really it's because they *think* they know all the information. And they keep telling themselves, "You don't have to tell me because I know the right way to do it." Teachers should be more open. At least consider something new. Try it. You might get in that classroom, and there might be one of those teachable moments that you go, "Whoa. That really worked. I'm going to keep trying that" (Instructor Cooper, 27 November 2012).

Practicing the notion of being responsive to, accepting, and providing critical feedback established a potential pattern to improve the university students' development of their professional teaching practice.

Faculty Reflections on the Mathematics Pedagogy Lab

The perspectives and reflections shared by Instructor Cooper and Professor Rugts provided additional insights on how teaching, learning, and pedagogical content knowledge development took place during the lab. Similarly to the Environmental Science Pedagogy Lab, a key facet of this Mathematics Pedagogy Lab provided university students with a safe and positive learning environment, while also stimulating exploration and risk taking. This was accomplished by requiring university students to collaborate and work in small groups to develop and present a microteaching segment on an assigned mathematics content standard. Recall that for many of the university students, teaching an actual lesson was their first experience embodying the behaviors of a teacher and instructing a larger group of learners. As Instructor Cooper noted, it was important that the Lab be a space where university students could cultivate the behaviors and attitudes of an excellent teacher. He elaborated:

> I was always open with the [university] students, definitely non-threatening. I guess I kind of describe my ideal for any teacher would not to be a sage on the stage, where you're the espouser of knowledge and you know everything and you're trying to put it into their heads. Teachers should be seen more as a facilitator of instruction, a facilitator of learning, that's what makes a good teacher (Instructor Cooper, Concluding Interview, 27 November 2012).

Instructor Cooper also asserted precisely what teachers should not become; he pointedly selected the terms “sage on the stage” and “espouser of knowledge” during the initial lab, in addition to repeating these undesirable characteristics during the concluding interview (Instructor Cooper, Session 1, 19 September 2012; Instructor Cooper, Concluding Interview, 27 November 2012). As a veteran educator, Instructor Cooper stressed that future PK-12 pupils should not be perceived as empty vessels or passive participants waiting to be filled with irrelevant knowledge. Instead, the teachers should strive to foster mutual learning among peers, colleagues, and students. Instructor Cooper exemplified this outlook and reaffirmed it throughout the five weeks of the lab:

> I would say to [the university students], I don't look at our relationship hierarchically, that I'm here and you're there. I'm looking at we're both professionals; that you're going into this profession and you're going to become a teacher and I'm a teacher also. Let's get as much as we can out of this together (Instructor Cooper, Concluding Interview, 27 November 2012).

This is a significant statement, as it indicates the mutual respect that is necessary in any teaching and learning environment, whether that is with PK-12 pupils or with adult learners in a university classroom.

For pre-service teachers to become successful educators, they too need a learning environment that is courageously supportive and collaborative between instructors and peers. Thus, Instructor Cooper emphasized mutual respect through his recognition of the essential need to build a sense of community in any classroom. Here, Instructor Cooper and Dr. Rugts explain how they grouped university students together:

> In fact, we thought about how are we going to assign their [micro] lesson that they were involved in. We didn't know those students. We thought about we'll give the easier tasks to the younger students and the ones that are more experienced, but then, we realized that the different grades didn't matter, we had some freshman who were outstanding math-wise. So what we did was we tried to comingle the groups where we had a freshman, a senior and a junior, or whatever, so that they had three people so they could learn from each other (Dr. Rugts, Concluding Interview, 29 October 2012).

This grouping strategy was intended to prevent any university student from feeling alienated, and more importantly, to distribute the academic and experience levels. Instructor Cooper and Dr. Rugts also wanted the university students to recognize each other as members of a collaborative effort in teacher preparation, rather than a classroom full of strangers. Thus, similarly to the Environmental Science Pedagogy Lab, much of the success observed during the Mathematics Pedagogy Lab could be attributed to the positive learning environment purposefully conceived and fostered by Instructor Cooper.

The Lab's positive learning environment could also be attributed to the self-reflection Instructor Cooper demonstrated during each of the Lab sessions. Instructor Cooper modeled and articulated what he had learned from the various micro-lessons and how this would influence his own future teaching. He often made exclamations like, "I never thought of that for the 176 class.[14] If I did teach that class now, I would claim it as my own! Very creative" (Instructor Cooper, Session 4, 2 October 2012). This symbolic learning between teacher and student was important during the concluding interview.

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[14] The numbers '176' designates a course number, which is titled Mathematical Explorations for Elementary Teachers.

Instructor Cooper emphasized his own development through his Pedagogy Lab experience:

> I did this Lab and you just grow professionally yourself. I just love doing that type of thing. I look at this as a professional development type of thing, for me, and those [university] students. Even though they're not in teaching yet, they are developing their profession and I am learning alongside them. If people walk away with 10% of what you're doing in class, that's good. That's enough (Instructor Cooper, Concluding Interview, 27 November 2012).

This perspective on teaching and learning is powerful, as it indicates that regardless of Instructor Cooper's status as a retired classroom teacher with decades of experience, he believed that the university students could teach him something new; this supports the idea that professional development has no end point (Bales & Mueller, 2008). As the next iteration of the Lab unfolds, one might want to further examine how university faculty and instructors embrace the opportunity to learn from university students. In doing so, they will establish a genuinely collaborative learning community.

The success of the Mathematics Lab could also be attributed to the extensive collaboration that took place between Instructor Cooper and Dr. Rugts. They hoped each of the five Lab sessions was meaningful for the university students. Here they sum their experiences:

> We probably spent as much time planning as we did in [teaching] the classroom situation. I think we tried to get that across to the kids, that if you're going to have - I'm sorry to say kids – the [university] students in the classroom, but they have to recognize that you don't just walk into a classroom and say, "Okay, we're going

> to do this today," without putting some thought into it and what are the questions that you want to ask of those students, what are your objectives? What should they walk out of the class with that they didn't have when they walked in? (Instructor Cooper, Concluding Interview, 27 November 2012).

Although Instructor Cooper and Dr. Rugts had a previously established working relationship, both instructors identified a tremendous gratitude for one another and the effort that went into designing and implementing this Lab.

Instructor Cooper suggested the lab's success was due to the unifying of two features. The first feature was Dr. Rugts' attention and knowledge of the required content pre-service teachers should be immersed in. The second feature emphasized cross-collaboration. He explained:

> [Dr. Rugts] did an outstanding job of finding Common Core objectives from 2nd, 3rd, 5th, 6th, and 8th, grade, so the [university students] could see how there's a common thread that goes through there. Additionally, I would keep the communication with the individual groups. I thought that was really valuable because those students could sit down with you and say - I think they felt, "Hey, this is a real person that I can deal with. He's a teacher" (Instructor Cooper, Concluding Interview, 27 November 2012).

Dr. Rugts also shed light on the university students' success with working collaboratively and the significance of the teaching the mathematics standards correctly:

> Typically when you have students give presentations like this and they critique each other, there is the chance you will only get poor presentations and everybody says, oh, that was great. One of the ways that we avoided that, I think, was

> having [the university students] talk to us beforehand. Without that we would have had a lot of presentations that didn't address the standards they were asked to present. We would have had presentations that didn't go deeply enough or weren't interactive enough to keep the class interested (Dr. Rugts, Concluding Interview, 29 October 2012).

To Dr. Rugts, a professional learning community is successful when there are multiple opportunities to inspire courageous support and constructive criticism:

> When we had the discussion after the presentations, if the presenting [university students] hadn't done a particularly good job, I encouraged people in lecture to tell me. I mean they have to, you have to learn to take professional, constructive criticism in a professional manner (Dr. Rugts, Concluding Interview, 29 October 2012).

From these concluding statements, it is important to present the information garnered from this Mathematics Pedagogy Lab and the various methods in which the participants created meaning. First, the importance of building a positive university learning community for pre-service teachers is significant. This supportive environment and the microteaching segments during the five sessions of the Lab, and within that, the microteaching segments, encouraged active participation as well as critical, yet valuable, peer and instructor feedback. The notion of courageous support emerged as Dr. Rugts, Instructor Cooper, and various university students shared honest reflections on their accomplishments and areas for improvement upon the conclusion of each teaching presentation. This is courageous because university students felt confident enough to move away from the scant meaning of saying "good job," or nothing at all, toward

critically examining particular areas for improvement without fear of repercussion. In particular, it is important to reiterate that many of the university students had never before had the opportunity to teach or plan a lesson based on academic standards. Therefore, the university students began to understand the necessary components of the successful teaching of specific content and, in turn, how to identify when those elements are not present in a lesson.

Reoccurring Themes

In a way similar to the previous case studies, the notion of collaboration and professional development emerged among both university students and the instructors. As presented earlier, Instructor Cooper was quite genuine when sharing the significance of collaborating with Dr. Rugts, and how that collaborative planning positively impacted the outcome of the Lab. Further, this notion of collaboration was an important area that Instructor Cooper hoped the university students grasped through the opportunity to collaboratively plan a mathematics lesson. Throughout this lab experience, collaboration with both instructors and peers was an important tool used to encourage confidence in both understanding the content and presenting it to a larger audience.

Another important concept that emerged was that of courageous support among the university students. The atmosphere of the Mathematics Pedagogy Lab encouraged feedback and constructive criticism of the pre-service teachers presenting each microteaching lesson. The university students shifted past the simplistic terms of "good job," and could explain what in the presentation needed to be clarified. Receiving this type of feedback can be intimidating, but because the climate was genuinely positive,

university students accepted the feedback and further engaged in the discourse of how to improve future teaching practices.

Upon the conclusion of this Mathematics Pedagogy Lab and the entire collective case study, a multitude of experiences and perspectives from both the university students and instructors have been presented. These perspectives shed light on particular areas for future consideration, as well as affirmed how vast the area of pre-service teacher development is. Thus, as this concluding statement from Dr. Rugts does an excellent job recapitulating, "There's an awful lot of things that could go into good teaching and I'm not sure we know what all of them are yet" (Dr. Rugts, Concluding Interview, 29 October 2012).

Cross-Case Analysis

In this final section, I synthesize the four constructed Pedagogy Lab cases to evaluate and elucidate the events that occurred between the university students, the faculty, and the content. This back-and-forth action of investigating cases, individually and as a whole, constructs a stronger research design (Gerring, 2007; Stake, 2006). Particularly, this "cross-level inference" (Gerring, 2007, p. 1) is significant when experiencing "the steady tension between the unique, contextually specific nature of single sites and the need to make sense across a number of sites" (Yin, 1981, p. 62). This tension allows themes to untangle and assertions to become evident (Stake, 2006).

I begin with the three attending research questions, presenting each in order to enhance the final presentation of findings for the overarching research question. For each of the attending questions, I provide assertions garnered during the analysis and presentation of the data disseminated from the individual cases. In closing this analysis, I

present the overarching research question to further understand the notion of pedagogical content knowledge and how the participants engaged with the facets of this concept. To accomplish this goal, I will apply the theory of liminality (Cook-Sather, 2006), along with the Ball, Thames, and Phelps (2008) diagram as a framework for analysis. This diagram was introduced in Chapter 3 and presents the six domains of pedagogical content knowledge, including how these domains are categorized under pedagogy and content knowledge (Figure 1).

Attending Research Question 1: How does participation in a Pedagogy Lab shape urban pre-service teachers' understanding of pedagogical content knowledge (PCK) as it relates to working in urban schools?

Assertion 1: The university student participants in this study initially struggled with the term pedagogical content knowledge; yet, similarly to the process occurring in PK-12 pupil learning, pre-service teachers best constructed their understanding of PCK when it was directly correlated to their lived experiences. Broadly speaking, the purpose of all the pedagogy labs was to introduce and elaborate on the concepts of pedagogical content knowledge and to present how that conceptual framework would become evident in future incidents of teaching and learning. Initially, the terminology used to explain the labs posed a challenge for most of the university students as they struggled to break down and understand the abstract concept. During their implementation of the four labs, instructors and faculty members approached the construction of PCK through various methods. These methods included having university students read the Ball et al. (2008) literature, view PowerPoint lectures, and participate in online discussions. When the faculty and instructors directly bridged the

concepts of PCK to the lived experiences of the university students, a sense of clarity emerged. In fact, this clarity occurred on multiple occasions and through various methods.

The Political Science Pedagogy Lab intentionally communicated the notion of pedagogical content knowledge as the amalgam of knowing and teaching current and controversial topics. By introducing these current topics, the university students employed their own background knowledge to make sense of how to teach the content and, in turn, conceived of potential learning opportunities for future PK-12 pupils. Some university students – for example, Matthew, Jaimie, and Lindsey – gained a deeper awareness of how to portray their burgeoning PCK into appropriate learning opportunities. As previously mentioned, of the 13 university students in the Political Science Pedagogy Lab, only Matthew and Lindsey chose to create the political science lesson plan to demonstrate their acquired knowledge base.

The Environmental Science Pedagogy Lab represents another instance when university students engaged in the development of pedagogical content knowledge in tandem with an exploration of their lived experiences. During this Lab, the characteristics of the university students varied across levels, years of professional teaching experience, and initial methods course work. Because of this variation, the instructors were strategic as they scaffolded the meaning of PCK for the university students. Similarly to the outcomes observed in the Political Science Lab, the university students in the Environmental Science Pedagogy Lab constructed a foundation to grasp the content of environmental justice and the pedagogy applicable for that particular subject matter. In this Lab experience, the university students were required to explore

their own urban community and construct meaningful experiences from their self-constructed awareness of the social justice issues in the immediate community.

