TECHNOHUBS IN TEACHER EDUCATION: THE LIVED EXPERIENCE OF
ASSISTING PEERS WITH INSTRUCTIONAL TECHNOLOGY ISSUES

A Dissertation in
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by
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ABSTRACT

This study examined prospective teachers’ lived experiences of assisting peers with instructional technology issues. The study built upon one of ISTE’s (2003) essential conditions for integrating technology in education: technical assistance for using technology. Through a review of relevant literature, an argument was made for the study based on a lack of understanding around peer technical assistance with prospective teachers in teacher education programs.

This study used social network analysis (Reeves, 2008; Kleinberg, 1998) to find the participants who offer instructional technology assistance to many of their peers. By combining technology and superhub, the word “technohub” was used as a label for the participant population. The study identified the following research question: What is a technohub’s lived experience of assisting peers with instructional technology issues in teacher education courses? A theoretical framework provided a starting point to explore technohubs’ lived experiences by combining the current tensions in teacher education, teacher and technology leadership, and sociocultural and social theories of how people learn.

To address the research question, the study drew from transcendental (Husserl, 1913/1982; Moustakas, 1994) and hermeneutic (Heidegger, 1927/1962; van Manen, 1997) strands of phenomenology to create a Neo-Vygotskian methodological orientation. Semi-structured interviews and observations provided data that spoke to technohubs’ experiences. Phenomenological thematic analysis was used to find six essential themes of the experience of assisting peers with instructional technology issues. Research outcomes included a discussion of the six themes and a peer-reporting technohub questionnaire.
Implications of the findings suggest that teacher education programs: (1) embrace a collaborative nature and environment that emphasizes inquiry and wonderings; (2) provide prospective teachers with opportunities to “play” with emerging technologies and tools; (3) embrace leadership development as an important part of a teacher education program; (4) promote field-based experiences with student-centered models of instructional technology; (5) change how to reward and identify successful technology leadership; (6) create a coherent community throughout a teacher education program; and (7) strongly link theory to practice. Limitations are discussed with an emphasis on the timing of the study and collection of the data. Finally, future avenues of research are presented with a look to additional outlets for the findings.
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In the next few pages, I explain my inspiration behind pursuing this particular topic of interest. In phenomenological research, this exercise is an attempt “to orient oneself to the phenomenon” (van Manen, 1997, p. 40). It is my goal that upon reading this section, the reader will gain an understanding of (1) how I became interested in this topic, and (2) what I hope to gain from a study of this topic.

In 2004, I enrolled in a graduate program in Secondary Education and Mathematics at the College of New Jersey. I entered the program after finishing a Bachelor’s degree in Computer Science, and brought with me prior experiences of using technology to develop web resources and assisting peers with computer programming issues.

One of the first courses I enrolled in during the graduate program was an educational foundations course, focused on introducing the cohort of graduate students to current educational theories and policies. The final assessment in the course involved the creation of an electronic portfolio that would contain initial artifacts from the educational foundations course and would serve as a place to publish additional artifacts as we completed the graduate program.

As the deadline for the final assessment drew near, our class met regularly in a computer lab and used Microsoft® Office FrontPage®, a discontinued what-you-see-is-what-you-get (WYSIWYG) web development software tool, to complete the electronic portfolio. Although I had never used FrontPage® before, I quickly familiarized myself with the tool because of my
strong background in computer programming. Upon learning the limitations of FrontPage®, such as the inability to create image-based menus (as evidenced by the menus used in my peers’ electronic portfolios in Figure P-1), I decided to create a wire-frame, buttons and background images in Adobe Photoshop, a photo editing software tool.

Figure P-1: Electronic Portfolios from Two of my Peers.

I used Photoshop to create a mock-up of my homepage with an interactive menu in front of a gradient background. I sliced the wireframe with the Photoshop slice tool and added link tags in tables in the FrontPage® coding window to include the slices in my page. Later in the graduate program, I added sample lesson plans and embedded a video of my classroom during student teaching in a high school. Figure P-2 provides a visual screenshot of my homepage.
After seeing my portfolio, my closest friends and peers in the program recognized my technical background and word circulated quickly to the point that I became the emergent go-to person for people who encountered issues during the development of the electronic portfolios. I helped problem solve coding issues that my peers encountered in hypertext markup language (HTML).

The debugging skills I had learned during my bachelors program provided me with the know-how to help my peers in the computer lab during the educational foundations course. I really enjoyed helping my peers work through issues, and I learned how to work with others in a way that I hadn’t experienced during my time with comparably skilled peers in computer science.
circles. My education peers were different (than computer science peers) in that they wanted to solve issues but they did not have the confidence in working with technology to work through issues on their own. They lacked a confidence in their own technology savvy-ness.

Between the end of my masters program in 2006, and the beginning of 2011, I helped numerous people and served in a similar role of go-to person for technology assistance in many of my communities. I can provide additional accounts of these experiences. However, my experience of helping peers in the educational foundations course remains my most vivid example of the experience of assisting peers in teacher education courses.

In 2011, I first began to conceptualize the topic of interest in this study during a discussion with Dr. Kyle Peck about Journalist Malcolm Gladwell’s The Tipping Point, a compelling story of how social epidemics spread (2000). In The Tipping Point, Gladwell explains that there are three types of people who contribute to the spreading of ideas: connectors, mavens, and salespeople. Mavens conceptualize ideas as “information brokers,” connectors bring people together and spread the ideas, and salespeople convince others to believe the ideas (p. 69).

Researchers (Veres & Carlsen, 2003; Bush & Mott, 2009) have used Gladwell’s theories to identify teachers who serve in technology-spreading roles within schools and classrooms. Veres and Carlsen (2003) explain the three roles from this perspective in the following excerpt:

The connector was an individual with special talent to bring people (teachers) together to work well in teams. Mavens were pivotal because they, unlike geeks or gurus, possessed both knowledge and social ability. Mavens give freely to colleagues. Mavens mentor and work along side those with less developed knowledge and skills. Finally, Gladwell identified salespeople who usually exhibit the characteristics of exuberance and enduring optimism. (p. 23)

The description that Veres and Carlsen give mavens, “work(ing) along side those with less developed knowledge and skills,” reminded me of the times I helped peers with electronic
portfolios in my graduate program. I became interested in learning more about this phenomenon, assisting peers with instructional technology issues in teacher education. In this study, I question and challenge my own understanding of the phenomenon to develop a deeper understanding of the experience of assisting peers in teacher education. I shed light on the topic in relation to the current work on peer assistance in the field of Educational Technology in the hopes that new knowledge can be created and disseminated based on my efforts in this study.
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CHAPTER 1

INTRODUCTION

“There can be infinite uses of the computer and of new age technology, but if teachers themselves are not able to bring it into the classroom and make it work, then it fails”

Nancy Kassebaum Baker, Former U.S. Senator

In today’s teacher education programs, there is a strong emphasis on getting prospective teachers to know how, when, and why to use technology to support teaching and learning (Polly & Moore, 2008). I define technology broadly in this context to include both devices and ideas such as computer hardware and software, Internet sites, personal computing devices, mobile applications, cloud computing, theoretical frameworks, and conceptual understandings. The strong emphasis on technology is evident in accreditation standards published by the National Council for Accreditation of Teacher Education (NCATE) and the International Society for Technology in Education (ISTE), nonprofit professional organizations for teacher education and educational technology (ISTE, 2003).

In 2002, ISTE brought together a committee of PreK-12 teachers, technology coordinators, administrators, and university faculty to develop a blueprint of a successful implementation of ISTE’s technology standards. The committee created ten “essential conditions” for a teacher education program including:

- a shared vision for technology use;
- access to technology;
- skilled educators in the use of technology;
- professional development to support technology use;
- technical assistance for using technology;
- content standards and curriculum resources;
- student-centered teaching;
- assessment of the effectiveness of technology;
- community support;
- and support policies. (ISTE, 2003, p. 22)

The ten conditions provide a blueprint for all levels of prospective teacher preparation including methods courses, student teaching, and induction practices (i.e. first-year teaching). While each
and every condition is important to the implementation of ISTE’s technology standards and helping prospective teachers use technology, I narrow my focus in this study to provide an in-depth, rich description of one of the conditions, technical assistance. In this chapter, I demonstrate the need to study the experience of assisting peers, and introduce a research question that can help extend ISTE’s notion of technical assistance in teacher education. The following section provides an introduction to technology in education to understand the need for technical assistance.

**Technology in Education**

Technological advances have been used to support educational practices since the beginning of formal education. The printing press, the chalkboard, the overhead projector, the television, the white board, the interactive white board, and the personal computer are all examples of technological advances that teachers have integrated into educational practices over the past 500 years. But it is only within the last 35 years that administrators have placed a significant emphasis on technology integration in schools, colleges, and departments of education. One explanation for the emphasis on technology integration is the expectation that teachers are preparing students to be members of an increasingly digital society. To this end, organizations have developed technology standards for teachers, students, and administrators to meet the demands and advances in personal computing devices (Polly and Moore, 2008).

Another explanation for the emphasis on technology integration is the effort that has been made to understand the impact, or lack thereof, of personal computers on educational practices. Many researchers (Papert, 1980; Clark, 1983; Cuban, 1986; Kozma, 1994; Means, 1994; Cuban, 2001; Harris, 2005) have debated the impact of computers on education. Even the late Steve Jobs
(from Apple®) attempted to understand the impact of personal computers on educational practices. In a 1996 interview with Wired magazine, Steve Jobs was asked if technology could improve education. The following paragraph is an excerpt of his response:

I used to think that technology could help education. I’ve probably spearheaded giving away more computer equipment to schools than anybody else on the planet. But I’ve had to come to the inevitable conclusion that the problem is not one that technology can hope to solve. What’s wrong with education cannot be fixed with technology. No amount of technology will make a dent… We can put a Web site in every school – none of this is bad. It’s bad only if it lulls us into thinking we’re doing something to solve the problem with education. Lincoln did not have a Web site at the log cabin where his parents home-schooled him, and he turned out pretty interesting. Historical precedent shows that we can turn out amazing human beings without technology. Precedent also shows that we can turn out very uninteresting human beings with technology. It’s not as simple as you think when you’re in your 20s – that technology’s going to change the world. In some ways it will, in some ways it won’t. (Wolf, 1996)

While much of the discussion (including Jobs’ thoughts) has centered on whether the personal computer is an agent of change in educational reform, the value of the literature for this study lies in findings about the roles that teacher education and professional development play in helping prospective teachers use technology to support teaching and learning.

The Role of Teacher Education

In the 1990s, Apple® partnered with local school districts to create the Apple® Classroom of Tomorrow (ACOT) program, a program intended to transform teaching and learning through the integration of technology in teacher education (Dwyer, Ringstaff, & Sandholtz, 1991). The ACOT program assisted prospective and inservice teachers in progressing through five stages of change in using technology in education: Entry, Adoption, Adaptation, Appropriation, and Invention (p. 47). When moving through the stages, teachers were able to more readily “reflect on teaching, question old patterns, and speculate about causes behind
changes in students” (p. 50). To help teachers reach the Invention stage, teacher education in the ACOT program involved “observing and learning in real classrooms where teachers could experience firsthand how technology could be integrated into classroom instruction” and experimenting and refining technology skills (Sandholtz, 2001, p. 372). Findings from the ACOT program provided information on how learning in authentic practices helps prospective and inservice teachers increase their use of technology to support teaching and learning (Sandholtz, 2001).