The well-known theory of teaching by building on PK-12 pupils' reserves of knowledge (González, Moll, & Amanti, 2013) became evident during each Pedagogy Lab. Those university students who made a direct link between their own experiences, the subject-specific content and pedagogy, had a deeper understanding of pedagogical content knowledge, an outcome which was reflected in their teaching plans for how they would embrace and facilitate that knowledge for their future classrooms.

Assertion 2: The setting for these Pedagogy Labs was an urban institution; yet, the participants' awareness of teaching and learning in the urban context varied significantly. Thus, pedagogical content knowledge in respect to urban teaching and learning was not thoroughly constructed across all the labs. All of the university students who enrolled in the pedagogy labs did so due to an interest in teaching and PK-12 pupil learning, yet this did not immediately translate into an interest in *urban* teaching or *urban* pupil learning. Urban University's School of Education upholds a dedication and emphasis for the urban context, in conjunction with a desire to provide equitable opportunities for students, families, and community members. Although this is a unifying principle, stark contrasts were evident between the university students who comprehended the unique characteristics of urban teaching and learning and those who had little to no knowledge or experience with urban schools. In the four Pedagogy Lab settings, it could not be assumed that each university student embraced equivalent beliefs about urban teaching.

A small number of university students across the labs expressed a tremendous passion and desire to become urban educators. For example, based on the online discussion posts, reflective assignments, and lesson plans, Laura (Chemistry/Biochemistry, Environmental Science), Matthew (Political Science), Mara (Environmental Science), Frida (Environmental Science), and Melanie (Environmental Science) articulated an astute awareness of the critical, urban pedagogical elements necessary for pupil success in urban classrooms.

Laura emphasized a need for urban pupils to receive a deeper level of content to decrease the achievement gap between urban and suburban pupils. Matthew referred to some urban pupils' lives as difficult, yet affirmed that educators should focus on how to connect positive learning experiences to the lives of these young people. Mara, Frida, and Melanie all directly identified the issues between the deficient, and even subtractive, education some urban pupils receive. Mara in particular vehemently expressed her concern for urban educators who are too "lazy" to construct unique learning opportunities and stated her intention to provide a rich learning environment for her future urban pupils. All five of these university students expressed a concern about marginalized learning environments, whether their concern was based on a classroom observation in a field placement or came from their own personal teaching experience. Notably, these five university students also had the greatest amount of experience in the classroom as either a pre-service or in-service teacher. Immersing these future teachers into the urban context appears to promote an acute awareness of the pedagogical practices necessary for academic success of urban pupils. This evidence supports the idea that pre-service teachers should be immersed immediately into the urban context.

Although all four pedagogy labs were intended to bridge the objectives with urban teaching and learning, only the Environmental Science Lab explicitly included components for discussion and analysis of pedagogy and pedagogical content knowledge for teaching and learning in the urban context. Thus, this situation reveals another possible assertion: Instructors and faculty who facilitate the preparation of urban teachers must overtly include opportunities to engage in and construct pedagogical content knowledge with the urban classroom in mind.

Assertion 3: Misconceptions existed among the pre-service teachers in this study as they expressed positive, negative, and preconceived notions of teaching and learning and the pedagogical content knowledge contained therein. All of the university students enrolled in the four pedagogy labs possessed preconceived beliefs about teaching and learning in PK-12 schools. Interestingly, the intensity of preconceived notions and the outright severity of negative misconceptions varied.

A commonly accepted tenet of urban teacher preparation holds that pre-service teachers, specifically white pre-service teachers, often have negative and deficit assumptions of pupils and pupil learning (Delpit, 1992, 2006; Groulx, 2001; Ladson-Billings 2000; Moll et al., 2004). The pedagogy labs yielded similar outcomes, yet through the labs' design, university students had opportunities to address their misconceptions in a constructive way.

Similarly to the findings seen in the aforementioned research by Ladson-Billings (2000) and Moll et al. (2004), a few of the university students in this study imagined themselves acting as purveyors of knowledge or giving knowledge to pupils for the sole purpose of memorization and recall (Calderhead & Robson, 1991; Feiman-Nemser, 2001).

Eugene (Political Science) and Laila (Political Science) believed that controversial topics were inappropriate for fifth-grade pupils. They stated their concern that pupils would get upset or that they would fall into "frenzied giggles." Devin (Political Science) presented himself as a sole resource of knowledge, imagining his perfect classroom as a space where he controlled the learning and pupils had to seek out the teacher for answers. Brendan (Chemistry/Biochemistry) and Karissa (Chemistry/Biochemistry) perceived that pupils lacked necessary knowledge that only the teacher could provide, which is disturbingly similar to the belief that pupils are empty vessels (Freire, 1970).

The university students' other misconceptions involved the actual practice of teaching – the pedagogy. Across the four labs, university students had rather unique and somewhat ambiguous self-constructed perceptions of the elements that made up teaching. Laura (Chemistry/Biochemistry & Environmental Science) identified a perception that science automatically lends itself to be a fun subject for pupils and that it would be rather easy to include the subject matter into the classroom. As discussed previously in the Chemistry/Biochemistry Lab, the concept of "fun" could be perceived in many ways. Additionally, the term "fun" is so ambiguous that it does not appropriately capture the true idea of constructive learning.

Joe (Chemistry/Biochemistry) and Brendan (Chemistry/Biochemistry) identified an additional misconception that future educational methods coursework would be too restrictive and prescriptive. Elaborating further, both suggested that lesson planning would become an arduous, uncreative chore made mandatory by faculty.

Mara also conveyed a preconceived notion of teaching, specifically that many urban teachers were "lazy" if they did not construct and integrate multidisciplinary

content for PK-12 pupils. Notably, the beliefs presented by Laura, Joe, Brendan, and Mara are not detrimental to the academic success of future pupils or insensitive to the pupils' background experiences. Rather, these misconceptions insinuate a negative perspective of teaching and reveal the perceived challenges pre-service teachers face as they develop into professional educators. Perhaps the university students are employing a deeper level of critical thinking.

Assertion 4: For the pre-service teachers in this study, the process of becoming a teacher cannot be accomplished in an isolated environment of only content or only pedagogy. Learning content in tandem with how to teach the content helped solidify the notion of pedagogical content knowledge. The experiences garnered from the four pedagogy labs presented the idea that content and pedagogy cannot be developed in isolation. The action of learning and/or reinforcing the content concurrently with developing the pedagogy to teach that content helped solidify the notion of pedagogical content knowledge. Repeatedly, throughout the four Labs of Political Science, Chemistry/Biochemistry, Environmental Science, and Mathematics, university students described the benefit of learning pedagogy and content synchronously. University students in the labs repeated the same sentiment – learning how to teach the content improved their own awareness and clarity with the subject matter.

The university students' experiences in the Pedagogy Labs seem to confirm the understanding that pedagogical content knowledge is comprised of various facets, which cannot be experienced in isolation. In addition, navigating each facet of pedagogical content knowledge seemed to further solidify complex content, and at the same time, knowledge of the intricacies of the content solidified the university students' pedagogy.

Laura (Chemistry/Biochemistry & Environmental Science) demonstrated this phenomenon as she struggled through the initial chemistry content. In the beginning of the Chemistry/Biochemistry Lab, Laura constructed a weak and inappropriate lesson plan based primarily on a Dr. Seuss text, lacking rich content. As Laura continued to build on her content knowledge, pedagogical skills followed, and as she developed her pedagogical skills, content followed. At the conclusion of the Chemistry/Biochemistry Lab, Laura produced an appropriate and rich lesson plan on chemical properties, which Dr. Kelly and Dr. Lindsey noted.

The Environmental Science Pedagogy Lab encouraged similar university student sentiment about simultaneously learning pedagogy and content. Mara (Environmental Science) and Laura (Chemistry/Biochemistry & Environmental Science) acknowledged a greater awareness of the facets of pedagogical content knowledge, which were exposed through presentation of environmental science content, discussion of associated issues of social justice, and reflection of how these facets intersected with urban teaching and learning. Specifically, Mara and Laura recognized the value of developing an integrated curriculum, in addition to gaining a greater awareness of how to gather the necessary content applicable to individual pupils.

This inclusive PCK process also appeared to have an impact on the university students enrolled in the Mathematics Pedagogy Lab. Once again, university students recognized a deeper understanding of the content and how to *effectively* teach that content to various grade levels and pupil interests. While the depth of content and pedagogy achieved varied across the labs, learning these elements concurrently improved the university students' understanding of pedagogical content knowledge.

Attending Research Question 2: In what ways do urban pre-service teachers who participated in a Pedagogy Lab translate their developing PCK into learning opportunities for students attending urban schools?

Assertion 5: Although the pre-service teachers in this study had little to no formative teaching experience, they demonstrated a rich potential to demonstrate effective teaching and learning concepts. However, only a small number of university students linked the urban context with effective pedagogical content knowledge to develop learning opportunities for pupils. All the university students participating in this study engaged in the discovery and implementation of skills necessary to construct learning opportunities for PK-12 pupils. Primarily, the discovery emerged due to the constructive discourse surrounding the three overarching themes of (a) inquiry-based learning, (b) making content relevant, and (c) getting to know pupils past a superficial level. This participation allowed the university students to actually implement concepts discussed through the various modes of learning made available in each of the pedagogy labs. Analysis of academic standards, construction of lesson plans, and participation in their own hypothetical learning opportunities provided the participants with multiple opportunities to construct the learning opportunities for PK-12 pupils. However, the depth and breadth of critical knowledge varied among the university students, in addition to their awareness of urban teaching and learning. For some in this study, ideas surrounding pedagogical content knowledge and urban teaching emerged richly through the conversations and submitted lesson plans. For other university students, only a superficial awareness materialized.

Matthew (Political Science), Lindsey (Political Science), and Lisa (Political Science) recognized the need to make and provide relevant learning experiences for pupils to achieve the quintessential "light bulb" moments. In fact, the lesson plan Matthew constructed for the final political science project followed the key steps necessary to plan and teach a rich learning opportunity. Matthew recognized that the hypothetical fifth-grade pupils needed to bridge their prior lived experiences with the new content. Recall, Matthew designed a lesson plan for students to construct their own classroom constitution in tandem with learning the complexities of state government and amendments. By asking pupils to contribute their expectations for classroom laws, Matthew recognized the need to empower pupil learning as well. This three-pronged lesson planning, which included students' lived experiences, rich content, and student empowerment, challenged Matthew's developing understanding of how to implement pedagogical content knowledge.

On the other hand, Jonathan (Political Science) did not choose to create a final lesson plan; thus, he did not present a concrete implementation of his pedagogical content knowledge for pupil learning. He did, however, emphasize his vision of a rich, inquiry-based classroom—a space where pupils would explore topics, discuss areas of interest, and ask questions, all by the pupils' own volition. Thus, he could discuss his vision for teaching, yet the actual construction of a lesson plan was perhaps too daunting or time-consuming.

The Chemistry/Biochemistry Lab also exposed the levels of understanding university students had of implementing pedagogical content knowledge in a teaching and learning opportunity. This Lab required all university students to construct a final

lesson plan to demonstrate their understanding of pedagogical content knowledge. For learning to be meaningful, Larisa, Joe, Laura, and Abbie explained that pupils must receive multiple opportunities to see and interact with relevant content. In particular, Joe identified the need for teachers to create a tailored education for pupils in respect to academic science standards, simultaneously considering the various ways people learn and comprehend complex information. Yet only Laura, who was already enrolled in a teaching preparation program, made the distinct link between pedagogical content knowledge and urban teaching. Laura expressed her fear of a subtractive education, where urban pupils do not receive adequate experiences with core content areas. Laura emphasized the need for the construction of lesson plans to be grounded in the correct academic standards while encouraging inquiry-based learning opportunities to make content relevant.

In the Environmental Science Lab, inquiry-based learning and urban teaching practices were integrated as core elements of the course. This required university students to conceptualize pedagogical content knowledge into learning opportunities specifically for urban pupils. In different ways, Mara, Frida, Laura, and Melanie all expressed a genuine interest of incorporating inquiry-based learning opportunities in the classroom. For Mara and Laura, both pre-service teachers, enthusiasm for pupils to engage in critical conversations surrounding environmental and social justice issues was a key for success among urban pupils. For Frida and Melanie, both in-service teachers, inquiry-based learning opportunities were time-consuming and challenging to create. This was due to the restrictive teaching and learning expectations of their school curriculum. Additionally, Frida remarked that a teacher's lack of content knowledge

prevented the appropriate implementation of various aspects of pedagogical content knowledge. All four of these university students acknowledged the need for educators to implement inquiry-based teaching and learning practices for the urban classroom, which would afford advanced learning opportunities for urban pupils.

University students participating in the Mathematics Pedagogy Lab ultimately had the most tangible opportunity to conceptualize and implement standards-based learning opportunities for future PK-12 pupils. The university students varied in their pedagogical abilities to capture and maintain the interest of the audience, revealing that teaching peers is a challenge in itself. The complex vertical and horizontal mathematics standards added to the difficulty of developing learning opportunities. In this instance, presenting university students received immediate, courageous feedback from peers regarding their pedagogical content knowledge and their ability to teach the content well. This style of reflection and consideration appeared to strengthen the university students' pedagogical content knowledge, as their microteaching experiences improved weekly.

When the university students were provided the safe space in the labs to express their perceived ideal teaching and learning environment, advanced lessons emerged. In part, this could be due to the scaffolding that took place within all the labs as university students constructed the various lesson plans and experienced learning opportunities. Additionally, the lack of boundaries or rigid expectations may have also contributed to a safe environment to explore various ways to implement pedagogical content knowledge.

Assertion 6: Each of the labs in this study became spaces for university students to conceive and construct inquiry-based learning opportunities as a facet of pedagogical content knowledge. Throughout the four labs, inquiry-based learning

emerged as one of the most favorable pedagogies to employ in the PK-12 classroom. Bridging inquiry with content specific topics made this an effective example of a pre-service teacher's burgeoning awareness of pedagogical content knowledge. University students in this study perceived a high level of PK-12 pupil enthusiasm and excitement through the discovery and exploration of subject matter. Inquiry- based learning was deemed to be a strategic tool to encourage full engagement and retention of important concepts.

Jonathan (Chemistry/Biochemistry) emphasized the creation of opportunities for pupils to explore and discover answers to their own questions. Laura (Chemistry/Biochemistry & Environmental Science) hoped for pupils to ask questions about their surrounding environment. Joe (Chemistry/Biochemistry) noted his intention to act as a facilitator in the classroom and hoped to encourage "give-and-take" between pupil and teacher, keeping a heightened awareness to adapt as events unfolded in the classroom.

In contrast, Frida (Environmental Science) and Melanie (Environmental Science), both in-service teachers, cautioned that teachers could not realistically implement inquiry-based learning opportunities for every content area and every lesson. While they did acknowledge that inquiry-based learning was necessary for pupil learning, both shared their insights surrounding the changing environment of urban schools, emphasizing that inquiry-based teaching might be unrealistic and challenging. Due to the near-elimination of social studies and science subject matter, Frida and Melanie felt constricted by the prescribed curriculum of additional interventions for mathematics and reading. However, this admission of a restrictive curriculum did not prevent Melanie

from constructing an engaging environmental science lesson plan, with a focus on inquiry-based learning. Further, Melanie intended to implement more inquiry-based learning opportunities in the next school year with her own elementary pupils.

Assertion 7: Academic standards, as well as the method in which content builds in both horizontal and vertical ways, were presented in all the Pedagogy Labs to demonstrate connectivity between subject matter and grade levels; this encouraged the university students in the study to construct appropriate and meaningful learning opportunities for potential PK-12 pupils. Across the four pedagogy labs, PK-12 academic standards were targeted as a significant area for developing educators. All the university students participating in the four labs gained insights into how academic standards guide the trajectory of teaching and learning. Although academic standards were introduced in all the labs, the standards were most closely examined in the Chemistry/Biochemistry Lab and the Mathematics Lab. In particular, the emphasis on standards-based learning rested on the evolution of topic to topic and grade level to grade level. This vertical and horizontal trajectory became visible within the lesson plans and learning opportunities designed by the university students enrolled in those labs.

Joe (Chemistry/Biochemistry) crafted a lesson plan on matter and molecules. The teaching and learning opportunity was based on a sound awareness of the academic standards, with the support of pedagogical content knowledge. Joe employed active, engaging, and inquiry-based strategies to convey how molecules function. The interests of the pupils were at the forefront of this lesson, illustrating Joe's sensitivity to making learning accessible for future pupils.

Abbie (Chemistry/Biochemistry) designed a learning opportunity involving the baking of cookies to demonstrate chemical properties and how those change. Similarly to Joe, Abbie positioned the hypothetical pupils in the forefront of her lesson planning. Taking into consideration the complexity of chemical change and the manner in which people learn, Abbie expanded her lesson to include distinct checkpoints and questions designed to ensure pupil learning. This lesson-planning experience provided university students with a firsthand opportunity to implement the learned pedagogical content knowledge.

All the university students in the Mathematics Pedagogy Lab crafted and presented a microteaching segment on some of the more challenging mathematics concepts: orders and operations, fractions, and geometry. Although the process of teaching this content was difficult for some university students, and the robustness of each teaching segment varied, the notion of standards-based teaching was not discounted. All of the university students placed the mathematics standards in the forefront of their presentations.

Attending Research Question 3: In what ways do faculty instructing the Pedagogy Labs promote and provide opportunities for urban pre-service teachers to engage in the development of pedagogical content knowledge as it relates to working in urban schools?

Assertion 8: During the Pedagogy Labs, the faculty members in this study illustrated how pedagogy and content knowledge wove together, forming the tapestry of pedagogy content knowledge. Yet, instructors and faculty remained deeply rooted in their own beliefs that one knowledge base was more important than the other, further

presenting the complexities of pedagogical content knowledge. All of the pedagogy labs engaged prospective teachers to understand how pedagogical knowledge and content knowledge weave together to create a complex foundation for successful teaching. However, for some of the faculty and instructors participating in the study, it was challenging to succinctly combine the two bodies of knowledge and weigh them equally. Across the four labs, a common and ongoing debate emerged about which was more important for a teacher's success, pedagogy or content. In part, this was due to the faculty and instructors' own beliefs about teaching and learning. These perspectives provided university students numerous opportunities to engage in the complexities and ongoing debate of pedagogical content knowledge.

Faculty members Dr. Kelly (Chemistry/Biochemistry), Dr. Lindsey (Chemistry/Biochemistry), and Dr. Rugts (Mathematics) believed that content knowledge was the most important characteristic of any teacher, developing or veteran. These faculty members further emphasized that future teachers should first construct a deep content knowledge and, only after that, develop pedagogical strategies to teach that content. An interesting phenomenon occurred as Dr. Kelly, Dr. Lindsey, and Dr. Rugts voiced the identical concern that the term "fun" should never be used to describe interesting or exciting learning opportunities. Rather, teaching should focus first on the content, and clearly communicate that to pupils.

Dr. Kelly and Dr. Lindsey agreed that a teacher who lacked content knowledge endangered pupil learning; thus, a deep understanding of content knowledge must always come first for educators. There was a sense of disappointment from Dr. Kelly and Dr. Lindsey as they remarked on the lack of chemistry knowledge observed among the

university students in the lab. They both remarked that a great deal of the lab's content was simply too advanced for the university students. However, even with this expressed frustration, an interesting perspective surfaced: both Dr. Kelly and Dr. Lindsey acknowledged that perhaps pedagogical knowledge did not receive an adequate amount of attention during the lab.

Likewise, Dr. Rugts expressed a belief that a critical awareness of content was the most important knowledge a teacher could have. Dr. Rugts embraced the belief that if a teacher does not have the content, he or she simply should not teach that particular subject or class. In addition, Dr. Rugts suggested that even possessing some of the additional professional skills, such as differentiation and awareness of how pupils learn, would not compensate for a teacher's weak or absent content knowledge.

In contrast, Dr. White (Political Science), Instructor Schiller (Political Science), Instructor Holly (Environmental Science), Instructor Hawthorn (Environmental Science), and Instructor Cooper (Mathematics) shared that a complex pedagogical knowledge was the critical element for educators.

In particular, Dr. White presented an interesting shift in his own thinking. First, he shared with university students that pedagogical knowledge was really *the* tool to make judgment calls regarding what pupils need in the classroom. Upon the conclusion of the Political Science Lab, however, Dr. White shared how his own pedagogical knowledge evolved due to teaching and learning alongside the university students. He hoped to make political science content more relevant for future university students. To accomplish this, Dr. White intended to incorporate university students' own interests and lived experiences.

Instructor Holly expressed the need for teachers to develop a sound pedagogical knowledge, asserting that these pedagogical skills influence the ways in which pupils make connections with the subject matter. Further, Instructor Holly expressed her concern about those teachers who only have content knowledge. From Instructor Holly's perspective, those educators might face extensive challenges as they attempt to disseminate the intricacies of content into robust learning opportunities for diverse pupils. She feared that a professional practice solely in content knowledge prevented educators' flexibility to comprehend why some learners have difficulty grasping complex subject matter.

Finally, Instructor Cooper (Mathematics) spoke of pedagogical knowledge as the art or science of teaching. Throughout the Mathematics Lab, Instructor Cooper referenced and modeled how teachers project their pedagogical knowledge and skills. During the Lab, he captured the meaning of this "art" as a way to encompass the multitude of ways teachers considered, engaged, and conducted a classroom full of learners.

Assertion 9: Faculty and instructors in this study established a relatively nonthreatening environment for university students to address preconceived beliefs about teaching and learning. This action led to courageous conversations and courageous support surrounding the development of pedagogical content knowledge. Humans innately hold various epistemological beliefs regarding how knowledge and knowing is constructed (Hofer & Pintrich, 1997). These beliefs are influenced by individuals' lived experiences, which typically include perceptions of the surrounding environment. All four of the labs became nonthreatening spaces where university

students could explore and question their beliefs regarding content and curriculum, pupil learning, and teaching practice.

Through online reflective postings, dropbox assignments, reflective writing, lesson planning, and microteaching segments, university students had opportunities to participate and engage in the construction of pedagogical content knowledge. The observed participation and level of engagement in all the labs took place in a low-risk environment, purposefully established by the faculty and instructors.

Both the Political Science and Chemistry/Biochemistry Pedagogy Labs relied on individual university student submissions through private online dropboxes. While this may have limited some cross-dialogue among the university students, Dr. White (Political Science) acknowledged that an open, online forum just did not work for the university students. From the single forum post, written by April (Political Science), Dr. White's assumption was that those enrolled in the Lab might be afraid to look stupid or be criticized as they navigated through the Lab. As mentioned, many of the university students struggled to initially comprehend the term *pedagogical content knowledge*. Thus, for the Political Science and Chemistry/Biochemistry Lab, the private dropboxes became a nonthreatening vehicle through which university students could submit work and receive faculty feedback. In their comments, Dr. White and Professor Schiller were encouraging, while also urging university students to think about other aspects of the questioning and teaching scenarios.

Conversely, the Environmental Science and Mathematics Pedagogy Labs engaged university students through a different teaching and learning dynamic. Although the Environmental Science Lab was held virtually, the university students were required to

participate within an online discussion board, encouraging a virtual critical discourse. Mara, Melanie, Laura, and Frida sustained a rich online dialogue integrating curriculum, urban teaching, inquiry-based practices, and getting to know pupils. Much of this Lab's success was due to Instructor Holly and Instructor Hawthorn's technological pedagogy, which encouraged the frequent and dynamic conversations among the university students.

The Mathematics Pedagogy Lab was held face to face, which, unsurprisingly, encouraged physical engagement among the university students and faculty. Dr. Rugts and Instructor Cooper facilitated the Mathematics Lab in this manner so that university students could provide one another with constructive criticism or courageous support. I suggest the term *courageous support* because university students were able to share their analysis of the group's teaching without fear or repercussions from peers or the faculty. Further, they had the initiative to speak up and directly point out flaws in the different microteaching presentations. Dr. Rugts even emphasized this courageous support as a way for pre-service teachers to "learn to take constructive criticism in a professional manner." This element continued to be evident through the behaviors and positive attitudes before and after each of the microteaching presentations. The nonthreatening learning environment encouraged university students to provide more elaborate comments and critical analysis than the empty term "good job." Better yet, faculty and university students verbalized specific incidents when the university students' teaching was unclear or where evident gaps resulted in misinterpreted content. Through this Mathematics Pedagogy Lab, university students successfully comprehended how pedagogical content knowledge was constructed and implemented from immediate and critical peer and faculty feedback.

Assertion 10: For the instructors and faculty facilitating the Pedagogy Labs in this study, cross-disciplinary collaboration encouraged professional development and professional awareness of teaching and learning practices. The instructors and faculty reflected on their own development and future implementation of pedagogical content knowledge with university students. Upon the conclusion of the four pedagogy labs, the faculty and instructors reflected and commented on the positive influence collaboration had on the success of the labs, as well as on their own professional growth. The method of pairing up faculty in different areas of expertise proved to be beneficial in portraying the various ways educators construct and interpret knowledge surrounding content and pedagogy. Although Assertion 8 presented that faculty tended to remain loyal to their beliefs about pedagogical knowledge and content knowledge, all the faculty members in the study expressed the benefits of *constructively* collaborating with someone from a different discipline.

The term *constructive collaboration* refers to the unique opportunity for faculty from different academic departments to collaborate, construct, and implement a Pedagogy Lab. Of the four labs, there was one anomaly – the Chemistry/Biochemistry Pedagogy Lab. During this Lab, both faculty members were from the same chemistry department, but possessed different teaching skills. Initially, during the concluding interview, both Dr. Kelly and Dr. Lindsey stated that they did not learn or experience anything new facilitating their Pedagogy Lab. Yet, further into the interview, Dr. Kelly and Dr. Lindsey presented how their perspective of teaching and learning had changed, and they described the implications for future Chemistry/Biochemistry Pedagogy Labs. Particularly, the educators expressed the notion that university students come from

various backgrounds, which may explain how some learners may struggle or grasp content differently.

Dr. White (Political Science), Professor Schiller (Political Science), Instructor Holly (Environmental Science), Instructor Hawthorn (Environmental Science), and Instructor Cooper (Mathematics) reflected and discussed the extent to which collaboration actually improved their own teaching practice.