Recent studies funded by the U. S. Department of Education through the Preparing Tomorrow’s Teachers to Use Technology (PT3) Grant program have found that successful teacher education programs expose prospective teachers to “effective (technology) practices within their methods courses” and “continuously support (prospective teachers) as they develop and implement technology-rich lessons” during student teaching practices (Mims et al., 2006, p. 23). Teacher educators who model appropriate and effective technology practices within methods courses are in a position to support prospective teachers in using technology in teaching and learning.

**Problem Statement**

Funded studies in the ACOT and PT3 programs speak to the role of university faculty and cooperating teachers as technical assistance, helping prospective teachers use technology to support teaching and learning (Sandholtz, 2001; Grove, Strudler, & Odell, 2004; Mims et al., 2006; Grove, Strudler, & Odell, 2007). However, these studies largely ignore the role of prospective teachers in supporting one another in using technology in teaching and learning. In other words, there is a gap in conceptual understanding about the role of peer technical assistance.
in teacher education. Efforts have been made to study peer technical assistance with inservice teachers (Glazer, Hannafin, & Song, 2005), teacher leaders (York-Barr & Duke, 2004), and teacher leadership training (Danello, 2008), but there is a lack of description of peer support and technical assistance among prospective teachers. More broadly, studies have looked at peer interactions in teacher education around peer assessment (Sluijsmans & Prins, 2006), peer learning (Blumenfeld et al., 1996; Hwang & Hu, 2013), peer instruction (Crouch & Mazur, 2001), peer mentoring (Le Cornu, 2005), peer coaching (Morgan et al., 1992; Swafford, 1998), peer tutoring (Ragonis & Hazzan, 2009a; Ragonis & Hazzan, 2009b), cooperative learning (Johnson & Johnson, 1979), peer collaboration (Damon & Phelps, 1989), and peer scaffolding (Ge & Land, 2004), but there is a lack of research in peer assistance with instructional technology issues. The problem that I investigate in the present study is a lack in understanding of the practices and experiences that prospective teachers have in assisting peers with instructional technology issues.

**Identifying Assistance**

Before I can begin to understand the practices and experiences of prospective teachers assisting others with technology, I first must identify the prospective teachers assisting others. In other words, it is important to establish an approach that will lead to the identification of prospective teachers assisting others. Observation of teacher education courses seems like the best method to find the prospective teachers who assist others, but observation would miss most of the dynamics outside of teacher education courses. Communication technologies enable prospective teachers to stay in touch outside of class with no limitations in location or time, making it almost impossible to observe any assistance outside of class.
In an ideal situation, I could turn to critical incident technique (Flanagan, 1954), a method and technique to gather data that involves participants recording personal memos and annotations of ideas and events as they occur. I could give all of the prospective teachers a digital recording device and teach them a protocol to record occasions of peer assistance outside of class. However, the time and resources needed to use critical incident technique in this manner would be outside of my budget and time restrictions for the present study. An alternative method to identify assistance, and the one I use in this study, is based on peer reporting (Ellwardt, Labianca, & Wittek, 2012) and social network analysis theory (Knoke & Yang, 2008). Peer reporting involves finding participants based on responses from the participants’ peers.

In social network analysis theory (2008), prospective teachers are refereed to as nodes. If prospective teacher A goes to prospective teacher B for assistance, there would be a connection between node A and node B in the social network. If multiple prospective teachers went to prospective teacher B for assistance, she/he would be considered a hub. Reeves (2006) coined the term “superhubs” to describe the nodes that have an “exceptionally large number of connections to other nodes or hubs” (p. 34). In other words, superhubs are the prospective teachers who have the most connections to others, or in this case, assist the most peers with instructional technology issues. To find prospective teachers assisting others, I use social network analysis theory to look at all of the connections in the teacher education program around technical assistance and identify the prospective teachers who assist the most peers.

**Technohubs**

In this study, I combine the words technology and superhubs to create the term technohubs, a shortened label for the population of prospective teachers that assist the most peers.
with instructional technology issues. In social network analysis theory, technohubs are the prospective teachers who have the most connections to their peers around assisting with instructional technology issues. Technohubs are discovered by completing an analysis of the “technical assistance” connections that prospective teachers have with their peers. Additional information about the technohub selection process is provided in Chapters 3 and 4.

**Purpose of the Study**

The present study identifies prospective teachers who other prospective teachers go to for support with technology issues and labels the identified prospective teachers as technohubs. The purpose of the study is to investigate technohubs’ lived experiences of assisting peers with instructional technology issues in teacher education. I use the word “lived” (van Manen, 1997) to describe the experiences because lived implies that the participants have first-hand experiences, not observations, of the phenomenon.

**Research Question**

The development of the topic described in previous sections of this chapter leads us to the following research question: **What is a technohub’s lived experience of assisting peers with instructional technology issues in teacher education courses?**

**Significance**

The findings in the present study have the potential to advance our understanding of teacher education and instructional technology by describing prospective teachers serving as technohubs. The present study could help teacher educators understand the population of
technohubs, identify prospective teachers serving as technohubs in their programs, understand how to provide support for technohub practices and activities, and use technohubs to advance the goals of their programs. Also, researchers could use ideas from the study to advance our notion of technical assistance, as described in ISTE’s essential conditions of a successful teacher education program.

**Definitions**

**Instructional Technology Issues:** Instructional technology issues are problems associated with using technology in the learning process or supporting a lesson with technology. Examples of instructional technology issues include determining how to use technology resources to support learning goals/outcomes in a lesson, learning how to use a software program like iMovie® or StudioCode® for a project, learning how to use a classroom technology like an interactive white board, or completing a technology project in a teacher education methods course.

**Peer Technical Assistance (also Peer Technology Support):** Peer technical assistance is the practice of helping a colleague with a technology issue that they might be having. In teacher education, technology issues often include instructional technology issues.

**Technohub:** The term technohub is a combination of technology and superhubs (from social network analysis). Technology is a tool that supports human activity and superhubs are the people that are connected to many others in a network. In this study, I use the term technohub to describe a prospective teacher that numerous peers go to for assistance with instructional technology issues in a teacher education program.
**Technology:** Technology is a tool that supports human activity. Examples of technology include both devices and ideas such as computer hardware and software, Internet sites, personal computing devices, mobile applications, cloud computing, theoretical frameworks, and conceptual understandings.

**Technology Issues:** Technology issues are problems that occur with using technology. Examples of technology issues include fixing a computer problem, installing a program, connecting to the Internet, or finding a saved file.
CHAPTER 2

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Chapter two establishes a framework for studying technohubs’ lived experiences assisting peers in teacher education programs. I position this study in relation to the current calls for research in education, and I develop a sociocultural theoretical framework as a lens and tool for constructing interview questions, collecting data, and generating findings from the data analysis. I start broadly by positioning peer assistance in the context of current tensions in teacher education and understandings of teacher leadership. I describe relationships between the tensions in teacher education and recent calls for research in teacher leadership. Next, I look closely at the theoretical foundations of peer assistance, drawing from both sociocultural and social theories of how people learn. Finally, I discuss limitations of my theoretical framework and conclude with a summary of my framework.

Overview of Teacher Education and Leadership

Recent calls for research on teacher education have focused on pedagogies of enactment (Grossman & McDonald, 2008), meaning that teacher education should be embedded in the classroom, the context in which the professional practice takes place. Recent calls for research in teacher leadership have focused on leadership among prospective teachers (York-Barr & Duke, 2004). In this section, I provide an overview of the research in teacher education that speaks to these two recent calls. I bring attention to current tensions in teacher education and understandings of teacher leadership. The goal of this section is to demonstrate the broader context of the research study.
Tensions in Teacher Education

As prospective teachers enter teacher education programs, they bring baggage with them in the form of misconceptions of teaching. Darling-Hammond (2006) identified three main tensions when learning to teach: the apprenticeship of observation, enactment, and complexity.

Apprenticeship of Observation

Before starting a teacher education program at the undergraduate level, a prospective teacher has been a K-12 student for approximately thirteen years. During the thirteen years as a student, the prospective teacher has seen and understood teachers’ actions from his/her own perspective. The perspective of pedagogy that has been learned in those years is defined as the apprenticeship of observation (Lortie, 1975). Ball and Cohen (1999) suggest that the apprenticeship of observation is difficult to overcome because it is reinforced repeatedly throughout K-12 education and some university courses. In studies of teacher education, researchers should acknowledge and speak to the apprenticeship of observation to understand prospective teachers’ experiences and perceptions. One way to move past the apprenticeship of observation is to provide prospective teachers with a way to understand teaching from an insider perspective such as a Cognitive Apprenticeship, something I discuss later in this chapter.

Enactment

As stated previously in this chapter, enactment refers to the belief that teacher education should be embedded in the context in which the professional practice takes place (Grossman & McDonald, 2008). In other words, enactment is the link between theory and practice. Darling-Hammond (2006) verifies the tension of enactment in prospective teachers’ complaints that
methods courses do not connect theories to practice. Prospective teachers complain about not being taught the practical skills that will enable them to connect learning theories to their classroom experiences. Enactment involves interpreting classroom events (from theoretical understandings of teaching) and providing the correct behavioral responses (i.e. practices) to teaching situations (Kennedy, 1999).

A professional development school (PDS) speaks to the tension of enactment by having prospective teachers immersed in the K-12 classroom during a teacher education program (NAPDS, 2008). A PDS is a yearlong student teaching experience, where prospective teachers explore teaching practices in the context where they occur, i.e. the classroom. A PDS, as explained by the Executive Council and Board of Directors of the National Association for Professional Development Schools, involves the following nine characteristics:

1. A comprehensive mission that is broader in its outreach and scope than the mission of any partner that furthers the education profession and its responsibility to advance equity within schools and, by potential extension, the broader community;
2. A school-university culture committed to the preparation of future educators that embraces their active engagement in the school community;
3. Ongoing and reciprocal professional development for all participants guided by need;
4. A shared commitment to innovative and reflective practice by all participants;
5. Engagement in and public sharing of the results of deliberate investigations of practice by respective participants;
6. An articulation of the agreement developed by the respective participants delineating the roles and responsibilities of all involved;
7. A structure that allows all participants a forum for ongoing governance, reflection, and collaboration;
8. Work by college/university faculty and P-12 faculty in formal roles across institutional settings; and

In a PDS, prospective teachers are provided opportunities to link theory and practice.
**Complexity**

An offshoot of both the apprenticeship of observation and enactment is a misconception of teaching complexity. Prospective teachers entering a teacher education program often view teaching as a fairly simple process (Darling-Hammond, 2006). Prospective teachers are unaware of the complexities inherent in teaching and how difficult it will be to go through the process of enactment. If teacher educators do not provide prospective teachers with an insider’s view of teaching, notions of simplicity may be reinforced in teacher educator programs. However, in reality, the profession of teaching is as complex a profession as any because no two teaching events are the same (Lampert, 2001). Content changes constantly, students come from a range of backgrounds, and teachers are asked to serve in different roles such as motivator, evaluator, guide, facilitator, and coach during a lesson.

**Teacher Leadership**

Past research efforts in teacher leadership have focused on teacher leaders (York-Barr & Duke, 2004), and teacher leadership training (Danello, 2008). A review of literature on teacher leadership (York-Barr & Duke, 2004) identified three factors that influence teacher leadership. First, teacher leadership is influenced by the culture and community of the school. Katzenmeyer and Moller (2001) found that schools that encourage and promote leadership in the culture and community were in a better position to have teacher leaders impact educational reform. Second, teacher leadership is influenced by perceptions within the school (York-Barr & Duke, 2004). Darling-Hammond, Bullmaster, and Cobb (1995) discovered that when teachers do not see the administration’s assigned teacher leaders as the real teacher leaders, teacher leaders fail to inform their peers’ practices. Finally, teacher leadership is influenced by professional development
(Darling-Hammond et al., 1995) and lifelong learning (York-Barr & Duke, 2004). Schools can create a healthy leadership culture by promoting teacher leadership across the culture and community, discouraging negative feelings towards identified leaders, and supporting teacher leaders with opportunities for professional development and continued learning.