Dr. White and Professor Schiller, both in the field of social sciences, joined together from different academic departments in Urban University. During the concluding interview, Dr. White and Professor Schiller shared how influential the collaboration was in connecting different disciplines and discussed the potential impact of collaboration on preparing future teachers. In particular, the educators recommended that faculty in other departments be cognizant of the purpose and work of the School of Education.

Similarly, the constructive collaboration between Instructor Holly and Instructor Hawthorn also influenced their professional practices. Although the two instructors were doctoral students in the same graduate program, they had had different professional experiences prior to facilitating the Pedagogy Lab together. Instructor Holly asserted that teaching the Lab was a unique opportunity to reaffirm her own pedagogical skills and expressed the realization that she was a stronger educator than she had imagined. Additionally, Dr. Hawthorn remarked on how collaborating with Instructor Holly changed her future pedagogical content knowledge when working with high-school pupils. Based on the experience of teaching the intricacies of inquiry-based learning,

Instructor Hawthorn realized she needed to provide a stronger student- centered learning environment.

Finally, the relationship between Instructor Cooper and Dr. Rugts was another example of constructive collaboration. Though both were very knowledgeable in mathematics content, Instructor Cooper had the deep pedagogical background from teaching at the high school level. Even so, Instructor Cooper was expansive in his description of teaching the Lab and expressed how much he had learned from both the university students and Dr. Rugts. Instructor Cooper particularly appreciated the depth Dr. Rugts gave to the academic standards, which acted as a guideline for the content of the Lab. Similarly, Dr. Rugts discussed the challenges he faced in the attempt to shift his own pedagogical practice, noting that it was "psychologically very hard leaving the lecturing mode." However, the collaborative effort between Instructor Cooper and Dr. Rugts encouraged Dr. Rugts to envision pedagogical content knowledge in practice. In particular, Dr. Rugts' concluding reflection summarized that pre-service teachers need not only to *learn* how to teach, but also to experience the sensation of "being a teacher in an actual classroom" (Dr. Rugts, Concluding Interview, 29 November 2012).

Findings on the Main Research Question

After the preceding discussion of each of the attending research questions, the conclusion of this cross-case analysis is now presented in the context of the findings on the main research question. This question and its conclusions are listed below.

How do urban pre-service teachers construct an awareness of the complexities of teaching, learning, and pedagogical content knowledge (PCK) through the structure of a Pedagogy Lab? To clearly explain the findings across the

four cases, I refer back to the theory of liminality (Cook-Sather, 2006), which I use in conjunction with the framework on pedagogical content knowledge as constructed by Ball et al. (2008). The majority of the university students participating in the pedagogy labs experienced a greater understanding of pedagogical content knowledge; the depth and breadth of this understanding is what differed. A few key conditions may have caused this – for example, exposure to teaching methods coursework, or lack thereof; experiences in the urban community, or lack thereof; amount of content knowledge; and general interest in in teaching. Awareness of these differences provides an appropriate lens to further present how university students participating in this study constructed and shifted "betwixt and between" (Head, 1992, p. 90) the understanding of teaching, learning, pedagogical content knowledge, and the complexities therein.

Liminal Space: The participants in this study continuously shifted between student and teacher, and between novice and proficient, as they constructed an understanding of pedagogical content knowledge. The university students rarely settled in one role during the Pedagogy Lab experience. Across the four pedagogy labs, it became clear that the university students in this study, both pre-service teachers and in-service teachers, alternated between thinking, acting, analyzing, collaborating, and reflecting as learner and as professional. While the individual university students' effectiveness varied across these different processes, each participant applied learned concepts to construct a foundational understanding of pedagogical content knowledge. Liminal space existed throughout each Lab, as the university students negotiated with the construction and in some cases, reconstruction of knowledge.

The Environmental Science Lab was a powerful representation of how university students shifted in liminal space between the role of student and the role of teacher. From various conversations, Mara and Laura (both pre-service teachers) and Melanie and Frida (the in-service teachers) learned from one another's experiences as they confronted the preconceived notions they held. In particular, the discourse surrounding the implementation of inquiry-based teaching frames this process. Mara was adamant that inquiry-based learning and cross-curricular teaching had the potential to occur in any classroom. The shift in awareness occurred as Frida asserted that due to various expectations and strict teaching requirements, a genuine challenge existed to implement inquiry-based teaching every day in the classroom. Further, Melanie also discussed her trepidation of planning for inquiry-based lessons, signifying that a lack of confidence has hindered her from implementing these open-ended lessons. Additionally, Melanie noted that it was truly challenging planning for inquiry-based learning compared to "just planning for direct instruction" (Melanie, Online Discussion Board, 20 June 2012). Through participation in these dialogues, both pre-service and in-service teachers recognized the opportunities as well as the challenges in today's teaching environment.

Similar events unfolded during the five weeks of the Mathematics Pedagogy Lab, particularly because of the face-to-face experience and microteaching presentation. The university students found themselves in a space of liminality as they embodied the behaviors and dispositions of university student, pre-service teacher, educator, observer, collaborator, and evaluator. Paige, Penny, Johanna, and Jace confirmed this as they reflected on the experience of participating in the Lab, noting an awareness to improve their teaching practice prior to entering a classroom. This venture into teaching

encouraged university students to envision themselves as practicing educators able to handle the intricacies required for successful pupil learning.

Although the Political Science Pedagogy Lab and the Chemistry/Biochemistry Pedagogy Lab were organized and facilitated differently, all the pre-service teachers alternated between thinking like a teacher and thinking like a student. In particular, the Chemistry/Biochemistry Lab exposed how imperative it is for teachers to have a deep content knowledge to appropriately engage pupils. Laura asserted this as she described her struggle with the content knowledge, but noted that she appreciated learning the pedagogical knowledge concurrently, as that aided in the construction of her pedagogical content knowledge. Similarly, the Political Science Pedagogy Lab also connected the complexity of political science topics to how these topics could be appropriately facilitated to PK-12 pupils. Matthew experienced a liminal space as he shifted between university student, fostering a pedagogical content knowledge, and teacher, a process that was evident in the detailed lesson plan he developed.

All the pedagogy labs in this study used the same framework to organize the features of teaching and learning appropriate for pre-service teacher development (Appendix A). With some commonalities, each Lab implemented its own unique method to present and convey the content specific knowledge and the appropriate pedagogical knowledge. While these labs varied, the university students experienced spaces of liminality as they moved between their roles of student, teacher, novice, and expert. These spaces engaged university students to question and construct a deeper knowledge of pedagogical content knowledge and epistemological beliefs about how pupils learn.

Urban Education: Across the Pedagogy Labs in this study, concepts of teaching and learning in the urban context did not emerge universally. Thus, a greater emphasis on urban education must be integrated early in the preparation of pre-service teachers. One of the most unexpected outcomes of the pedagogy labs was the lack of dialogue on urban teaching and urban pupil learning. As previously discussed in Assertion 2, pedagogical content knowledge was not directly linked to the urban context across all of the pedagogy labs. While there were some undercurrents of teaching and learning for diverse student populations, the emphasis was not very apparent. Education researchers assert repeatedly the impact of engaging pre-service teachers in a critical discourse focused on complex topics of urban education, such as culturally responsive pedagogy, disparities in education, effects of policy, language and literacy, and educational bureaucracy (Oakes et al., 2002). Perhaps some of these topics were overlooked during the short five-week sessions; however, it is worth calling attention to the particular moments when university students posed questions and considerations involving teaching and learning in the urban context.

Across the four pedagogy labs, there were a few university students who overtly integrated the notions of urban teaching and learning into the Pedagogy Lab. For example, Matthew (Political Science) and Laura (Chemistry/Biochemistry & Environmental Science) often referenced their experiences and presented a deeper awareness of the unique pedagogy urban teachers need in order to best facilitate learning opportunities for urban pupils.

There were other instances where university students in the study integrated concepts from the pedagogy labs that could be applicable to urban teaching. From his

own personal experiences, Jace (Mathematics) revealed the harm caused by teachers who devalue pupils' participation if an answer was not the *one* right answer. Jaimie (Political Science) described good teachers as having the required content knowledge, but in addition, having the ability to tailor various learning experiences for the unique pupils in the classroom. Larisa (Chemistry/Biochemistry) also pointedly shared that to create accessible learning opportunities, teachers need to provide and connect correct subject matter to the pupils' lives.

Of all the labs in this study, the Environmental Science Pedagogy Lab was the only Lab in which the university students explicitly investigated the complexities of urban teaching, integrated social justice pedagogy and examined how diverse pupils learn and develop. Purposeful grounding in the areas of inquiry-based learning, integrated curriculum, social justice issues, and awareness of the urban community created a rich and meaningful blended learning experience for the university students. These topics engaged university students in the critical dialogue necessary to examine both the disparities and benefits of teaching and learning in the local urban city environment. In addition, discussion of the topics promoted understanding of how issues of social justice are integrated with the curriculum. The Lab's focused discussion questions and assignments revealed the realistic challenges in-service teachers face, as well as the enthusiasm pre-service teachers have to implement multiple pedagogical elements.

In sum, although all four pedagogy labs did not address urban education equally, throughout the study, the university students constructed an awareness of teaching, learning, and pedagogical content knowledge.

Pedagogical Content Knowledge: University students in the study developed a stronger foundation for the particular content knowledge when directly linked with the pedagogical knowledge, i.e., how to teach that content. When the university students engaged in the content in tandem with how to teach that content, pedagogical content knowledge solidified. Larisa's comment, "Tell me and I will forget; show me and I may remember; involve me and I will understand" (Larisa, online discussion response, 3 November 2012), captured the general sentiments the university students experienced. As university students were *involved* in the construction of their own learning, a more concrete understanding of pedagogical content knowledge emerged. During each of the labs – Political Science, Chemistry/Biochemistry, Environmental Science, and Mathematics – the complex content was incorporated with how to teach the content. This process may have gone awry without the simultaneous, direct link to a constructive investigation of how to teach that content to PK-12 pupils.

The Chemistry/Biochemistry Pedagogy Lab was considered a challenging and content-heavy course, according to the university students who participated in the Lab. In part, this was because the university students engaged in complex information in a short amount of time. Laura examined her own deficient chemistry content knowledge and said that the Lab actually assisted her in developing a stronger foundation in chemistry. To affirm this statement, both Dr. Kelly and Dr. Lindsey shared an observation of Laura's increased knowledge and skill in the chemistry pedagogical content knowledge.

Instructor Cooper and Dr. Rugts also observed weaknesses in the mathematics content among the university students in the Pedagogy Lab. The university students did

not deny this observation; rather, Dana emphasized the need to improve her content knowledge and teaching skills in mathematics. Joanna asserted her need to know the material better in order to teach it well. This notion of knowing the content in order to teach it further supports the claim that pre-service teachers need a deep level of content in order to teach it *well* to pupils. Combining pedagogical knowledge and content knowledge produces pedagogical content knowledge.

The construction of knowledge takes place in a social environment; knowing PK-12 pupils, understanding individual pupil experiences, and constructing a community for learning empowers and encourages connectivity between pupils, teachers, and the content (pedagogical knowledge). Humans learn by observing the world and the people around them; in turn, we determine which actions to replicate and build upon (Bandura, 1993). This concept – the premise of social-cognitive theory – indicates that the environment has the capacity to affect the learning process, encompassing both the actions of those situated in the environment and the content knowledge presented through those actions (Meaney et al., 2008). In the cases of the four pedagogy labs, university students, to a varying degree, observed and participated in a social academic environment, thus translating how particular practices could be replicated for future PK-12 classrooms.

While the Political Science Pedagogy Lab and the Chemistry/Biochemistry Lab had limited peer social interaction, learning did occur through the interaction with the faculty and instructors who modeled pedagogical practices and provided feedback to the university students. In the online environment for Political Science and Chemistry/Biochemistry, university students' conceptions about pupil learning included a

significant focus on learning in a social environment and, in particular, an environment of inquiry.

Lisa (Political Science), Matthew (Political Science), and Jonathan (Political Science) acknowledged that PK-12 pupil learning could take place when grounded in discussion, creating an environment where pupils could confidently explore topics by their own volition. Further, university students identified that content should be related back to the pupils and their interests, as that would encourage additional "light bulb moments" with the subject matter. However, when the Political Science university students were given the option to create a lesson plan to indicate *how* they would connect content and pedagogy together, only Matthew and Lindsey did so. Thus, for pre-service teachers, using a scaffolded lesson plan could help those university students who have a conceptual understanding of pedagogical practices, but are challenged when envisioning those methods in practice.

Laura (Chemistry/Biochemistry) emphasized that PK-12 pupils learn as they observe their teacher facilitate conversations around the pupils' questions. Similarly, Joe asserted that learning should take place through a framework of curiosity, observation, interaction, and knowing pupils. Joe's belief further underscored the need for PK-12 pupils to feel part of the learning community, in order to feel safe asking questions and presenting or exposing their own perceptions. In turn, Laura and Joe acknowledged that as an educator, one must be prepared for new ways of thinking and adapt as pupil learning evolves. In essence, Laura and Joe's assertions point to the need for pedagogical skills to make content relevant to the particular group of learners in the classroom.

Through the unique face-to-face organization of the Mathematics Pedagogy Lab, university students had the opportunity to observe Dr. Rugts and Instructor Cooper model effective pedagogy in the facilitation of mathematics content. Instructor Cooper recognized that the first step for university students to begin the development of pedagogical content knowledge was to break down barriers between the university students, the pupils, and the mathematics content. This process encouraged university students to actively participate and critically examine the processes in which relationships promote a collaborative environment in the classroom.

Further, these broken-down barriers presented university students an opportunity to observe, make sense of, and implement various pedagogical strategies appropriate for the teaching of mathematics to elementary pupils. To a varying degree, university students employed teaching methods gleaned through the social interaction with peers and with Dr. Rugts and Instructor Cooper. Some of the university students exemplified these pedagogical practices, while other university students were visibly uncomfortable teaching in front of a group of learners. It appeared that due to the weekly observations, the microteaching presentations given toward the end of the five-week Lab became stronger; university students began to include accepted pedagogical practices, such a asking for volunteers to come to the board, posing follow-up questions, speaking to small groups, and providing immediate feedback. The observed learning environment for this Mathematics Pedagogy Lab was rich with support, which encouraged the pre-service teachers to test their own professional boundaries.

With the conclusion of Chapter 4, the rich perspectives and experiences of both students and faculty help to inform not only the research questions driving this study, but

the field of education as a whole. Specifically, the assertions garnered from the participants has the capacity to inform the theory framing this research study, in addition to informing teacher educators, teacher education programs, and teacher education policy. The pedagogy labs acted as spaces to encourage liminality, where university students and faculty participated in the construction of knowledge surrounding the complexities of teaching and learning. To demonstrate this, the following graphic disseminates the common themes and how those intersect (see Figure 3). These spaces allowed for the ongoing "betwixt and between" (Head, 1992, p. 90) as participants addressed their actions and beliefs as a university student, teacher, expert, and novice. In particular, university students had opportunities to critically examine their beliefs and actions as they relate to an educational context. I invite readers to continue to Chapter 5, which presents the conclusions and implications for future teacher education research.

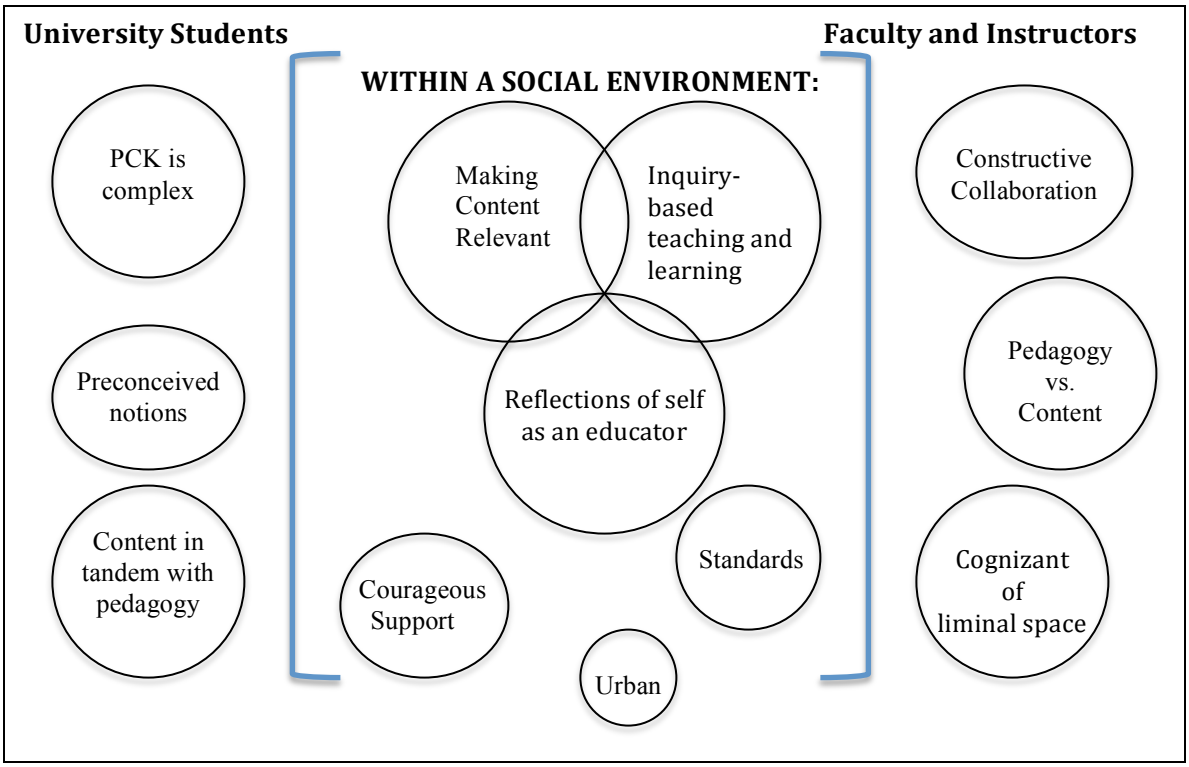

Figure 3: The Interconnectivity of the Participants' Experiences

Chapter 5: Conclusions and Implications for Teacher Education Practice, Policy, and Future Research

Conclusions

This collective case research study was designed to investigate the ways in which urban pre-service teachers construct an understanding of teaching, learning, and pedagogical content knowledge (PCK) through the structure of a five-week pedagogy lab. Additionally, each case examined the process urban pre-service teachers employed to incorporate PCK into hypothetical learning opportunities specific to urban PK-12 pupils. The conclusions that emerged from studying the experiences of the university students and instructors have the capacity to further inform theory, teacher education policy, and the methods most important to the preparation of future urban educators.

Little scholarship exists explicitly linking urban pre-service teacher development with the ongoing construction of a deep PCK. While PCK has been studied copiously across various educational disciplines (Grossman, 1990; Hashweh, 2005; Park & Oliver, 2007; Shulman, 1986, 1987), so too have various meanings and definitions emerged surrounding this complex knowledge base. With these multiple interpretations, PCK is in danger of becoming so diluted that Shulman's true conceptualization becomes 'lost in translation' and fades from the forefront of a teacher's professional preparation. The broad description of PCK embodies how a teacher's subject matter knowledge is tailored to meet the needs of PK-12 pupils in particular content areas (Geddis et al., 1993; Park & Oliver, 2007), yet this does not capture the richness required of *urban* pre-service and in-service teachers to facilitate exceptional teaching and learning opportunities for diverse pupil populations.

Presently, urban schools face numerous challenges across many different spectrums. Those challenges include, but are not limited to: poverty, large class size, teachers with poor and/or inexperienced pedagogical content knowledge, a lack of resources, and the barrage of high-stakes assessments. These challenges are never isolated and predictably overlap, further preventing urban students from receiving an equitable education (Banks, 2010; Banks & Banks, 1995; Cross, 2003; Darling-Hammond, 2006; Freire, 1970; Hollins & Guzman, 2005; Haberman, 2005; Ladson-Billings, 1995; Milner, 2010; Miner, 2011; Sleeter, 2001, 2012). In particular, the multitude of high-stakes academic assessments are of great concern as our nation becomes even more driven by the data surrounding achievement of academic standards and content knowledge. Recently, the agencies regulating high-stakes assessments have enforced harsher consequences on urban schools, urban pupils, and urban teachers (Amrein & Berliner, 2002), and many of these stringent requirements contribute to the large number of teachers who leave urban classrooms within three to five years of starting (Haberman, 2005; Ladson-Billings, 2000; Marx, 2004; Nieto, 2003;). Thus, a reevaluation of pre-service teacher preparation and public policy is necessary.

Urban schools continue to need high-quality educators who are resistant to a watered-down curriculum and who can effectively engage pupil learning, encourage inquiry, and participate in academic risk-taking (Belfiore, Auld, & Lee, 2005). This complex amalgamation is accomplished through the implementation of a PCK founded in diverse practices, incorporating the multifaceted nature of today's urban PK-12 pupil and the urban community (Haberman, 2003). As urban school districts continue to grow and become more diverse, there becomes a critical need for excellent educators who have a

deep level of content knowledge, an awareness of cultural responsiveness, and the pedagogical knowledge to bridge these areas together (Ladson-Billings, 1995; Milner, 2010; Miner, 2011; Sleeter, 2001, 2012). Thus, pre-service teachers must experience and internalize how to appropriately intersect an effective pedagogical content knowledge appropriate for urban teaching and learning. To address this area of concern, the research question guiding this study examined: **How do urban pre-service teachers construct an awareness of the complexities of teaching, learning, and pedagogical content knowledge (PCK) through the structure of a pedagogy lab**?

Through the principles of collective case study, this study investigated the interactions between university students, faculty, and the construction of pedagogical content knowledge in pedagogy labs across the different academic disciplines of Political Science, Chemistry/Biochemistry, Environmental Science, and Mathematics. The findings derived from each of the labs contribute to the existing scholarship, as well as further support the theoretical and practical implications as they relate to the experiences of the participants, their construction of pedagogical content knowledge, urban education, and the complexities therein. Each lab encompassed inherent similarities and differences, which further translated the ways in which learners interacted with the concept of pedagogical content knowledge within the environmental structures of teacher preparation (Bandura, 1993; Hoy & Spero, 2005).

This final chapter presents first the theoretical implications surrounding liminal space as it intersects with the development of pre-service teachers and their pedagogical content knowledge. Second, I propose a renewed vision for pedagogical content knowledge appropriate for the urban teacher preparation and, truly, the universal

preparation of all educators. Third, I identify the practical implications as they relate to pre-service teachers, teacher educators, and teacher education public policy. I conclude this chapter with the areas for future research.

Conclusions Addressing Learning to Teach in Candidates' Liminal Space

Beginning with the theoretical implications that ground this study, and as presented in Chapter 2, liminal space identifies the process in which humans experience a transition from one dimension or space to the next (Cook-Sather, 2006; Head, 1992; Nelson & Harper, 2006; Turner, 1987). This liminal space encompasses a "fundamental change, as the view of the world is altered while individuals are given time to consider both social and personal difficulties and beliefs and to learn from 'elders' who themselves have gone through the rite of passage" (Wood, 2012, p. 86). Thus, translated across the four pedagogy labs, the university students had the opportunity to reflect on their beliefs and present changes in thinking through the engagement of critical discourse, development of learning opportunities, and implementation of pedagogy, while simultaneously becoming immersed in a particular content knowledge. The faculty and instructors who facilitated each lab acted as the 'elders' within this learning environment, as the faculty and instructors had once experienced their own liminal space when preparing to become educators in various academic institutions.

During these labs, the university students had multiple opportunities to "unlearn, reorient, and choose a fresh path" (McWhinney & Markos, 2003, p. 16) as it pertained to teaching and learning, which in some cases became a humbling experience as certain university students' beliefs were exposed and addressed (Meyer & Land, 2005). In some instances, this became a "disorientating vertigo" spurred on by the transition occurring

between familiar and unfamiliar views and possible misperceptions (Jardine, 1994, p. 20). During these pedagogy labs, the familiar and unfamiliar blended together as a means to construct a tangible definition of PCK and how to implement its various features in future teaching environments. Each of the university students have experienced their own lived events, thus each university students' liminal space was distinctive as they presented and dissected various beliefs surrounding pupil learning, teaching practices, and the knowledge of content.

To further delineate this, I refer back to Brendan and Karissa (Chemistry/Biochemistry) as they faced and addressed their misconceptions of teaching by expressing similar beliefs that the classroom teacher should act as the purveyor of knowledge with a group of learners. In other instances, university students acquired a greater foundation of knowledge in a specific content area, such as Laura (Chemistry/Biochemistry and Environmental Science), who frequently referenced her expanding knowledge of chemistry content and inquiry-based teaching practices. Matthew (Political Science) also shared his prior understanding of teaching urban pupils and his weakness in political science, and in turn, constructed an extensive lesson plan for elementary pupils. The university students began each pedagogy lab with various levels of awareness and understanding surrounding the concept of PCK in addition to various personal and professional goals. Thus, the university students entered a liminal space, which forced them to examine and reorient their beliefs surrounding teaching, learning, and pedagogical content knowledge.

The process to become an educator is complex; one must thoroughly and relentlessly evaluate his or her own knowledge, beliefs, and perceptions in order to be

effective. Throughout these pedagogy labs, the participants had the opportunity to experience this liminal space as they shifted between the roles and mindset of university student, pre-service teacher, community member, classroom teacher, and back again through this continuum. These spaces engaged university students to question and construct a deeper knowledge surrounding their epistemological beliefs about how pupils learn. The findings from this study further reify how both prospective and in-service educators continuously experience a space of discovery, change, and enlightenment. Ideally, this cycle of liminal space must continue throughout their professional career, as teaching should never be a static practice (Bales & Mueller, 2008).

Conclusions Addressing Urban Teaching and Learning

As explicated previously in Chapter 1, pedagogy, content, and culturally responsive teaching too often become and remain divorced from one another throughout the various stages of teacher preparation (Beyer, 2001; Milner, 2010; Scherff & Spector, 2011; Young, 2010). Thus, the emphasis of this qualitative research study was inherently, to study how *urban* pre-service teachers developed an understanding of the complexities of teaching and learning in *urban* and diverse environments. Unfortunately, at the conclusion of this collective case study, of the four pedagogy labs, only the Environmental Science Lab provided a clear and astute urban focus.