York-Barr & Duke (2004) found that identified teacher leaders engage in similar practices, and they created a model to describe the practices. Teacher leaders:

1. build trust and rapport with colleagues;
2. are supportive of colleagues;
3. are effective in communicating, handling conflict, and negotiating and mediating;
4. have an ability to deal with process, displaying effective group processing skills;
5. have an ability to assess teacher needs and concerns;
6. display a solid understanding of current tensions and consequences of decisions.


In terms of teaching, teacher leaders:

1. have significant experience in their field;
2. have extensive knowledge of teaching and learning;
3. have a clearly developed philosophy of education;
4. are creative, innovative, seekers of challenge and growth, lifelong learners;
5. assume responsibility for actions;
6. are respected and valued by colleagues;
7. are sensitive and receptive to thoughts of others;
8. have cognitive and affective flexibility;
9. are hard-working.


In prospective teacher education, leadership often takes the form of informal leadership or technology leadership (Danello, 2008). The following two subsections present research on informal teacher and technology leadership to provide additional context for the present research study.
**Informal Teacher Leadership**

Researchers (Wasley, 1991; Darling-Hammond et al., 1995) have looked at the notion of informal teacher leadership in teaching practices. They found that there are noticeable differences between formal and informal teacher leadership. In a study of two formal teacher leaders and one informal teacher leader, Wasley (1991) found that the teacher who was an informal leader, meaning she was not labeled as a leader, was considered the best teacher leader among her/his peers.

Darling-Hammond et al. (1995) suggest that teacher leadership does not need to involve formal leadership roles. Rather, it can be an organic process, with teacher leaders naturally emerging in a community. Teacher leaders who emerge from among their peers are “recognized as a major resource to the school community, one that has previously gone untapped” (p. 95).

**Technology Leadership**

Studies of teacher leadership with technology, or technology leadership, have uncovered four practices in which teacher leaders engage (Riel & Becker, 2008; Howell, 2012). Riel and Becker (2008) labeled the four practices as the teacher technology leadership (TTL) model, which includes:

1. learning with technology
2. collaborating around technology
3. networking in technology-active communities
4. contributing to knowledge about educational technology.
   (Riel & Becker, 2008, p. 412)

Howell (2012) used the TTL model as an analytical framework in a study of high school teachers serving as technology leaders with a one-to-one laptop to student initiative. Howell (2012) found that these technology leaders engaged in the first three practices in the TTL model.
The fourth practice, contributing to knowledge about educational technology, was not found. During the study, Howell (2012) explained the fourth practice as conducting and publishing research on educational technology, something that high school teachers do not do regularly.

Summary of Teacher Education and Leadership

In teacher education, prospective teachers bring with them ideas and thoughts about teaching, learning, and using technology in the classroom from thirteen years spent as students in a classroom, in what is known as the apprenticeship of observation. The apprenticeship of observation is one of three current tensions in teacher education that researchers are investigating. The other two tensions involve connecting theory and practice (i.e. enactment), and understanding the complexities of teaching. Professional development schools offer opportunities to connect theory and practice by immersing prospective teachers in the K-12 classroom during their teacher education program.

Successful teacher leadership involves establishing a positive culture and community of a school, influencing the perceptions of peers, and increasing opportunities for teacher leaders to engage in professional development. Informal teacher leadership can be even more powerful than formal teacher leadership because teachers who emerge as leaders from within their communities are often the teachers that peers go to for help (as opposed to the teachers appointed by the administration).

Teacher leaders have experiences in common. They support others, handle and negotiate conflict using effective communication, and earn respect from their colleagues (York-Barr & Duke, 2004). In technology leadership, teacher leaders network in technology-rich communities,
learn technology on their own, and collaborate with and contribute to the community (Riel & Becker, 2008).

The overview of teacher education and leadership spoke indirectly to peer assistance by suggesting that research in prospective teacher education address the apprenticeship of observation, enactment, complexity, and identify opportunities to develop informal teacher and technology leaders. The following section speaks directly to peer assistance by presenting the foundational literature upon which the present study is framed.

**Theoretical Foundations of Peer Assistance**

The topic of peer assistance has gained popularity in educational research through the influence of sociocultural and social theories of how people learn. Lev Vygotsky, a Russian Psychologist, posited that a student’s learning is embedded in the culture, language, and interactions with the people in the environment. The following two subsections examine the contributions of the Sociocultural Theory of Learning (Vygotsky, 1978; 1986), and the Social Theory of Learning (Greeno, 2006; Wenger, 1998) on peer assistance. Throughout the subsections, I will present relationships between these theories and explain how they provide a lens to understand peer assistance.

**Sociocultural Theory of Learning**

The Sociocultural Theory of Learning draws from Vygotsky’s theories (1978; 1986; 1934/1987) on learning. In Vygotsky’s theories, learning occurs by constructing knowledge through interactions with others and tools, and using the languages that are shared by the people in the environment and culture. Karpov (2003) summarizes Vygotsky’s theories by explaining,
“human mental processes, just like human labor, are mediated by tools” (p. 139). Tools are resources that provide assistance to a learner. However, tools do not need to be physical objects in the environment. For example, theoretical frameworks and conceptual understandings are just as much tools that assist people with the learning process as are computer hardware and software. Students learn by using tools and interacting with people in their environment. The relationship between a student and his/her environment, or “social situation of development” (Chaiklin, 2003, p.47), is an important aspect in the sociocultural theory of learning.

As opposed to pure constructivist theorists that view learning as being constructed by individuals, or behaviorists who view learning as being transmitted or taught, the Sociocultural Theory of Learning explains learning as being mediated by others in a social environment (Karpov, 2005). The use of the word “mediated” is important because it implies that there is a social dimension of learning as well as an individual dimension. The social dimension of learning is culturally and historically contextual. That is, learning is specific to and embedded in the cultural and historical norms of the environment. According to Vygotsky, the social dimension of learning involves interactions with people who assist us through development. He describes this understanding of assistance as the Zone of Proximal Development.

**Zone of Proximal Development**

The Zone of Proximal Development (ZPD) describes what an individual can do with assistance from others (Vygotsky, 1978). The ZPD is the “distance between (a learner’s) actual developmental level… and the level of potential development through problem solving under adult guidance or in collaboration with more capable peers” (p. 86). The ZPD can be described
as both a tool and a method to understand and foster development. Vygotsky explains his notion of development using a metaphor of a gardener and apple orchard:

Psychological research on the problem of instruction is usually limited to establishing the level of the child’s mental development. The sole basis for determining this level of development are (sic) tasks that the child solves independently. This means that we focus on what the child has and knows today. Using this approach, we can establish only what has already matured. That is, we can determine only the level of this child’s actual development. To determine the state of the child’s development on this basis alone, however, is inadequate. The state of development is never defined only by what has matured. If the gardener decides only to evaluate the matured or harvested fruits of the apple tree, he cannot determine the state of his orchard. Maturing trees must also be taken into consideration. The psychologist must not limit his analysis to functions that have matured. He must consider those that are in the process of maturing. If he is to fully evaluate the state of the child’s development, the psychologist must consider not only the actual level of development but the zone of proximal development. (Vygotsky, 1978, p. 208-209).

In the example of the apple orchard, the gardener has a more accurate view of his orchard when he includes the apple trees close to maturation. Vygotsky used this metaphor to explain how the ZPD seeks to identify all of an individual’s development as it occurs in an environment and culture. One thing to note is that Vygotsky’s notion of development in the ZPD is embedded in culture and cannot be removed from culture. Newman and Holzman (1993) compare Vygotsky’s notion of development to ethnography (i.e. the study of culture), because Vygotsky is concerned with capturing continuous development acted upon by the environment and culture in which an individual participates. Stated another way, the ZPD is neither a framework nor a model, but rather a way to explain the interaction of more capable peers and peers in a community and culture.

The term more capable peer was used by Vygotsky (1978) to define the role of the more capable “other.” To aid a learner through the ZPD, more capable peers should have an understanding of learners’ “current state of development” (Chaiklin, 2003, p. 51). The current
State of development involves learners’ preconceived notions or preconceptions of a topic. More capable peers need to have an understanding of learners’ preconceived notions of content so learners’ knowledge can be confirmed or refuted (Bransford, Brown, & Cocking, 1999). If learners’ preconceptions are not activated and/or challenged, learners’ do not change their conceptions and “may fail to grasp the new concepts and information that are taught” (p. 15). More capable peers should therefore activate and engage learners’ preconceived notions of content. Two concepts explain how more capable peers provide assistance through the ZPD: mediation and scaffolding. Both are presented in the following subsections.

**Mediation.** Mediation provides a way to understand the learning process in the ZPD on two levels: the interpersonal and the intrapersonal. On the interpersonal level, learning is a collection of practices within a community. On the intrapersonal level, learning is mediated by tools (both psychological and physical) or by people (Kozulin, 1998). People can provide mediation by helping a learner to understand concepts in relation to what he/she already knows on the intrapersonal level.

For an interaction to be classified as mediation, three conditions must be satisfied. The interaction must be intentional, purposeful, and transcend time and culture (Feuerstein, 1990). In other words, the more capable peer or the tool should provide appropriate support. Appropriate support becomes intentional when the more capable peer considers the current development of the learner. The support becomes purposeful when it is related to the work or practices that the learner engages with in the community. Finally, the support transcends time and culture when the support person or tool offers advice that can be applied across situations and contexts.
**Scaffolding.** Although the term is not attributed to Vygotsky, scaffolding explains the type of support provided in Vygotsky’s ZPD. Wood, Bruner, and Ross (1976) are attributed with developing the concept of scaffolding and explaining it as a “process that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts” (p. 90). Examples of scaffolding techniques include question prompts, guided teacher-student interactions, and guided peer interactions (Ge & Land, 2004).

In informal settings, scaffolding may take the form of unguided peer interactions. Unguided peer interactions are defined as interactions in which no participants are tasked with organizing the interaction or guiding the scaffolding process. Studies (Webb, 1989; Greene & Land, 2000; Ge & Land, 2003) have examined the promise of unguided interactions as scaffolds. Ge and Land (2003) suggested that unguided interactions were effective “when group members offered suggestions, negotiated ideas, and shared their experiences” (p. 23).

Scaffolding is an alteration to Vygotsky’s ZPD and thus, it could be considered a Neo-Vygotskian perspective on the ZPD. The reason it is an alteration is because there is a difference between the theory of scaffolding (Wood et al., 1976; Ge & Land, 2004) and Vygotsky’s theories with the notion of development. The definition put forth by Wood et al. (1976) views development as individual (i.e. involving a problem, task, or goal), while Vygotsky would argue that development cannot be separated into small pieces (Newman & Holzman, 1993). Rather, development is a cultural activity, embedded in the practice and culture of a community.

**Social Theory of Learning**

The second theory of learning that provides an understanding of peer assistance is the Social Theory of Learning. The Social Theory of Learning and the Sociocultural Theory of
Learning both emphasize that language and meaning are social and environment based (Greeno, 2006). The Social Theory of Learning provides an additional understanding of peer assistance by defining “learning as participation” (Wenger, 1998, p. 13). Through participation in a community, a learner increases both individual knowledge and community knowledge.

The activities that contribute to learning are situated within a community structure. One of the activities, members’ negotiation of identity, becomes a central activity of the community and the learning process because “participation in practice is a central part of what students learn” (Linn, 2006, p. 92). Members negotiate their identity “by changing all at once who we are, our practices, and our communities” (Wenger, 1998, p. 227).