The instructors of the Environmental Science Pedagogy Lab, Instructor Holly and Instructor Hawthorn, constructed and facilitated the lab to include multiple explicit opportunities to critically examine the intricacies of becoming an urban educator. Particularly, the Environmental Science Pedagogy Lab framed urban teaching and learning with tangible examples and opportunities to further explore: environmental and

social justice issues, culturally responsive teaching, and Urban City's diverse community resources. Further, this lab bridged together these areas for the university students to create various learning opportunities applicable for PK-12 pupils in Urban City Public Schools. Due to these genuine hands-on experiences, the four university students enrolled in this lab, Laura, Kara, Melanie, and Frida, engaged in critical discourse surrounding the realities of urban teaching. These conversations prompted a rich understanding of teaching, learning, and pedagogical content knowledge in urban schools.

While the Environmental Science Pedagogy Lab successfully and thoughtfully encouraged the examination of urban teaching and learning, the dimension of *urban* teaching were relatively absent throughout the Political Science, Chemistry/Biochemistry, and Mathematics Pedagogy Labs. A focus on urban teacher preparation and cultural responsive teaching was initially outlined in the Pedagogy Lab syllabus template (see Appendix A), then how and why did these absences occur within the labs? Perhaps just as some faculty and instructors in this study remained committed to either pedagogical knowledge or content knowledge as the most important trait in a developing teacher, the same was true when attempting to weave in culturally responsive teaching. Otherwise, another answer to the aforementioned query is that truly, one cannot teach *what* they do not know or even *where* they do not know (Flynn, Kemp, & Perez, 2010; Howard, 2006). In these pedagogy labs, faculty may have been challenged to facilitate and/or maintain conversations surrounding social justice issues specific to Urban City due to their own lack of knowledge or discomfort in teaching what and where they do not know. Thus, as a commitment to urban PK-12 pupils, urban schools, and the urban community, teacher educators must also embody rich knowledge of pedagogy, content, and culturally

responsiveness specific to the urban community the teacher preparation program is situated in.

To further delineate the necessary dimensions of pedagogical content knowledge for successful urban teacher preparation, the subsequent conclusions in this chapter will further detail the much-needed refined facets of PCK and how the fusion of those have the capacity to establish the notion of culturally responsive pedagogical content knowledge (CRPCK). Future urban educators must embody an ongoing commitment for a deep content knowledge, pedagogical knowledge, and cultural responsiveness to ensure for success among diverse PK-12 pupils, their families, and within the larger urban community.

Conclusions Addressing the Newly Exposed Facets of Pedagogical Content Knowledge

This collective case study is rooted in the scholarship of both Shulman (1986, 1987), the father of PCK, and Ball et al. (2008), the creators of the mathematical PCK framework (see Figure 1). Both of their work has significantly contributed to the definition and implementation of PCK and the designation of what type of skills and knowledge prospective teachers need. Naturally, as research evolves, it is necessary to expand on and contribute to the work of both Shulman and Ball et al. to further delineate the process of constructing and implementing PCK for various content areas—and importantly, with urban teaching and learning at the forefront.

From this research design and from the voices and actions of the participants, I propose a reevaluation and redesign surrounding the existing pedagogical content knowledge framework. This is not to denounce the significant work contributed by

Shulman or Ball et al.; rather, it is to further develop the groundwork already constructed. In particular, the proposed additions to PCK incorporate the scope of urban teacher preparation and a deeper consideration of what intricacies and knowledge are required when preparing to teach diverse PK-12 pupils. Further, it is important to note that the constructs of PCK should not be viewed as separate pieces of a literary patchwork quilt, as somewhat represented by Ball et al. (2008, p. 403). Rather, the structures of PCK should overlap and become fused together, relying on each element to further improve the depth and breadth of one's pedagogical content knowledge. It is no longer appropriate to pigeonhole or "cut our activities along Shulman's epistemological seams in teacher preparation programs" (Larkin, 2010, p. 335). in teacher preparation programs" (Larkin, 2010, p. 335).

Across the four pedagogy lab case studies of Political Science, Chemistry/Biochemistry, Environmental Science, and Mathematics, the reoccurring themes of: *making content relevant, inquiry teaching and learning,* and *reflection of self as an educator* exposed a call to revise and clarify the epistemological understanding of PCK specifically with urban teacher preparation in the forefront. To elaborate on the framework presented by Ball et al. (2008), it is helpful to reshape an understanding of PCK that could be applicable to many, if not all, content areas, as well as to growing pupil diversity. This revision requires an intricate figure that can adequately include areas of cultural responsiveness, inquiry-based learning, and knowledge of self as a teacher. In this case, a logical leap is the shape of a diamond (see Figure 4), a complex structure comprised of numerous, intersecting angles and facets. Additionally, the diamond in its three-dimensional format is considered around the world to be precious.

Therefore, I use this imagery to explicate PCK and return much-needed focus to the critical tenets of teaching and learning across multiple disciplines and in the presence of diverse pupils.

The Brilliant Facets of Pedagogical Content Knowledge

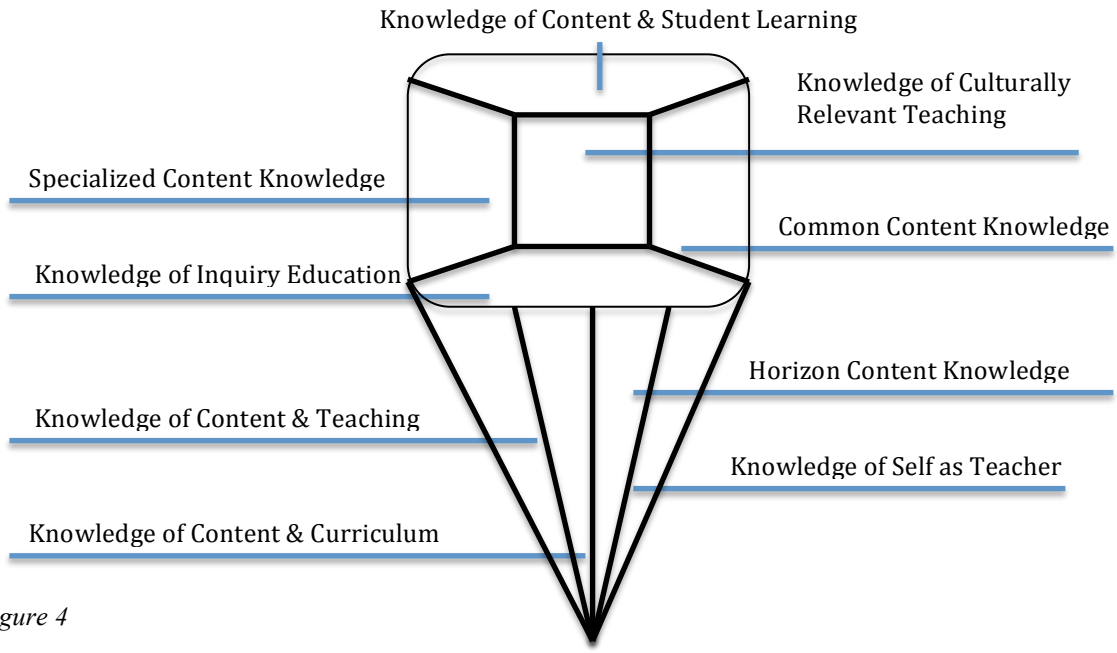

Figure 4

To properly establish the facets of PCK, it is imperative to preserve the integrity of Ball, Thames, and Phelps' (2008) original domains – Common content knowledge; Horizon content knowledge; Specialized content knowledge; Knowledge of content and students; Knowledge of content and teaching; and Knowledge of content and curriculum. I propose the inclusion of the following additional facets which support PCK, particularly within the context of urban teaching: *Knowledge of Culturally Responsive Teaching; Knowledge of Inquiry; Knowledge of Self as an Educator*; and a revision of Ball et al's (2008) Knowledge of Content and Student, to become *Knowledge of Content and Student Learning.* Through the interconnection of these characteristics, pre-service teachers can

have the capacity to become well-versed in pedagogical practice and content knowledge; in other words, the fusion of these concepts may foster the development of excellent educators. Of course, diamonds are unique in shape and size; the portrayal of PCK in a diamond figure also supports the notion that educators should retain a sense of individuality and ownership to develop the necessary facets.

A diamond is a complex thing to create. Intense pressure and heat bond and compress carbon atoms over time, creating incredibly strong covalent bonds (Lineberry, 2006). This scientific explanation captures the relationship between the diamond and the fusion of the facets of pedagogical content knowledge, emphasizing that PCK should no longer be viewed as a general patchwork of skills. One's multi-faceted PCK is bonded together from experience to experience, adding more clarity and value to their professional development and propelling them to higher stages of excellence as an educator. Not only does the process of creating a diamond transform a group of molecules into something more brilliant and vivid; it also translates directly to PCK: "The idea of pedagogical content knowledge implies that teachers' content knowledge has been transformed into something different from what it was before, a form that has practical application in teaching" (Major & Palmer, 2006, p. 621).

Conclusions that Refine Facet 1: The Knowledge of Culturally Responsive Teaching. The first facet, Knowledge of Culturally Responsive Teaching, is defined as the rich understanding of pupils, their culture, community, lived experiences, and how these fundamental complexities intersect to create unique individuals who differ in relation to the specific subject or content to be taught in the classroom. This facet goes well beyond the knowledge, assumptions, and misconceptions of students (Ball, Thames,

& Phelps, 2008). Rather, it requires both pre-service and veteran educators to embody a responsiveness of how diverse young people learn and develop in the classroom, the school, and in the greater socio-political community. To do so, pre-service teachers must engage in ongoing discourse which allows them to understand and implement a deep awareness of how backgrounds and lived experiences contribute to the *whole* student, not only how this student learns in one or two content areas.

Culturally responsive teaching is a complex framework that many pre-service and even in-service teachers find challenging to incorporate in their teaching practice (Ladson-Billings, 1994; Young, 2010). Similar to pedagogical content knowledge, culturally responsive teaching has also experienced an evolution of meaning. However, three principles continue to be in the forefront, emphasizing that students must "experience academic success, develop and/or maintain cultural competence, and develop a critical consciousness through which they challenge the status quo of the current social order" (Ladson-Billings, 1995a, p. 160). These ideas act in tandem with PCK to combine an educator's deep content and pedagogical knowledge with the knowledge of the student to positively impact a pupil's academic achievement. Furthermore, educators must not only encourage pupils, but provide opportunities for them to "engage the world and others critically" (Ladson-Billings, 1995a, p. 162). This critical engagement with the environment lends to the next facet, *inquiry learning.* As pupils have the opportunity to examine their surroundings critically, students should also have vast experiences to address and solve the observed sociopolitical issues.

Conclusions that Refine Facet 2: The Knowledge of Inquiry Learning. The notion of inquiry learning or inquiry-based education is not a new phenomenon. Rather,

inquiry-based education dates back to John Dewey (1916), who emphasized that learning needs to be an active event, not one of rote, factual memorization. This precise notion of active learning emerged during the various pedagogy labs and through the experiences of the university student participants. Through the submitted assignments, conversations and concluding interview, the pre-service teachers emphasized that pupils, whether young or old, need to experience opportunities of learning that engage and encourage ownership and the confidence to question and investigate the events and situations that concern them. Furthermore, the pre-service teachers acknowledged that it is also the teacher's responsibility to present material rooted in the students' interests, just as Dewey identified a century ago.

The research surrounding inquiry learning indicates that pupils need to have experiences "to inquire into authentic problems as they can substantially enhance their understanding" (Levy et al., 2013, p. 2). Even the more recent revision of some academic standards appear to have encompassed the notion of inquiry learning in particular subject areas (Levy, et al., 2013; Minner, Levy, & Century, 2010)—for example, in sciences, as portrayed through the Next Generation Science Standards (NGSS); social studies too, as delineated in the C3 Framework for Social Studies (C3). This is especially noteworthy, because the inquiry method was historically housed in the sciences, being associated with the implementation of the scientific method of constructing and implementing science experiments. However, just as the pedagogy lab participants and newly-defined academic standards ascertain, inquiry is an additive to learning across all content areas. This arrangement has the potential to further engage students through the foundational properties of inquiry learning and advanced learning and problem-solving skills,

"providing learners with opportunities to inquire into authentic problems can substantially enhance their understanding" (Levy et al., 2013). Therefore, it is appropriate for inquiry-based education to become a facet of a teacher's pedagogical content knowledge. If inquiry-based teaching is at the forefront of every developing teacher's repertoire, the process of integrating discovery and authentic problem-solving can occur throughout all content areas. Essentially, this facet can encourage questioning and wonder among children and adolescents, which has the capacity to tremendously improve their learning and development.

However, one cannot expect inquiry education to become an innate skill among pre-service educators. Rather, distinct steps must take place in order for developing teachers to understand how to stimulate inquiry and implement inquiry-based learning opportunities. The method and strategy behind these steps need to be modeled throughout teacher preparation course work by other master teachers and professionals (Barrow, 2006). In a way similar to the experiences in the various pedagogy labs, the act of modeling these inquiry-based skills and implementing additional best teaching practices can be carried over into future PK-12 classrooms (Haberman, 1995). Additionally, it is important for this notion of inquiry education to shift away from the misunderstanding of assigning meaningless projects and/or the naïve concept that one should have a "fun" classroom. Essentially, this inquiry-based classroom becomes one of academic rigor and rich pupil engagement to further benefit the pupil's own interests in socio-political issues.

Conclusions that Refine Facet 3: Knowledge of Self as Educator. Both

prospective and veteran educators need to participate in an ongoing awareness of self and how their 'selves' intersect with their teaching practice (Haberman & Post, 1998). This becomes a critical belief structure for pre-service teachers in particular, helping them to actively explore, examine, and establish their current, developing, and future teaching practice as it relates to their own lived experiences. This awareness and understanding includes different beliefs and perceptions, or "A thorough understanding of one's own cultural roots and group affiliations" (Haberman & Post, 1998, p. 98), which contribute to their development as an educator.

To construct a knowledge of self, a tremendous amount of ongoing critical reflection needs to take place. This notion became evident as university students in the pedagogy labs interpreted and internalized the events that took place during different learning experiences. The university students of this study were encouraged to build professional confidence, question their peers' teaching practices, and construct the awareness of how to implement an effective pedagogical content knowledge. For example, during the Mathematics Pedagogy Lab, university students were encouraged to participate in effective discussions (Rice & Roychoudhury, 2003) regarding the outcomes of the various microteaching opportunities. As all the university students in the Mathematics Pedagogy Lab were in the initial stage of teacher preparation, there was a great deal of discourse surrounding how PK-12 pupils learn and what effective teaching practices look like. Many of these university students noted that they had wished to learn these mathematical strategies when they were in grade school, as they would have improved their understanding and knowledge of the content. As such, the university students' experiences support the notion that reflective practices must be planned for and

included early in methods course work, and perhaps even earlier, during initial content-based coursework. The earlier prospective teachers have the opportunity to reflect on their teaching practice, the earlier they become aware of what aspects of content, teaching, learning, planning, and collaboration, they lack confidence in. This provides ample time for pre-service teachers to revise and better prepare their pedagogical content knowledge for the more critical PK-12 classroom time.

Conclusions that Refine Facet 4: Knowledge of Content and Student Learning.

The final facet, *knowledge of content and student learning,* is significant as it redefines the importance of educators' ability to embody an awareness of students and the process in which students learn with respect to particular content areas. Ball, Thames, and Phelps (2008) initially identified that one element of an educator's pedagogical content knowledge is that of Knowledge of Content and Students. Reemphasizing Ladson-Billings' (1995a) work on culturally responsive pedagogy, knowledge of content and student learning should be defined as how an educator "utilizes students' culture as a vehicle for learning" (p. 161). This foundational understanding guides prospective teachers to maintain the pupils' backgrounds in the forefront as lesson planning and curriculum development take place. It also includes the ways in which educators predict the challenges pupils may face, as well as the ease they may have with particular subject matter.

Conclusions Addressing Culturally Responsive Pedagogical Content Knowledge.

The notion of culturally responsive pedagogical content knowledge (CRPCK) was presented earlier in Chapter 1 of this dissertation. After analyzing the voices, beliefs, and actions of the university students, faculty, and instructors of this research study, it is

imperative to return to the initial discussion surrounding CRPCK. Through the conception of the newly-revised facets of pedagogical content knowledge, culturally responsive pedagogy needs to become interwoven with pedagogical content knowledge; these two frameworks can no longer be considered separately from one another. In light of the claim that there are three elements of culturally responsive teaching (Ladson-Billing, 1995a, 1995b), a CRPCK framework becomes necessary for a variety of reasons, one being that in the era of growing pupil diversity, all teachers must be prepared to engage, educate, and mentor all PK-12 pupils. A second supporting idea indicates that as the curriculum becomes more rigid and prescriptive due to external accountability and high stakes assessments (Settlage & Meadows, 2002), educators need to become creative with their teaching pedagogy to ensure pupils' academic success. Finally, as pupils become contributing citizens in society, it is imperative to establish a sense of critical consciousness among young people (Freire, 1970), which can only be done if educators themselves embrace a critical consciousness (Gay & Kirkland, 2002).

Thus situating these two pedagogies together does not dilute or weaken either pedagogical framework; rather, building them together may strengthen and improve the preparation of all pre-service educators. Culturally responsive pedagogical content knowledge (CRPCK) assures that both PCK and CRP are in the forefront of a teacher's preparation. Furthermore, it is essential for teacher preparation programs to seamlessly integrate the notions of CRPCK throughout all methods of course work. This further emphasizes that neither pedagogical knowledge, nor content knowledge, nor cultural responsiveness are dismissed or absent from a prospective teacher's preparation. While these delineated facets may be both fairly obvious yet also daunting to a burgeoning

educator, each area becomes a critical element that attributes to the success of educators, which in turn leads to the success and academic achievement of PK-12 pupils. As explicated previously, this framework of CRPCK has the capacity to refocus the critical areas for teacher preparation and ongoing professional development.

The diamond framework of PCK lends itself to implications for practice. While common in teacher preparation programs, methods course work is compartmentalized, and not always clearly associated with either cultural responsiveness or subject-specific content knowledge. Prospective educators should engage in the preparation of culturally responsive pedagogy, inquiry-based methods, and an awareness of self, all while situated within a deep understanding of subject matter and the curriculum. Thus, culturally responsive pedagogical content knowledge situates itself between both the content necessary to teach as well as how to teach to the unique, inquisitive individuals situated in the classroom.

Implications for Teacher Educators and Preparation Programs

The collective case study of these pedagogy labs presented implications for the preparation of teachers, in particular how pre-service teachers grappled with the complex notions of pedagogical content knowledge. This glimpse of teacher development can provide some insights on a more extensive level. In particular, pre-service teachers who begin their core course work in tandem with pedagogy labs in the beginning of their preparation may sooner understand how to scaffold their beliefs and develop the critical skills necessary to become an excellent urban educator. The following sections will delineate how the pedagogy labs inform teacher educators, teacher preparation programs, and public policy.

First and foremost, the successful preparation of teachers lies, in part, in the hands of faculty and instructors facilitating both methods coursework and content coursework in teacher preparation programs. Prospective educators need to be well prepared for the increasing demands and diversity in today's contemporary classroom, whether that is in an urban or suburban school. Together with the knowledge and skills of master educators, pre-service teachers can best develop rich teaching skills, which could in turn potentially lead to greater success among PK-12 pupils. It is important to bring together the implications for teacher educators and teacher preparation programs, as they are innately situated within each other. Thus, the following sections delineate how the experiences of the university students and faculty of this study inform both teacher educators and teacher preparation programs.

Pedagogy Labs as Sites to Improve Content Knowledge and College Readiness

More frequently, many students beginning a postsecondary education are not prepared well enough for the rigorous curriculum to successfully complete advanced university coursework, or exhibit college and career readiness[15] (Kirst & Venezia, 2001; Maruyama, 2012; Venezia & Kirst, 2005). Statistics indicate that 40% of university students must take remedial courses to assure for postsecondary success and attain success in career pathways (Venezia & Kirst, 2005). During the four pedagogy labs in this study, university students across each of the labs referenced insecurity with the content knowledge. Some university students asserted that their purpose to enroll in the pedagogy lab was to actually improve their understanding of the course content. Thus,

[15] College readiness may be defined as the "accumulation of knowledge and experiences that prepare students for college" (Maruyama, 2012).

these labs may have the potential to become sites to improve content knowledge for university students as they consider entering various aspects of teacher education.

Specifically, in the Political Science, Chemistry/Biochemistry, Environmental Science, and Mathematics Pedagogy Labs, the university students echoed similar sentiments that learning how to teach the content improved their own understanding of the content. This fact strongly suggests that providing pedagogy labs early in the preparation of teachers may improve and expand a complex content knowledge as well as a pedagogical knowledge across various content areas. Additionally, these pedagogy labs may attract and possibly better inform those who are interested in teaching, but may have little awareness of what becoming a teacher actually entails.

Bridge Pedagogy Labs with Rich Clinical Experiences

To elevate the structure of the pedagogy labs one step further, teacher preparation programs could implement these labs earlier in university coursework, facilitated by faculty with a deep PCK. Importantly, they could also situate the labs within diverse field placements to allow for pre-service teachers to implement their growing PCK. A great deal of research surrounds the notion that excellent teacher preparation requires a great deal of hands-on learning within well-established classrooms and diverse field placements or clinical experiences (Darling-Hammond, 2010; Blue Ribbon Panel, 2010; Ronfeldt & Reininger, 2012; Zeichner, 2003). I must emphasize that simply requiring additional courses or additional observation hours in various PK-12 classrooms is not enough. The emphasis here is to bridge these areas together with the support of pedagogy labs in order to strengthen content knowledge, pedagogical knowledge, and first-hand experiences.

Deconstructing the Teacher Education Silos in Higher Education to Build Supportive Learning Environments

Learning environments play an important role in how individuals engage, internalize, and comprehend complex subject matter, theories, and intricate skills. In a way similar to the university students' reflections which emerged during the pedagogy labs, faculty and instructors must establish, facilitate, and maintain a supportive learning environment that allows prospective teachers to confidently, courageously, and critically examine their emerging teaching practice (Ladson-Billings, 2000; Rice & Roychoudhury, 2003; Singleton, 2006).

Looking to the scholarship on constructing healthy classroom environments and classroom emotional climate (Brackett et al., 2011; Noddings, 1992), teacher educators must model how to construct a healthy classroom emotional climate that includes: a sensitivity to the needs of university students, respectful instructor-student relationships, encouragement of active participation, and an "absence of abrasive disciplinary practices and cynicism" (Brackett et al., 2011, p. 27). To support this notion further, I link this directly to the theory of liminal space as university students who begin the process of teacher education experience a space of uncertainty which can at times be disorientating and overwhelming. For university students and prospective teachers to critically examine these events, the environment for learning must be supportive involving active engagement.

As observed particularly during the Environmental Science Pedagogy Lab and Mathematics Pedagogy Lab, university students experienced a positive emotional

classroom climate, which encouraged the construction of pedagogical content knowledge in addition to an investigation of inquiry-based practices and reflection as a teacher. Notably, this positive climate was established in a short five-week course, which further suggests that a positive learning environment can also be accomplished in a semester-long course. University students interested in teaching and those already enrolled in teacher preparation programs need to experience a positive climate for learning. This climate has the capacity to encourage critical examination of a developing professional practice as well as the knowledge and processes to develop their own future supportive classroom.

Faculty and instructors situated within higher education may find themselves isolated in academic silos, completely disconnected from other departments or disciplines. As presented in each of the four pedagogy labs, the faculty and instructors noted the benefit of collaborating with individuals from other disciplines, expertise, and backgrounds. Bridging these areas together solidifies the notion of a well-rounded, integrated teaching experience for faculty. In turn, pre-service teachers early in their preparation programs have the benefit of learning across different content areas, along with the different methods, practices, and theoretical frameworks effective throughout the various dimensions of teaching and learning. In part, by facilitating a pedagogy lab, not only are faculty engaging prospective teachers, but those faculty members also have the opportunity to participate in an intimate, and professional learning community (Bausmith & Barry, 2011). To refer back to reflections shared by the faculty and instructors in this study, the common theme of learning from a fellow colleague in a similar, yet different area of expertise emerged. Thus, the benefits of the pedagogy labs in terms of

deconstructing academic silos are two-fold. First, faculty have opportunities to advance their professional practice in content knowledge as well as teaching practice through the support of a fellow academic and scholar. The second benefit is the capacity to enrich the preparation of future educators through the experiences of two faculty perspectives.

Implications for Teacher Education Policy

The landscape and trajectory of teacher preparation programs continues to be in the forefront of many contested debates surrounding the specific skills many teachers lack when they begin the induction years of teaching (Darling-Hammond, 2010; Haberman, 1995). Recently, the Teacher Prep Review published by the National Council on Teacher Quality (2014) identified that teacher education programs are not successfully preparing teachers for the quickly-changing contemporary learning environment. In particular, the Teacher Prep Review (2014) identified that too often, poorly-prepared educators enter the classroom as the lead teacher and only then receive remedial solutions, such as "increasing support, adding more professional development, and finding less challenging placements" (p. 13). With the concern of urban schools in the forefront, this practice of learning to teach on the job cannot continue. Pre-service teachers should enter the classroom with a rich professional readiness to assure for pupil learning and developmental success. The implications garnered from the pedagogy labs presented in this study have the potential to further inform and develop the necessary professional practice imperative for excellent educators.

A challenge beckons within education policy to redefine the ways in which teacher education is organized and implemented, in part for urban pupils, who are too often marginalized. Research and scholarship surrounding urban education, urban

student learning, and urban policy are extensive. Yet, the perpetuating statistics bleakly illustrate that many urban schools continue to struggle in promoting an equitable education for all pupils. This struggle (or the politics of knowledge, as defined by Kincheloe (2004)) further indicates how people in positions of power dominate the resources that urban and diverse pupils have access to. For urban pupils to attain the resources comparable to their suburban counterparts, urban educators and invested policy makers must demand, and more importantly, act for change. Educators must be involved and engaged to resist the forces that attempt to marginalize populations of color, speakers of a second language, or those living in poverty: "To teach, learn, and lead democratically requires the individual to engage in problem posing and in critiquing taken-for-granted narratives of power and privilege" (Gause, 2011, p. ix). Educators cannot stand aside and politely accept policy that is not suitable for today's learner.