Identity is formed through identification (i.e. the choices we make) and negotiability (i.e. adoption of practices). People choose to identify with communities and adopt the practices of the community. Through participation, people negotiate their identity and contribute to the learning process. Wenger (1998) defines identity “as a lived experience of participation in specific communities” (p. 151) that is “more diverse and more complex than categories, traits, roles, or labels” (p. 163).

In teacher education, prospective teachers identify themselves within a teacher education program and learn to adopt the practices of teaching and learning. Through participation and engagement in the shared discourse around teaching and learning, prospective teachers form an identity and network with peers in the hopes that they will participate soon as full members in the community of teachers. The hopes become a reality when they move through induction experiences into participation as inservice teachers.

As inservice teachers, teachers’ professional development often takes the form of participation in learning communities (Bransford et al., 1999). Bransford et al. (1999) recognized
teacher-learning communities as successful modes of professional development during inservice teaching practice. Learning communities enable teachers to learn from each other in a learner-centered environment, rather than a consultant led teacher-centered professional development environment. Participation in learning communities involves enculturation into the community’s practices (Brown, Collins, & Duguid, 1989). Enculturation is the process of learning to speak as teachers speak, know what teachers know, think as teachers think, and act as teachers act. In the following subsection, I present the Cognitive Apprenticeship Framework, a framework created by Collins, Brown, and Holum (1991) that speaks to enculturation into teaching practices.

**Cognitive Apprenticeship Framework**

In traditional apprenticeships (including the apprenticeship of observation), the work that is completed is modeled and observed. Collins, Brown, and Holum (1991) created the Cognitive Apprenticeship Framework to help understand the development of concepts in “authentic activity” (p. 39). With Cognitive Apprenticeships, “the teacher's thinking must be made visible to the students and the student's thinking must be made visible to the teacher” (1991, p. 40). The methods that lead to expertise involve modeling, coaching, scaffolding, articulation, reflection, and exploration.

The Cognitive Apprenticeship Framework has been used to understand peer assistance among inservice teachers (Glazer, Hannafin, & Song, 2005). Glazer et al. (2005) created and studied a Collaborative Apprenticeship model to understand how teacher-leaders interact with beginning teachers in professional development for technology integration. The Collaborative Apprenticeship model used the four phases from the Cognitive Apprenticeship Framework – introduction, developmental, proficiency, mastery – but also drew from Wenger’s (1998) notion
of participation to understand the reciprocal interactions between a beginning teacher and a teacher leader. In their study, Glazer et al. (2005) found that teacher leaders and/or mentor teachers provided beginning teachers with the guidance needed to move through the ZPD around technology integration, with evidence that beginning teachers passed from introduction to proficiency phases of the Collaborative Apprenticeship model.

Summary of the Theoretical Foundations of Peer Assistance

Sociocultural and social theories of learning are useful lenses through which to understand peer assistance. In the ZPD, a more capable peer provides assistance to a learner at a level of expertise just beyond what they are capable of performing when unassisted. The more capable peer provides assistance through mediation and scaffolding. Mediation is a way to think about interactions. Mediated interactions must be intentional, purposeful, and transcendent (Feuerstein, 1990). Interactions are mediated through the use of tools or more capable peers. Once learning is mediated, the learner is able to understand the concepts at an intrapersonal level of understanding. Intrapersonal understanding and participation contributes to a learner’s formation of an identity within the learning community. Scaffolding is a term that describes the type of assistance a more capable peer provides to help another person solve an issue they would not have been able to solve on their own. Examples of scaffolding include question prompts and guided interactions (Ge & Land, 2004).

Limitations of the Theoretical Framework

The main limitations of the theoretical framework involve the limitations in the Sociocultural Theory of Learning in relation to this study. First and foremost, there is a concern
over the translations of Vygotsky’s original work. One of the main works that I draw from in this study is Vygotsky’s *Mind in Society* (1978). There have been concerns with this work around the liberties that the editors (i.e. Cole et al.) took in translations and phrasings of Vygotsky’s theories (Gredler, 2012). It is not clear what liberties the editors took and at what times during the compilation of Vygotsky’s work. Although one of the main challenges of this work, a concern over the minimum age that can be applied to the ZPD (Gredler, 2012), does not apply to this study, possible issues in translation could have changed the meaning of Vygotsky’s theories used in this study.

Studies that are closely aligned with Vygotsky’s position on the ZPD view collective learning and social organizations as possible units of analysis. However, others have challenged Vygotsky’s position on units of analysis. Researchers who explore phenomena and use the individual as the unit of analysis ignore Vygotsky’s claim that learning is social and not confined to an individual (Newman & Holzman, 1993). The perspective that takes the individual as the unit of analysis is a Neo-Vygotskian perspective on ZPD because it extends Vygotsky’s notion that learning is social but suggests that it can be analyzed from the perspective of an individual.

There is a concern over the Neo-Vygotskian extensions of Vygotsky’s work that present different notions of ideas than what Vygotsky intended. For example, the unit of analysis (in the present study) and notions of scaffolding are two concepts that focus on the individual and are in contrast to Vygotsky’s perspectives on the ZPD. When I discussed both occurrences in the present study, I used the term Neo-Vygotskian to draw a distinction between the extensions of Vygotsky that do not align completely with Vygotsky’s perspectives.

Finally, according to Vygotsky (1934/1987), collaborative learning in the ZPD requires an adult-student interaction as opposed to a peer interaction because adults are better able to
recognize the student’s current stage of development. In this study, I discussed technohubs as more capable peers but did not spend time or resources studying whether technohubs are able to recognize their peers’ preconceptions of technology and current stage of development.

Summary of the Theoretical Framework

This chapter focused on two lenses that informed the research design. I started with an orientation to teacher education and teacher leadership to situate this study in a broader context. I introduced the apprenticeship of observation, enactment, and complexity as tensions in teacher education. I presented work on teacher leadership and included informal teacher and technology leadership to help understand the notion of peer assistance presented in this study.

The second lens was (the theoretical foundation of) peer assistance. I drew from both the Sociocultural Theory of Learning, which defines learning as constructing knowledge through interactions with others and tools, and the Social Theory of Learning, which defines learning as participation. Although I drew heavily from sociocultural notions of how people learn, my unit of analysis in the study was based on a Neo-Vygotskian perspective, highlighting the individual descriptions of experience to understand the research question. In the next chapter, I provide additional details about my unit of analysis. Also, I overview my research design which will draw from this theoretical framework to outline a way to address the research question.

Definitions

Apprenticeship of Observation: A perspective of pedagogy that has been learned through observation during Kindergarten through Grade 12, during the thirteen years that an individual participates in teaching and learning as a student.
Cognitive Apprenticeship (of Teaching): An apprenticeship between a prospective teacher and a teacher or teacher educator, where the thought process and rationale for decisions being made during the teaching process are discussed explicitly, so the prospective teacher can begin to understand the complexities of teaching, address misconceptions learned during the apprenticeship of observation, or enact classroom behaviors.

Enactment: Enactment is defined as interpreting classroom events and providing the correct behavioral responses to teaching situations.

Enculturation: Enculturation is defined as the process of learning to speak as teachers speak, know what teachers know, think as teachers think, and act as teachers act. Enculturation describes the experience of participating in teaching as an insider.

Neo-Vygotskian: Neo-Vygotskian implies an extension of Lev Vygotsky’s theories that does not align completely with Vygotsky’s perspectives and intentions.

Sociocultural Theory of Learning: The Sociocultural Theory of Learning views learning as knowledge construction. Learning occurs through interactions with others and tools, and using the languages that are shared by the people in the environment and culture.

Social Theory of Learning: The Social Theory of Learning views learning as occurring through participation in a community, the negotiation of identity, and the adoption of the community’s practices.

Zone of Proximal Development (ZPD): The Zone of Proximal Development or ZPD for short is a concept that describes the distance between what an individual can do on her/his own and what an individual can do with assistance from others.
CHAPTER 3
RESEARCH DESIGN

In the present chapter, I describe the research design that addresses the proposed research question: **What is a technohub’s lived experience of assisting peers with instructional technology issues in teacher education courses?** The research design includes the context of the study, the methodological orientation, research methods, trustworthiness of the findings, limitations of the research design, and research outcomes.

**Context of the Study**

The context of the study involves a professional development school (PDS) at the Pennsylvania State University. A PDS was used as the research setting because of the coherent community within the PDS and the fact that teacher education courses (and communities) outside of the PDS at the Pennsylvania State University are fractured and do not use cohorts (S. McDonald, personal communication, August 7, 2012). By fractured, I mean that a prospective teacher will have different peers in each of his/her courses.

The PDS followed in the present study was structured around the notion of teacher inquiry. Inquiry was described as preparing prospective teachers (labeled “interns”) to have a disposition and a mindset of continually asking questions around the effectiveness of teaching practices. The program had four goals: (1) enhance the education experiences of all K-12 children; (2) ensure high quality induction with interns; (3) provide inservice teachers and teacher educators with ongoing professional development; and (4) educate the next generation of teacher educators (J. Nolan, personal communication, April 3, 2013). The 2012-2013 PDS
involved multiple groups of people including 60 interns, 10 professional development assistants (PDAs), and 63 mentors (cooperating teachers) in K-6 grades across 11 elementary and middle schools. The role of the PDA was similar to a supervisor, teacher educator, and mentor all in one. The PDAs consisted of teacher educators, graduate students, and instructors of PDS methods courses.

The four methods courses during the Fall 2012 semester were organized around the following disciplines: mathematics, social studies, science, and building classroom community. The building classroom community course focused on the specifics of classroom behavior and management issues and thinking about learning environments.

Although technology wasn’t a specific goal of the PDS, it was a strong focus. The PDS incorporated two main technology tools to assist with intern learning and reflection. First, the school district had its own Google® server. Interns were asked to use Google® documents, forms, spreadsheets, and websites throughout the methods courses to support teaching practices. Second, the PDS used the video analysis software tool StudioCode® to analyze teaching practices from recorded classroom video.

During the first two weeks before classes started, the PDAs provided a series of orientations (labeled “jump-starts”) to acclimate the interns to the tools and policies specific to the PDS and school district. There were two jump-start programs offered in August 2012 that focused on technology training. The first technology orientation program provided an overview of StudioCode® and the second technology orientation program involved the school district’s wireless internet guidelines and tools including Google® documents, forms, spreadsheets, and sites.
Methodological Orientation

The methodological orientation used to address the research question is phenomenological in nature. Phenomenology is based on the work of philosophers (Husserl, 1913/1982; Heidegger, 1927/1962; Gadamer, 1960/1998) around the notion of lived experience. Researchers (Moustakas, 1994; van Manen, 1997; Laverty, 2003) have provided descriptions of phenomenology as a methodology, method, and technique through which to understand lived experience. van Manen (1997) differentiates methodology, method and technique in the following way. The methodology provides a philosophical framework through which to understand the study, the method involves the orientation to the methodology, and the technique suggests specific ways to accomplish the method (1997).

In this study, I use a phenomenological methodology that is grounded in both transcendental (Husserl, 1913/1982) and hermeneutic (Heidegger, 1927/1962; Gadamer, 1960/1998) strands of phenomenology. I provide a research design and method that draws from transcendental (Moustakas, 1994) and hermeneutic (van Manen, 1997) phenomenological methods. And, I apply techniques such as semi-structured interviews, thought-by-thought coding, and thematic analysis to address the research question that is qualitative in nature. In the following subsections, I provide an overview of the traditions of transcendental and hermeneutic phenomenology to understand how my unit of analysis fits within notions of lived experience. Then, I present my unit of analysis and explain how it follows a Neo-Vygotskian theoretical orientation and a transcendental/hermeneutic phenomenological orientation to address the research question.
**Transcendental Phenomenology**

Laverty (2003) explains that Husserl’s approach to phenomenology involved attending to the “epistemological question of the relationship between the knower and the object of study” (p. 26-27). In other words, Husserl was concerned with distinguishing between the nature of the experience and the individual description of the experience. When using transcendental phenomenology, the unit of analysis falls on the individual while the epistemic interests are the nature of the experience.

This distinction also is outlined in transcendental phenomenological methods. The first step of transcendental phenomenological methods is bracketing, removing the researcher’s own bias and experience from the data collection and analysis process in order to avoid researcher bias. Also, there is an attempt to explain the phenomenon through textural descriptions and structural descriptions. Moustakas (1994) explains this as noema and noesis. Noema is defined as “perceived as such” while the noesis is defined as the “perfect self-evidence” (p. 30). “Perceived as such” suggests that the textural descriptions of experience stay as close to the data as possible, showing the participant’s own description of the experience. However, the transcendental phenomenology researcher must create “perfect self-evidence” structural descriptions of the experience drawing from both textual descriptions and imaginative variation to uncover the essences of the experience. Imaginative variation is defined as alternative ways to look at the data while essences are the essential constituents of an experience or what makes the experience what it is and what it is not.
Hermeneutic Phenomenology

van Manen (1997) defines hermeneutic phenomenology as “a descriptive methodology because it wants to be attentive to how things appear, it wants to let things speak for themselves; it is an interpretive methodology because it claims that there are no such things as uninterpreted phenomena” (180). In hermeneutic phenomenology, the focus is on “the nature of reality and ‘Being’ in the world” (Laverty, 2003, p. 27). While Husserl’s transcendental phenomenology separated the individual from the experience, Heidegger’s hermeneutic phenomenology was unable to separate the individual from the experience. In hermeneutic phenomenology, lived experience involves attending to the cultural, social, and historical contexts in which the experience occurs (2003). In this way, it is not possible to avoid researcher bias because any prior experience or understanding is a part of our identity and our reality.

In hermeneutic phenomenological methods, an emphasis is on interpretation based on cultural, social, and historical contexts. Every experience must be described and understood in relation to the prior and current contexts within which it resides. When using hermeneutic notions of phenomenology, the unit of analysis falls not on the individual but on the interaction between the individual and the contextual or situative nature of the experience.

Unit of Analysis

In the present study, the unit of analysis is a PDS intern serving as a technohub. I situate the unit of analysis on the individual so that the phenomenon can be described according to first-person narratives of the experience. However, thinking of an individual as the unit of analysis is contradictory to my presentation of Vygotsky’s theoretical framework in Chapter 2 and contrary to hermeneutic notions of phenomenology presented in the previous sections. In a true
sociocultural methodological orientation, the unit of analysis would involve the interactions between the technohub and all of the people during occasions of peer assistance.

In order to work within the constraints of time and resources during data collection, I constrain the unit of analysis in the present study to the individual, thus changing the theoretical orientation from a Vygotskian-influenced sociocultural orientation to a Neo-Vygotskian orientation and the methodological orientation from a pure hermeneutic orientation to a transcendental/hermeneutic phenomenological orientation. The implications from such a shift involve separating the interpretations of the phenomenon from the context and situation. This is a limitation in the study because I rely on my participants’ descriptions of the phenomenon as my primary sources of data instead of observations of the phenomenon as primary sources and participants’ descriptions as secondary.

Although the individual is the unit of analysis, the present study acknowledges and describes the inseparable relationship between the individual and the environment. The Neo-Vygotskian perspective is useful because it extends Vygotsky’s notion of “individual-in-society-in-history” (Newman & Holzman, 1993, p. 85). In the present study, I pay attention to the notion of individual-in-society-in-history to situate the activity and provide a rich description of the experience of technohubs in a teacher education program.

**Research Methods**

The research methods described in this section speak to my transcendental/hermeneutic phenomenological orientation. I draw from both transcendental and hermeneutic methodologies in order to analyze individual interpretations of experience (through transcendental methods and techniques) while at the same time attend to the individual in relation to the cultural, social, and
historical contexts in which the experience occurs (through hermeneutic methods and techniques).

**Sampling Procedures and Rationale**

Participants were sampled purposively in the present study. A purposeful sample implies that the participation selection was planned and individuals were selected based on criteria as opposed to a random selection. I previously explained that the PDS provided a coherent community and yearlong cohort across multiple teaching methods courses. Finding a coherent community was necessary for the research design because the technohub population is not a population that is assigned or accessed easily. In the context of the present study and PDS, a technohub is someone who assists many other interns with instructional technology issues in her/his methods courses and PDS program.

To find out who is a technohub, I used a peer-reporting questionnaire (similar to Ellwardt, Labianca, & Wittek, 2012) in which interns were asked whom they go to for different issues related to using and integrating technology in teaching and learning. It was important that I receive peer reports from all sixty interns (or as close to sixty as possible) in order to get accurate results. Thus, all sixty PDS interns were invited to participate in the technohub questionnaire and subsequent phenomenological research study. Participant solicitation was made on September 9, 2012 during one of the PDS methods courses. Interns agreed to participate by signing an informed consent document associated with the Office of Research Protections at the Pennsylvania State University. From 60 possible participants, 3 immediately declined to participate in the study, leaving 57 participants. An email with a link to the technohub
questionnaire was sent to the 57 participants after 7 weeks, 10 weeks, and 13 weeks of a 16-week semester. An example questionnaire is included in Appendix C.

The same questionnaire was given at different points during the semester. Multiple iterations and timing of the questionnaires were made for the following reasons. First, a delay of 7 weeks in starting the first questionnaire allowed time for the interns to acclimate to the PDS experience and to get to know and befriend the other interns. Second, three questionnaires were given at different points during the semester so the interns could provide answers based on whom they went to for help on recent projects. Finally, by spacing the questionnaires (i.e. 2-3 weeks apart), interns could respond based on whom they went to for help recently, and not rely on recollections of what they might have responded on previous questionnaire(s).

Of a possible 57 participants, 52 completed the first questionnaire, 53 completed the second questionnaire, and 48 completed the third questionnaire. Even though some participants did not complete all three questionnaires, all data were used because the results from the peer reporting questionnaires did not depend on one individual completing all questionnaires. Each questionnaire provided an individual snapshot of technical assistance. In other words, the responses for each questionnaire were unique because they were based on past and recent occasions of assistance.

Data from each questionnaire were added to two social network analysis tools, UCINET (Borgatti, Everett, & Freeman, 2002) and Meerkat Lite (Zaiane & Goebel, 2002), and analyzed using social network analysis methods to discover and identify any hubs and technohubs. During the analysis of the questionnaires, three interns emerged as technohubs. A detailed description of how the technohubs were found is provided in Chapter 4. I use the pseudonyms Alice, Betsy, and Chloe as a naming convention for the technohubs. Following the analysis of the questionnaires, I
conducted observations of the three interns, and I invited the ten PDAs to participate in an interview to provide additional triangulation regarding the selection of technohubs. From a possible ten, four PDAs volunteered and were interviewed. Additional information about triangulation from the observations and four PDA interviews is provided in Chapter 4. After PDA interviews and observations verified the selection of technohubs, the three identified technohubs were invited to participate in a series of three open-ended, semi-structured interviews.

Because of the nature of phenomenology, there is no required number of participants needed to understand the phenomenon in this study. The rationale for the sampling procedures is based on the goal of qualitative research, to produce rich descriptions of authentic practice, studying a few participants in depth, and using theoretical frameworks to analyze findings and provide appropriate implications. The goal was to reach a point of saturation around technohubs’ lived experiences of assisting peers with technology issues.

**Data Collection**

Upon completion of the third questionnaire (explained in the *Sampling Procedures and Rationale* section above) and analysis of the three questionnaires (described in Chapter 4), the three selected candidates were interviewed using Seidman’s (2012) phenomenological interview methods regarding the experience of serving as a technohub and the practice of supporting others with technology issues. Seidman’s (2012) method involves a three-interview series where the researcher pays attention to (1) the focused life history of the experience during the first interview, (2) the details of the experience during the second interview, and (3) a reflection on the meaning of the experience during the third interview. I followed suggestions from Seidman
(2012) and Moustakas (2004) to construct interview questions. A sample of the semi-structured interview protocol is provided in Appendix A.

Interviews were recorded using a digital audio recording device (i.e. iPhone), and following the interview, the recordings were converted to an .mp3 file, transferred to a digital flash drive storage device, deleted from the digital recording device, and stored under lock and key until transcription took place. I (the researcher) completed transcription to ensure that nuances in the speech were coded correctly. Transcription involved a foot pedal and the use of the program ExpressScribe® to increase the proficiency and accuracy of the results.

Observations of the selected technohubs were conducted to provide triangulation of the findings from the interviews. Observations allowed me to be attentive to the phenomenon of interest in the setting in which it occurs. Results from the observations are explained in Chapter 5.

Data Analysis

Phenomenological thematic analysis involves using participants’ own voices to understand the lived experience of an event (Moustakas, 1994). There are three possible techniques to begin data analysis: detailed or “line-by-line” coding of participant transcripts, selective or “thought-by-thought” coding, or “holistic” coding (van Manen, 1997, p. 92-93). There is no right way to find initial codes. The three separate coding techniques each speak to different ways to approach the data.

The following coding protocol was used to conduct the analysis. First, each transcript was split into lived experience stories/narratives and/or answers to conceptual questions about how technohubs think, feel, or have been changed by the experience of assisting peers in teacher
education courses. Of the three identified technohubs, Alice had 70 stories, Betsy had 63 stories, and Chloe had 67 stories. An example of a narrative is provided in Table 3-1. I use the naming convention “nameOfTechnohub-interviewNumber_timeOfTranscribedFile” for each citation of transcribed data in this study. For example, the following narrative (in Table 3-1) was discussed during Alice’s second interview at the twenty-eight minute and nine second mark.

Table 3-1. An Example of a Narrative.

<table>
<thead>
<tr>
<th>Narrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Can you describe a situation in the methods courses, any of them, where another student asked you for help in solving a technology issue?) Yeah, actually we just had to turn in a project on Tuesday and it was one of our finals. One of my friends did StudioCode® and she couldn't figure out why she couldn't get the movie to play on another computer. She had burned the disk and she couldn't figure out why it wasn't working. I just went back and we looked at how she saved it (StudioCode® movie) and you know, how she burned it. And we actually ended up having to buy more DVDs 'cuz (sic) it wasn't a rewriteable DVD. We just went back and looked and she had saved it as just a regular file, timeline file, and with StudioCode® you have to save it as a whole package. You have to actually almost export it out. And then she also, she forgot to press the button burn, which I thought that was a pretty silly one. Some other technology hiccups that I kind of see a lot is (sic) I have one of the older computers of the class, so often times people won't think through their project and will forget that the elementary school has dongles in the library, but we don't. The one that's in the PDS classroom is for old computers. So a lot of times people will be (laughing) using my computer for their presentations. Other than that, I'm trying to think, kind of, you know, just general questions about how to put movies into Word documents. I help a lot of my friends with Prezi, just getting the path right, things like that. I mean I'm not that super knowledgeable but just certain things, you know, I'm not too shabby with. I also did an iMovie presentation twice for two classes and both times I ended up putting it on my computer and actually being the one who edited it because the other girls were struggling to understand how to get the transitions to flow evenly. How to adjust, like background noise because they weren't using microphones. They were using their computers, things like that. So, yeah, I try to take the editor position when I can just because it's a lot easier (laughing). (Alice-2_28:09)</td>
</tr>
</tbody>
</table>
Second, initial coding involved thought-by-thought coding (van Manen, 1997), staying as close to the data as possible. I used thought-by-thought coding because the participants’ narratives often had multiple codes embedded in each narrative. An example of thought-by-thought coding is included in Table 3-2.