However, the great challenge lies in the fact that some policy makers continue to view urban teaching and learning through a deficit lens. This lens assumes that urban pupils suffer from a long list of problems or deficiencies, and when these are solved, these pupils will then have the capacity to assimilate to a White, middle-class population (Cammarota, 2011). Current reforms and policies continue to fail due to this deficit belief system. Thus, it is important to return to the work of Shulman (1987), who close to three decades ago asserted, "Needed change cannot occur without risk, however. The currently incomplete and trivial definitions of teaching held by the policy community comprise a far greater danger to good education" (p. 20). While pedagogy labs are one glimpse of an effective means of preparation of educators, it is imperative to return to the conversations that questioned how and why pupils, particularly urban pupils, suffer at the

hands of a skeleton curriculum propped up by endless high-stakes assessments. The opportunity for in-service and pre-service teachers to engage in these critical conversations may further inform policy makers. Such conversations took place among Mara, Melanie, and Frida during the Environmental Science Pedagogy Lab, which sparked a renewed interest to implement inquiry-based learning opportunities within a prescribed elementary curriculum. Through an intimate experience of participating in the pedagogy labs, both novice and veteran educators become aware that they have the power to face the imposed challenges, and to take the steps to best improve their teaching and learning practice.

Implications for Future Teacher Education Research

Upon the conclusion of this research study surrounding four pedagogy labs, the findings present a number of considerations for future research and areas of inquiry. In the forefront is a further examination of the nine facets of pedagogical content knowledge, as defined earlier in this chapter. To refine and reaffirm these PCK facets would require an examination of additional pedagogy labs across a wider range of subject areas to determine how these experiences further influence the development of PCK among prospective teachers in content areas not studied in this dissertation. Although during this study, one university student, Laura, completed the Chemistry/Biochemistry and Environmental Science Pedagogy Labs sequentially, both of these labs were science-focused. An investigation into how pre-service teachers develop PCK across additional subject areas such as, but not limited to: literature, composition, history, and geography, would be especially informative for the future development of pre-service teachers and their PCK. As elementary and even middle school teachers are more frequently expected

to integrate or teach several subjects throughout the school year, it is especially critical to examine how the facets of PCK are developed across multiple content areas.

A second area of research would be to investigate how pedagogy labs foster the development of a deeper content knowledge imperative for future educators, and particularly urban educators. Numerous university students in this study remarked on their intention to improve content knowledge through the participation in a pedagogy lab. As indicated previously, high school students are entering institutions of higher education with gaps across various content areas. If those knowledge gaps are not sufficiently addressed, a systematic cycle of ill-prepared educators teaching the next generation of pupils will continue. Perhaps with the influence of the pedagogy labs, these gaps in core content areas can be appropriately address and perhaps, eliminated. Broadly speaking, a study could investigate the influence of pedagogy labs on the acquisition of core content and university students' course grades.

A third research focus would be to further investigate how the implications of culturally responsive pedagogical content knowledge (CRPCK) influence the preparation of pre-service teachers. As both urban and suburban classrooms continue to become increasingly diverse in students' language, race, culture, socioeconomic status, sexual orientation, religion, and other lived experiences, educators need to be well versed in content, cultural responsiveness, and pedagogical practices. To further research how these key facets intersect may inform the preparation and ongoing professional development of novice educators.

The fourth area of inquiry deals with how faculty and instructors develop and maintain their own pedagogical content knowledge and the influence that has on the

preparation of teachers. During the research study, faculty members such as Dr. Kelly, Instructor Holly, Dr. White, and Instructor Cooper, remarked on a number of particular incidents that influenced their future teaching practices when instructing university students. This has the capacity to inform what tools and skills are critical when engaging with university students, for both their academic success and their success as future educators. Thus, it would be particularly interesting to examine how faculty and instructors encompass the nine newly defined facets of pedagogical content knowledge in their practice in higher education.

Finally, it is also critical to investigate how pre-service teachers who participate in pedagogy labs maintain and further develop the facets of pedagogical content knowledge through student teaching and into the induction years of teaching. This ongoing engagement with peers and master educators may have the capacity to strengthen the skills of student teachers, first, second, and third-year teachers and encourage these educators to remain in classrooms situated in some of the most challenged environments. In a way, these labs could also act as ongoing professional learning communities (Bausmith & Barry, 2011), further encouraging critical self-reflection, courageous support, and in turn, an ongoing construction of a deeper PCK. The end goal of all of these potential research studies is to assure for greater PK-12 pupil academic success throughout all communities.

Concluding Statements

This cross-case research study was designed to investigate how pre-service teachers constructed an understanding of the complexities of teaching, learning, and pedagogical content knowledge specific for the urban classroom through the structure of

a pedagogy lab. To reiterate the words of Dr. Rugts at the conclusion of the Mathematics Pedagogy Lab, "There's an awful lot of things that could go into good teaching and I'm not sure we know what all of them are yet" (Dr. Rugts, Concluding Interview, 29 November 2012). I select Dr. Rugts' statement as the conclusion for this research study because it pointedly presents the necessary humility that educators and researchers should embrace in order to continue relentlessly examining ways in which the future practices of teaching and learning can be improved.

Just as professionals in higher education and teacher preparation programs constantly emphasize high expectations among PK-12 pupils, high expectations should also be emphasized in every step of pre-service teacher development. These rigorous expectations need to begin as soon as a university student decides to become a teacher. To refer back to the figurative image of a diamond, the scientific process of creating and artfully caring for this precious gemstone takes time, care, and diligence. Becoming an educator is not, and should not be seen as, an easy profession. Thus, the diamond analogy mirrors the requisite need for teacher educators and education programs to diligently prepare excellent educators. As diamonds are one of the most priceless gems in the world, so too are our educators; they foster the creativity and ingenuity of our future pupils. Without the necessary expectations of rigor, deep knowledge of content, pedagogical practice, and cultural responsiveness, the facets of PCK will not become thoroughly exposed or developed. Yet again, a negative cycle would begin as unprepared educators enter classrooms lacking the necessary skills to interact and learn alongside with every student they come into contact with.

It is relatively impossible for every prospective teacher to be prepared for the endless scenarios that may unfold in the classroom and during their teaching career. However, as a collective, teacher education programs, teacher educators, and pre-service teachers need to collaborate, question, and most importantly, be prepared for the realities of becoming a professional in today's ever-changing classroom environment.

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Appendix A: The Pedagogy Lab Syllabus Template

Session Focus	**Content-related Knowledge**	**Pedagogical-related Knowledge**	**PCK Products Created/Due for Class**
Session 1: **Nature of the discipline.** (envision faculty teaching/learning together).	Nature of teaching and learning in the discipline: Explaining the nature of inquiry in the discipline as exemplified by the selected topic.	Who decides what is learned and how it is taught: • Problematizing the nature of academic standards. Introduce language of PCK and the model (Shulman (1987) and Ball, et al (2008) model	Students will construct some type of graphic organizer or concept map of PCK to illustrate: • Connections between the theoretical underpinnings of the discipline; and **How that learning is translated into learning opportunities for students.**
Session 2: **Specific content/specific pedagogy** (envision content focus to be drawn from discussion section work)	Scaffolding disciplinary-based content within the field Consider how 'content' is situated, and sequenced in the discipline. Video analysis of teaching appropriate content.	• Scaffold disciplinary-based content within the field. • Standards of equity-based content within the field: culturally responsive teaching. Watch video and analyze teachers teaching similar content at various grade levels.	Students draw together best-practice elements in teaching the discipline/topic to answer the following questions: 1. How do you teach this topic in ways tat are developmentally appropriate? • **How do you connect this teaching to standards of equity.**
Session 3: **Engaging learners in the disciplinary content.** (envision this session will focus on examining students' prior knowledge, surfacing students' misconceptions, and sequencing learning)	Introduction of discipline-specific types of questioning: • What aspects of this topic are students most likely to find difficult? • What kinds of questions are students likely to ask related to this content area. Video addressing questioning,	• Introduce the relationships among instruction, assessment, and student learning. • What must be learned before or after the lesson? • How do teachers know students are learning? Video addressing relationships among	Students analyze a video-based case study in the discipline to begin to address the complexity of teaching the topic by: • Unearthing characteristic ways of thinking and reasoning in

	misconceptions, and/or prior knowledge.	instruction, assessment, and student learning	the discipline. • Constructing teaching and learning principles associated with those processes.
Session 4: Developing PCK (envision students select content from L&S course and engage in lesson study in small groups)	Developing multiple representations of knowledge.	**What representations might be appropriate developmentally?**	Craft lesson highlighting developmentally appropriate content.
Session 5: Highlighting PCK in student-crafted lessons (envision students using Ball PCK framework to analyze own lessons. perhaps 'teach' to peers)	Revise lesson content based on feedback from peers.	Revise pedagogical aspects of lesson based on feedback from peers.	Analysis and revision of lesson, using Ball et al., (2008) PCK framework.

Appendix B: Interview Protocol – Faculty

Instructor Interview Protocol

1. How do you define pedagogy? How have you defined the purpose of your pedagogy lab?

2. What traits do you associate with a teacher's pedagogy? In other words, what would you see a teacher doing in a classroom if that person was a pedagogical 'wizard'?

3. How would you describe the relationships between content knowledge and the ability to teach that content to students in a classroom (pedagogical content knowledge)?

4. Over the years, state requirements in teacher preparation programs have elevated the value of one's content knowledge and minimized or eliminated the associated value of one's pedagogical knowledge. What value to you attach to a teacher's pedagogical knowledge and why?

5. In what ways do you think the presence or absence of a pedagogy lab shapes students' understandings about teacher/student relationships?

6. Describe the lesson you are teaching.
    a. How did you determine what to teach?
    b. In what ways do you make your pedagogy explicit to students?

7. Explain what information you use to determine how complex lessons should be? In what ways do you make that information explicit to students?

8. How do you help students think about the connections among the 'content' of a lesson, the pedagogy associated with the learning of that content and PK-12 students' lives?

9. How do you promote students' language and literacy development in your course? How do you then ask education-intended students to transfer the importance of that development to future PK-12 students?

10. When you are teaching, how do you know students are learning?

11. How do you facilitate conversations about student learning in your discussions about teaching and learning in your course? Describe the nature of those conversations.

12. In what ways has your teaching of this pedagogy lab shaped your understanding about the teaching and learning relationship?
    a. How has the teaching of this pedagogy lab shaped your own teaching?
    b. Describe the value, you believe, this course has added to the development of these education-intended students?

13. Would you teach a pedagogy lab again? If so, what would you keep the same? What might you change?

Appendix C: Interview Protocol – Student

Student Group Interview Protocol

1. Describe your ideal classroom.

2. Tell me about the interactions going on between the students and teacher in that classroom.

3. Describe the lesson you are teaching.
    a. How did you determine what to teach?
    b. What factors will you consider as you prepare to teach that lesson?

4. Describe the relationship between content knowledge and the ability to teach that content to students in a classroom (pedagogical content knowledge).

5. Explain what information you will use to determine how complex the lesson should be.

6. How will you connect a lesson with students in the classroom?

7. Identify how the lessons you design will you promote students' language and literacy development?

8. How will you know students are learning?

9. In what ways has being in this pedagogy lab shaped your understanding about the teaching and learning relationship in your future PK-12 classroom? What do you still have questions about?

Appendix D: Student Recruitment Advertisement

UNIVERSITY of WISCONSIN
UWMILWAUKEE
POWERFUL IDEAS | PROVEN RESULTS

What distinguishes a great teacher from just a good one?

Take advantage of this unique opportunity to participate in a 1-credit course to explore the link between content knowledge and pedagogy for the PK-12 classroom.

OVERVIEW

Good teachers have strong Content Knowledge. Good teachers have strong Pedagogical Knowledge. However each of these independently, does not foster high levels of learning in every student. Research suggests that a combination of the two – Pedagogical Content Knowledge – is what distinguishes a great teacher from simply a good one.

COURSE STRUCTURE

The 1-credit, 5-week Pedagogy Lab course is a unique space for you to gain insights from both faculty from the college of Letters and Science and the School of Education. The instructors bridge their expertise to provide opportunities for you to translate content from your L & S courses into learning opportunities for students in the PK-12 classroom.

ENROLL NOW THROUGH PAWS:

CURRINS 565:
Linking Science Content with Pedagogy
Section: 291, Class # 27838
Online access required
Course runs during Mini Term II:
October 8th through December 8th
Last day to drop this class is October 12th

CURRINS 565:
Linking Mathematics Content with Pedagogy
Section: 301, Class # 28136
Meets face-to face Tuesday evenings 5:00pm – 7:30pm
9/11, 9/18, 9/25, 10/2, 10/9
Lapham Hall 253

****This course is at no extra cost if you are a full-time student with 12-17 credits.**

COURSE HIGHLIGHTS

With enrollment in this course, you will also have a rare opportunity to participate in the Pedagogy Lab research study found only at University of Wisconsin - Milwaukee and Boston College. Your insights will provide how to best prepare and support current and future urban educators.

Preliminary research suggests that students who participate in the pedagogy labs:

1. Enrich their own development as future teachers;
2. Understand their L & S course content more thoroughly; and
3. Begin to comprehend the complexities in how this knowledge translates to school-age children; complexities they share in essays written for admission to one of the School of Education certification programs.

CURRICULUM VITAE

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