Coding was organized with the help of the spreadsheet software program Microsoft® Excel. Thought-by-thought coding produced 190 initial codes for Alice, 109 initial codes for Betsy, and 114 initial codes for Chloe. During initial coding, I kept the following questions in mind:

1. What is the action?
2. What are the participants trying to convey?
3. What are the meanings behind the participant’s word choices?
   (I. Baptiste, personal communication, May 30, 2013)
4. Is the proposed interpretation at the level of the participant’s lived experience?
5. Does the proposed interpretation take into account previous passages of the transcript?
   (Thompson, Locander, & Pollio, 1989)
6. Does the proposed interpretation preserve the phenomenon in the texture of what is being said?
7. Are thought-by-thought coding techniques used to find the constituents of the experience?
   (I. Baptiste, personal communication, May 30, 2013)

Third, I identified meaning from thought-by-thought codes by applying a level of abstraction and interpretation. In applying a level of abstraction, I kept the following questions in mind:

1. Is the proposed abstraction close to what the participant is saying?
2. In paraphrasing, is the proposed abstraction framed as an action?
3. Does the proposed abstraction answer the research question?
   (I. Baptiste, personal communication, May 30, 2013)
Table 3-2. An Example of Thought-by-Thought Coding and Meaning Units.

<table>
<thead>
<tr>
<th>Narratives</th>
<th>Thought-by-Thought Codes</th>
<th>Meaning Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Can you talk about experiences where you were helping others in college?) In college, for some reason, I don't know how this has happened but, I just feel like whenever, like I'll just mess around with something that it's just, I feel like it happens that a couple weeks later I'll mess around with a program on my computer, a couple weeks later we'll haveta (sic) use that for a class or something, and then it's just something that I'm already familiar with, and I'm like, oh, well you just do this. So I think in college is when I started, like actually helping people with technology and I have a group of friends that normally, if there's (sic) technology issues, they come to me. But I (laughing) don't know how that happened because I swear I don't know that much about (technology) (laughing). (Alice-1_06:18)</td>
<td>After messing around with a program on her own, she would need to use it in a college course</td>
<td>Explores tool on own</td>
</tr>
<tr>
<td></td>
<td>Helped peers with software because she was already familiar with it</td>
<td>Familiarity with tool prior to assistance</td>
</tr>
<tr>
<td></td>
<td>Found that a group of friends would go to her in college for technology issues</td>
<td>Assisting as Technology support</td>
</tr>
<tr>
<td></td>
<td>Not sure why anyone goes to her because she doesn't know much about technology</td>
<td>Lack of confidence with technology savvy-ness</td>
</tr>
<tr>
<td>(What about compared to your friends, your peers in high school, and your first 3 years in college, were you the one that was helping others or were others helping you with different technology issues?) I think it kind of shifted when I was in high school. I definitely received help and I helped people but I was always more interested in people helping me because I was just, always worried about making a mistake and then losing files or messing something up. And then in college, once I had my own computer, I kind of became, I mean I really don't care if, you know, I hid something and it goes away, I'm confident that I could get it back or, I'm more, I think competent to just experiment with different programs. So then in college I started becoming the one, I think, more people came to when they had technology issues but I don't know. I guess maybe it is a little 50-50 because I still definitely go to my peers and ask them for help sometimes, or you know, if they know something that I don't know, I'm really willing to try it, but I just think I'm more experimental than I used to be. (Alice-1_06:18)</td>
<td>Worried about making a mistake or messing something up</td>
<td>Lack of confidence with technology savvy-ness</td>
</tr>
<tr>
<td></td>
<td>Became the person that people came to with tech issues in college but still goes to others 50% of the time</td>
<td>Assisting as Technology support</td>
</tr>
<tr>
<td></td>
<td>More experimental with technology in college</td>
<td>Explores tool on own</td>
</tr>
</tbody>
</table>
Abstraction involved placing the initial thought-by-codes in relation to the research question and the context of the interview as a whole. An example of meaning units derived from thought-by-thought codes is presented in Table 3-2.

Fourth, I removed repetitive meaning units to uncover the invariant constituents or horizons of the experience. The invariant constituents are defined as the essential interpretations or ways of seeing the data. Table 3-2 can be used to explain the distinction between meaning units and invariant constituents. In Table 3-2, there are seven meaning units. The meaning units include one occasion of “familiarity with tool prior to assistance”, and two occasions of the following meaning units: “explores tool on own”, “assisting as technology support”, and “lack of confidence with technology savvy-ness.” Upon removing repetitive meaning units, I am left with four. Thus, there are four invariant constituents listed in Table 3-2.

I uncovered 44 invariant constituents for Alice, 42 invariant constituents for Betsy, and 43 invariant constituents for Chloe. Combined, the technohubs have 70 invariant constituents. To triangulate the selection of invariant horizons, I applied the following criteria: first, “does it contain a moment of the experience that is a necessary and sufficient constituent for understanding (the experience)” (Moustakas, 1994, p. 121)? And second, “is it possible to abstract and label (the constituent)” (p. 121)?
Fifth, I combined and grouped codes among all participants to find six emergent and essential themes. For each essential theme, I applied the following criteria outlined by van Manen (1997):

In the process of apprehending essential themes… one asks the question: Is this phenomenon still the same if we imaginatively change or delete this theme from the phenomenon? Does the phenomenon without this theme lose its fundamental meaning? For example, we presume that having offspring or children is essential to the notion of parenting. To test this theme we try to conceive of the experience of parenting such that the experience does not include children. This seems impossible. (p. 107)

In addition, I used imaginative variation and knowledge from my theoretical framework to confirm the essential quality of each of the six emergent themes. Table 3-3 provides an example of moving from invariant constituents to essential themes using the four invariant constituents from Table 3-2. The first two invariant constituents are similar essences of the experience and are combined into one theme, “learning and familiarity with tools.” The other two invariant constituents describe separate essences of the experience and speak to two different themes: “getting approached and offering forms of assistance,” and “views and feelings when assisting peers.” An additional example of moving from narratives to initial codes, invariant constituents, and themes is provided in Appendix B. A list of all of the invariant constituents that comprise each of the six essential themes can be found in Table 5-1 or Appendix D.

Sixth, using stories/narratives from participants’ own voices, I created descriptions of each theme that provide evidence towards the experience of assisting peers with instructional findings. Descriptions of each theme are provided in Chapter 5.

Seventh, and finally, I framed each theme in relation to the empirical and theoretical findings from my theoretical framework to develop a discussion of each theme. The discussion of themes is presented in Chapter 6.
Table 3-3. An Example of Invariant Constituents and Themes.

<table>
<thead>
<tr>
<th>Invariant Constituents</th>
<th>Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explores tool on own</td>
<td>Learning and Familiarity with Tools</td>
</tr>
<tr>
<td>Familiarity with tool prior to assistance</td>
<td>Learning and Familiarity with Tools</td>
</tr>
<tr>
<td>Assisting as Technology support</td>
<td>Getting Approached and Offering Forms of Assistance</td>
</tr>
<tr>
<td>Lack of confidence with technology savvyness</td>
<td>Views and Feelings when Assisting Peers</td>
</tr>
</tbody>
</table>

**Trustworthiness of the Findings**

Lincoln and Guba (1985) recommend providing evidence of credibility, transferability, dependability, and confirmability to ensure the trustworthiness of qualitative analyses and findings. These four terms match up with internal validity, generalizability, reliability, and objectivity often described in quantitative analyses and findings. The following sections speak to the quality of credibility, transferability, dependability and confirmability in the present study.

**Credibility**

Quantitative researchers maintain internal validity by controlling variables to remove the possibility of competing reasons for a finding. In qualitative research, the idea of controlling variables does not make sense given the complexities of a phenomenon of interest. Credibility provides a way to speak to internal validity by addressing possible competing reasons through methods of triangulation, peer debriefing, and member checks. Peer debriefing and member
checks involve having colleagues and participants verify the findings from the data to ensure credibility (Guba, 1981).

In this study, two graduate students reviewed the methods and findings from the data analysis (i.e. peer debriefing). The three identified technohubs were contacted after data analysis was completed, and the three technohubs provided summative feedback to contribute additional credibility of the findings (i.e. member checks). In addition, observations provided triangulation of the data to add to the credibility. Additional details regarding peer debriefs and member checks are provided in Chapter 5.

**Transferability**

External validity is the ability to generalize a finding to any population and situation. In qualitative work, the phenomenon of interest is “context-bound,” implying that the findings are specific to a population and cannot be extracted and applied to all populations and situations (1981, p. 86). Instead of generalizability, qualitative researchers speak to transferability, the ability to transfer the findings to a similar population and situation. Methods of transferability included purposeful sampling and rich description.

In the present study, transferability was attended to by using rich descriptions of the classroom culture, the prospective teachers’ past experiences and background, and the practices and methods used during the research design. During the research process, I kept memos and notes to remember and document important decisions. In the description of the research design and findings, a level of transparency was applied to ensure possible transferability of the findings. In addition, the dissertation committee provided feedback regarding the level of detail needed to meet transferability.
Dependability

Dependability provides a way to speak to reliability that occurs in quantitative research. While quantitative work ensures that findings are consistent with similar conditions, dependability involves providing opportunities to prove the “stability” of the data collection and analysis procedures (1981, p. 86). Dependability was established by overlapping methods in both the selection of technohubs and the collection of data, and by involving the use of an audit trail to demonstrate the appropriateness of decisions made during the process.

Confirmability

Finally, confirmability offers a way to address notions of objectivity found in quantitative work. Confirmability moves away from the objectivity of researchers and towards the confirmability of the interpretations made during qualitative analyses of data. In the present study, confirmability was attended to by keeping an audit trail that demonstrated the interpretations of the data. During the writing of the study, I regularly met with my Advisor Dr. Simon Hooper to confirm decision points and changes in my thinking and theoretical orientation. In addition, I included my orientation to the phenomenon in the preface to reveal my underlying assumptions about the phenomenon.

Limitations of the Research Design

The limitations of the research design begin with my choice to use both transcendental and hermeneutic phenomenology for the methodological orientation and research methods. In an ideal study, I would approach the research question from a cultural, social, and historical perspective. This hermeneutic perspective would involve data collection methods that used a unit
of analysis consisting of the interaction between the individual and the contextual nature of the experience. By contextual nature, I mean the situation within which the experience occurs. An example of data collection in the hermeneutic perspective involves using observations of the experience as a primary source. This example follows a true Vygotskian perspective on the Sociocultural Theory of Learning, rather than the Neo-Vygotskian perspective I discussed in my theoretical framework. However, the experience of assisting peers does not occur only in places and at times that can be easily observed. Because it is hard to follow a true hermeneutic unit of analysis in practice, I chose to use the individual as the unit of analysis, I added transcendental phenomenology to my orientation, and I used Neo-Vygotskian perspectives in my theoretical framework.

The selection of the technohubs involved using triangulation from three data sources: the questionnaire, PDA interviews, and observations. However, the following three limitations might have prevented (the most) accurate selection of technohubs. First, the use of a questionnaire as the primary triangulation technique to find technohubs is troublesome. It is open to data entry error in peer reporting and reliance on participants to have a command of the names of peers that they may have met as little as seven weeks prior to the first questionnaire. If I could redo the questionnaire, I would include images of all sixty interns next to their names. By including images, I would allow participants to remember peers based on names and/or facial recognition.

Second, the questionnaire questions were open to interpretation. What one participant might have classified and remembered as an instructional technology issue, and thus marked as such on the questionnaire, another participant may not have viewed (the similar issue) in the same way.
Third, although multiple iterations and timing of the questionnaires were made for specific reasons, the timing also was based on the successful defense of my dissertation proposal during the fifth week of the Fall 2012 semester. Thus, the first questionnaire was administered in the seventh week after access was established, informed consent granted, and email addresses obtained. In an ideal situation, it might make more sense to have a questionnaire completed after 5, 10, and 15 weeks of the 16-week semester.

After technohubs were selected, a semi-structured interview process was used as the primary data collection tool. Limitations in time and resources informed the data collection process. The interviews provided enough detail to enable the researcher to produce a rich description of the experiences of assisting peers. However, more data collection could have been conducted to provide even richer descriptions. For example, I could have observed every course session during the Fall 2012 semester.

Also, I could have provided each of the three identified technohubs with a digital audio recorder. Using critical incident techniques (Flanagan, 1954), I could have asked each technohub to summarize every event where they either received assistance or gave assistance to another intern during the semester. The results (described in Chapter 5) demonstrate that many events occurred outside of the times and location of the PDS methods courses, therefore increasing the potential richness of using critical incident techniques. Upon receiving all summaries, I could have cross-analyzed the data from the digital audio summaries with the data transcribed from the interviews and observations. However, the final questionnaire was sent after 13 weeks of the 16-week semester, meaning that technohubs were not identified until the final two weeks of the semester. Technohubs would only have the chance to use these techniques for the final two weeks of the semester. The rationale for not using critical incident technique during these two
weeks was because it would be an investment in time to teach the technohubs a protocol to record occasions of peer assistance outside of class, when most (if not all) of technohubs’ experiences assisting peers happened before Week 14. An alternative plan could have been established to provide all of the 57 initial participants (i.e. prospective teachers) with digital recording devices and teach them the protocol during Week 1 of the semester. However, the time and resources needed to use critical incident technique in this manner were outside of my budget and time restrictions for the study.

**Summary of the Research Design**

The study of technohubs presented in the present study followed a group of prospective teachers in a professional development school at the Pennsylvania State University during 2012-2013. Drawing from phenomenology, and specifically transcendental and hermeneutic strands of phenomenology, I outlined a research design that was used to answer the research question and collect data based on the unit of analysis, an individual technohub.

Sampling procedures involved using a peer-reporting questionnaire to identify technohubs in the professional development school. Following identification and access to the participants, technohubs were interviewed using a semi-structured interview protocol based on Seidman’s (2012) phenomenological interview methods. Interviews were transcribed and a data analysis protocol was followed based on the work of Moustakas (1994) and van Manen (1997). Data analysis involved identifying the lived experience narratives, creating initial thought-by-thought codes, identifying meaning from the codes, removing repetitive codes to uncover the core invariant constituents of the experience, combining and grouping codes to find themes, applying an essential theme test to confirm the findings, creating descriptions of the themes, and
developing a discussion of the themes in relation to current research. A sample analysis protocol is provided in Appendix B.

Finally, the trustworthiness of the research design was established and limitations of the research design were addressed.

**Definitions**

**Essences:** Essences are defined as the essential constituents of an experience. Essences are what make an experience what it is and what it is not.

**Hermeneutic Phenomenology:** Hermeneutic phenomenology is a specific methodological approach to phenomenology that understands all lived experiences in relation to cultural, social, and historical contexts. It is both a descriptive and interpretive methodology.

**Imaginative Variation:** Imaginative variation is defined as alternative ways to look at the data.

**Invariant Constituents (or Horizons):** Invariant constituents are defined as the essential interpretations or ways of seeing data.

**Noema:** Noema is defined as “perceived as such” or textural descriptions that stay as close to the participants’ voices as possible (Moustakas, 1994, p. 30).

**Noesis:** Noesis is defined as “perfect self-evidence” or structural descriptions that draw from imaginative variation to uncover the essences of experiences (Moustakas, 1994, p. 30).

**Phenomenology:** Phenomenology is defined as the study of lived experience. It is rooted in philosophical theories from Husserl (1913/1982), Heidegger (1927/1962), and Gadamer (1960/1998).
**Professional Development School:** A professional development school (PDS) is defined as a school-university partnership where prospective teachers work through a year-long student teaching experience in the classroom involving teacher educators, graduate students, and K-12 teachers.

**Transcendental Phenomenology:** Transcendental phenomenology is a specific methodological approach to phenomenology that is attuned to epistemological interests including the difference between the nature of the experience and the individual description of the experience.
CHAPTER 4
FINDING TECHNOHUBS

The goal of administering a peer-reporting questionnaire was to identify prospective teachers serving as technohubs. Technohubs are defined as the prospective teachers (i.e. interns) that numerous peers go to for assistance with instructional technology issues. In the present chapter, I present the results from the technohub questionnaire and explain which interns were selected as technohubs and how they were selected. All intern names were replaced with pseudonyms starting with the letter A, B, or C. Also, the interns in the 2012-2013 PDS cohort were comprised of 59 females and one male.

In-Degree Measure

The first analysis completed on the questionnaire data was to measure the in-degree nature of the peer-reported data. In social network analysis, in-degree describes the number of incoming connections that an actor has with other actors. In the case of the peer-reporting questionnaire, each time a peer (e.g., Bonnie) identified another intern (e.g., Alice) as someone she goes to for assistance with technology or instructional technology issues, Alice’s in-degree measure would increase by one. So, if eleven interns say that they go to Alice when they need assistance, Alice would have an in-degree measure of 11. Out-degree measures the number of peers that the individual intern went to for help or assistance with technology or instructional technology issues. I provide in-degree and out-degree data for all interns in Table 4-1 sorted by in-degree measure. The top in-degree measures belonged to Alice (11), Betsy (11),
Table 4-1. In-Degree and Out-Degree Measures for All Prospective Teachers.

<table>
<thead>
<tr>
<th>Prospective Teacher</th>
<th>In-Degree Measure</th>
<th>Out-Degree Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alice</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Betsy</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Chloe</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Amelia</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Cassidy</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Carina</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Alyssa</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Avery</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Brian</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Brielle</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Brooklyn</td>
<td>5</td>
<td>*</td>
</tr>
<tr>
<td>Catherine</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Charlotte</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Christina</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Alexis</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Anna</td>
<td>4</td>
<td>*</td>
</tr>
<tr>
<td>Arianna</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Autumn</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Bette</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Blakeley</td>
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<td>5</td>
</tr>
<tr>
<td>Cadence</td>
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<td>6</td>
</tr>
<tr>
<td>Callie</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Camila</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Carly</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Charlee</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Chelsea</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Cheyenne</td>
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<tr>
<td>Claire</td>
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<td>3</td>
</tr>
<tr>
<td>Cora</td>
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<tr>
<td>Addison</td>
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</table>

<table>
<thead>
<tr>
<th>Prospective Teacher</th>
<th>In-Degree Measure</th>
<th>Out-Degree Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aubrey</td>
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</tr>
<tr>
<td>Bella</td>
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<td>5</td>
</tr>
<tr>
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<tr>
<td>Beverly</td>
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<tr>
<td>Bevin</td>
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</tr>
<tr>
<td>Bianca</td>
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<td>Brenna</td>
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<td>5</td>
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<tr>
<td>Bria</td>
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<td>9</td>
</tr>
<tr>
<td>Bridget</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Brooke</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Caitlyn</td>
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<td>*</td>
</tr>
<tr>
<td>Camryn</td>
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<tr>
<td>Cecilia</td>
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<tr>
<td>Clara</td>
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<td>3</td>
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<tr>
<td>Aaliyah</td>
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<td>1</td>
</tr>
<tr>
<td>Allison</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Ashlyn</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Audrey</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Ava</td>
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<td>6</td>
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<tr>
<td>Barbara</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Beatrix</td>
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<td>4</td>
</tr>
<tr>
<td>Beth</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Blossom</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Caroline</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Abigail</td>
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<td>2</td>
</tr>
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<td>Alexa</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Alexandra</td>
<td>1</td>
<td>*</td>
</tr>
<tr>
<td>Ariel</td>
<td>1</td>
<td>*</td>
</tr>
<tr>
<td>Camile</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>

*Denotes that this prospective teacher did not participate in any of the three questionnaires.
and Chloe (9), meaning that both Alice and Betsy helped the most peers. The top out-degree measures belonged to Carina (8), Autumn (8), Alexa (9), and Bria (9). The highest out-degree measures represent the interns who received help from the most peers.

The distribution of in-degree connections is presented in Figure 4-1. The two bars on the right side of the figure represent the top three interns, with two interns having an in-degree measure of 11 and one intern having an in-degree measure of 9. These two bars represent the number of interns (i.e. three) with the largest number of connections from their peers.

Figure 4-1: The Distribution of In-Degree Measures for Prospective Teachers.
A visual description of in-degree is provided in the sociograph in Figure 4.2. A sociograph is defined as a visual representation of social network connections (Knoke & Yang, 2008). In a sociograph, lines represent connections between people in a network. A line can be unidirectional or bidirectional. The unidirectional and bidirectional lines in Figure 4.2 represent the connections around instructional technology issues, or more specifically, whom interns go to for assistance with instructional technology issues. Unidirectional lines represent one intern going to another intern for assistance. Bidirectional lines represent reciprocal relationships between interns. For example, Alexis goes to Betsy for assistance (i.e. unidirectional line) and Betsy and Chloe go to each other for assistance (i.e. bidirectional line).

All interns are displayed as squares except for the top three represented by circles. The size of the squares and circles represents the in-degree measure. Also, the name for each intern is a pseudonym starting with the letter A, B, or C.
Figure 4-2. The Prospective Teacher Sociograph by In-Degree Measures.
Hub and Authority Test

A second analysis was completed on the questionnaire data to measure the nature of the peer-reported data around Kleinberg’s (1999) Hub and Authority Test. Kleinberg’s Hub and Authority test is similar to Reeves’ identification of superhubs (2006) in that they both seek to identify the people who have an “exceptionally large number of connections to other nodes or hubs” (Reeves, 2006, p. 34). These people are referred to as superhubs or authorities.

The Hub and Authority Test measures which interns serve as information brokers (i.e. authorities) or connectors (i.e. hubs) to information brokers. The formula computes authorities by finding the interns who have a large in-degree measure and have multiple hubs pointing to them and labeling them authorities. Hubs are described as having connections to numerous authorities (Kleinberg, 1999). The results from the Hub and Authority Test are provided in Table 4-2 sorted by authority measure. Findings show that Alice (0.42), Betsy (0.39), and Chloe (0.35) again have the top authority measures in the network. The top hub measures belong to Alexa (0.40), Chloe (0.34), and Autumn (0.33). Figure 4-3 provides as a bulls-eye visual representation of the authority scores.

Technohubs

In Chapter 1, I combined the words technology and superhubs to create the term technohubs, a shortened label for the population of prospective teachers that assist the most peers with instructional technology issues. Kleinberg’s Hub and Authority Test is one way to identify the authorities (or technohubs) of this study. I compare Kleinberg’s test and the in-degree measure in the next section to identify the technohubs.
Table 4-2. Measures of Authority and Hub for All Prospective Teachers.

<table>
<thead>
<tr>
<th></th>
<th>Authority Measure</th>
<th>Hub Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alice</td>
<td>0.42</td>
<td>0.12</td>
</tr>
<tr>
<td>Betsy</td>
<td>0.39</td>
<td>0.11</td>
</tr>
<tr>
<td>Chloe</td>
<td>0.35</td>
<td>0.34</td>
</tr>
<tr>
<td>Brooklyn</td>
<td>0.26</td>
<td>0.00</td>
</tr>
<tr>
<td>Alyssa</td>
<td>0.24</td>
<td>0.20</td>
</tr>
<tr>
<td>Avery</td>
<td>0.23</td>
<td>0.15</td>
</tr>
<tr>
<td>Amelia</td>
<td>0.23</td>
<td>0.00</td>
</tr>
<tr>
<td>Brian</td>
<td>0.22</td>
<td>0.08</td>
</tr>
<tr>
<td>Arianna</td>
<td>0.21</td>
<td>0.29</td>
</tr>
<tr>
<td>Autumn</td>
<td>0.15</td>
<td>0.33</td>
</tr>
<tr>
<td>Bevin</td>
<td>0.13</td>
<td>0.06</td>
</tr>
<tr>
<td>Claire</td>
<td>0.13</td>
<td>0.11</td>
</tr>
<tr>
<td>Christina</td>
<td>0.12</td>
<td>0.08</td>
</tr>
<tr>
<td>Brooke</td>
<td>0.12</td>
<td>0.15</td>
</tr>
<tr>
<td>Addison</td>
<td>0.11</td>
<td>0.15</td>
</tr>
<tr>
<td>Cassidy</td>
<td>0.11</td>
<td>0.09</td>
</tr>
<tr>
<td>Charlee</td>
<td>0.11</td>
<td>0.04</td>
</tr>
<tr>
<td>Aubrey</td>
<td>0.09</td>
<td>0.06</td>
</tr>
<tr>
<td>Charlotte</td>
<td>0.09</td>
<td>0.04</td>
</tr>
<tr>
<td>Carina</td>
<td>0.09</td>
<td>0.11</td>
</tr>
<tr>
<td>Alexis</td>
<td>0.09</td>
<td>0.25</td>
</tr>
<tr>
<td>Belle</td>
<td>0.08</td>
<td>0.09</td>
</tr>
<tr>
<td>Beth</td>
<td>0.08</td>
<td>0.11</td>
</tr>
<tr>
<td>Anna</td>
<td>0.07</td>
<td>0.00</td>
</tr>
<tr>
<td>Ava</td>
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<td>0.27</td>
</tr>
<tr>
<td>Beverly</td>
<td>0.07</td>
<td>0.05</td>
</tr>
<tr>
<td>Camryn</td>
<td>0.06</td>
<td>0.03</td>
</tr>
<tr>
<td>Blakeley</td>
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<td>0.06</td>
</tr>
<tr>
<td>Audrey</td>
<td>0.06</td>
<td>0.10</td>
</tr>
<tr>
<td>Chelsea</td>
<td>0.06</td>
<td>0.09</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>Authority Measure</th>
<th>Hub Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashlyn</td>
<td>0.06</td>
<td>0.27</td>
</tr>
<tr>
<td>Aaliyah</td>
<td>0.05</td>
<td>0.08</td>
</tr>
<tr>
<td>Cora</td>
<td>0.05</td>
<td>0.00</td>
</tr>
<tr>
<td>Carly</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>Brielle</td>
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<td>0.08</td>
</tr>
<tr>
<td>Bonnie</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>Brenna</td>
<td>0.05</td>
<td>0.08</td>
</tr>
<tr>
<td>Callie</td>
<td>0.04</td>
<td>0.01</td>
</tr>
<tr>
<td>Bette</td>
<td>0.04</td>
<td>0.02</td>
</tr>
<tr>
<td>Clara</td>
<td>0.04</td>
<td>0.08</td>
</tr>
<tr>
<td>Cadence</td>
<td>0.04</td>
<td>0.06</td>
</tr>
<tr>
<td>Bridget</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>Bella</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>Bria</td>
<td>0.03</td>
<td>0.07</td>
</tr>
<tr>
<td>Catherine</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>Caitlyn</td>
<td>0.03</td>
<td>0.00</td>
</tr>
<tr>
<td>Cecilia</td>
<td>0.03</td>
<td>0.07</td>
</tr>
<tr>
<td>Ariel</td>
<td>0.03</td>
<td>0.00</td>
</tr>
<tr>
<td>Camila</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>Bianca</td>
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<td>0.00</td>
</tr>
<tr>
<td>Allison</td>
<td>0.02</td>
<td>0.07</td>
</tr>
<tr>
<td>Beatrix</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>Blossom</td>
<td>0.02</td>
<td>0.10</td>
</tr>
<tr>
<td>Caroline</td>
<td>0.02</td>
<td>0.04</td>
</tr>
<tr>
<td>Cheyenne</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>Barbara</td>
<td>0.02</td>
<td>0.04</td>
</tr>
<tr>
<td>Camile</td>
<td>0.01</td>
<td>0.11</td>
</tr>
<tr>
<td>Alexa</td>
<td>0.01</td>
<td>0.40</td>
</tr>
<tr>
<td>Alexandra</td>
<td>0.01</td>
<td>0.00</td>
</tr>
<tr>
<td>Abigail</td>
<td>0.00</td>
<td>0.02</td>
</tr>
</tbody>
</table>
Identifying Technohubs

After running the in degree and authority tests, I acknowledged that the same three prospective teachers (Alice, Betsy, and Chloe) emerged at the top of both lists. Although I could
have run more social network tests, I decided to compare this initial finding with observations and interviews.

I selected Alice, Betsy, and Chloe as possible technohubs and triangulated these selections through observations of the PDS science methods courses and interviews with four PDAs. I observed Alice helping multiple peers with an instructional technology issue related to using StudioCode®. Although my observations did not yield findings for Betsy, Chloe, or any alternative prospective teachers, I considered this first test of triangulation a success. My observations of Alice confirmed that I was looking in the right direction.

During the PDA interviews, PDAs identified Alice, Betsy, Chloe, and nineteen other interns as the prospective teachers that peers go to for advice with technology issues. However, of the twenty-two interns named, only Betsy (in-degree measure of 11) and Alexis (in-degree measure of 4) were named by more than one PDA. I considered this second test of triangulation a success because the PDAs identified Betsy and Chloe, in addition to Alice. I removed the other interns whom the PDAs mentioned (including Alexis) because they did not correspond with the results from the peer-reporting questionnaire.

I decided to move forward with the technohub study and invited Alice, Betsy, and Chloe to participate in semi-structured interviews. In the following sections, I provide individual sociographs for each of the identified technohubs, and I compare the results from the technohub questionnaires to show similarities and differences between the types of assistance each technohub provided their peers.
Individual Sociographs

Technohub Sociograph: Alice

Figure 4-4. The In-Degree Connections for Alice.

Technohub Sociograph: Betsy

Figure 4-5. The In-Degree Connections for Betsy.
Comparing Technohubs

In the following section, I give an overview of the type of assistance each technohub offered her peers. I report specific data for the following three reasons. First, the data provide an inside look at how peers reported assistance in the technohub questionnaire. The complete technohub questionnaire protocol is included in Appendix C. Second, the data in this section enable the reader to find similarities and differences between the number of times technohubs assisted peers in each methods course. Third, the data allow the reader to see that the three identified technohubs did not help the same individuals. Although overlap existed, they helped unique peers too.

In Figure 4-6, I provide data that represents the number of peers that each technohub assisted with the following five items: (1) technology support; (2) help or advice with
instructional technology issues; (3) help or advice with instructional technology issues in the science methods course; (4) help or advice with instructional technology issues in the social studies methods course; and (5) help or advice with instructional technology issues in the mathematics methods course. I separated the methods courses in the technohub questionnaire so I also report them individually in Figure 4-6.

Technology issues included fixing a computer problem, installing a program, connecting to the Internet, or finding a saved file. Instructional technology issues included determining how to use technology resources to support learning goals/outcomes in a lesson, learning how to use a software program such as iMovie® or StudioCode® for a project, learning how to use a classroom technology such as an interactive whiteboard, or completing a technology project in a teacher education methods course.

Findings show that Alice helped 11 of her peers, which represents 18.6% of the total number of peers she could have helped in the PDS. Of the 11 peers Alice helped, she provided technology support and help with instructional technology issues to 90.9% or 10 peers of the 11 she helped. Of all of the methods courses, Alice helped the most peers in social studies.

Betsy also helped 11 of her peers in the PDS, but helped the most peers with instructional technology issues (90.9% or 10 peers of the 11 she helped). Of all of the methods courses, Betsy helped the most peers in science (7 or 63.6%). In Chloe’s case, she helped 9 of her peers and was similar to Betsy in helping the most peers with instructional technology issues (88.9% or 8 peers of the 9 she helped), and helping the most peers in science (4 or 44.4%). Combined, the technohubs assisted 22 unique peers, which is roughly 36.7% of the total prospective teachers in the PDS.
Table 4-3. Peer-Reported Questionnaire Data for each Technohub.

<table>
<thead>
<tr>
<th>Type of Assistance</th>
<th>Technohub A: Alice</th>
<th>Technohub B: Betsy</th>
<th>Technohub C: Chloe</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># of Peers</td>
<td>% of Peers</td>
<td>% of Total Peers</td>
<td># of Peers</td>
</tr>
<tr>
<td>Provides Technology Support</td>
<td>10</td>
<td>90.9%</td>
<td>16.9%</td>
<td>9</td>
</tr>
<tr>
<td>Provides Help or Advice with Instructional Technology Issues</td>
<td>10</td>
<td>90.9%</td>
<td>16.9%</td>
<td>10</td>
</tr>
<tr>
<td>Provides Help or Advice with Instructional Technology Issues in Science Methods Course</td>
<td>7</td>
<td>63.6%</td>
<td>11.9%</td>
<td>7</td>
</tr>
<tr>
<td>Provides Help or Advice with Instructional Technology Issues in Social Studies Methods Course</td>
<td>9</td>
<td>81.8%</td>
<td>15.3%</td>
<td>6</td>
</tr>
<tr>
<td>Provides Help or Advice with Instructional Technology Issues in Mathematics Methods Course</td>
<td>7</td>
<td>63.6%</td>
<td>11.9%</td>
<td>6</td>
</tr>
<tr>
<td># of Peers Helped</td>
<td>11</td>
<td>18.6%</td>
<td>11</td>
<td>18.6%</td>
</tr>
<tr>
<td>Total # of Peers</td>
<td>59*</td>
<td>59*</td>
<td>59*</td>
<td>60**</td>
</tr>
</tbody>
</table>

*For each individual technohub, the total number of peers that they could help is sixty total interns removing one (themself).

**When combining technohubs, the first technohub could have helped the other two technohubs, and the other technohubs could have helped the first technohub. Thus, there is no need to remove an intern and the total number of peers is equal to the total number of interns.
Summary of the Findings

In this chapter, I outlined the two tests that were completed after compiling the questionnaire data. Both the in-degree measure and Hub and Authority Test identified the same prospective teachers as technohubs, Alice, Betsy, and Chloe. Triangulation was accomplished through observations and interviews of PDAs in the professional development school. The sociographs and tables throughout the chapter provide an overview of the network and information economy within the PDS.

Definitions

In-Degree: In-degree is defined as the amount of incoming connections that an actor has with other actors in a social network. In the current study, the incoming connections refer to times that a technohub helped a peer with a technology or instructional technology issue.

Social network: A social network refers to a group of people that are connected to each other in some shape or form. In the present study, the social network involves the connections among a cohort of prospective teachers around helping one another with instructional technology issues.

Sociograph: A sociograph is defined as a visual representation of social network connections among actors in a social network.
CHAPTER 5

RESULTS

The findings in this chapter provide evidence to address the research question of interest:

What is a technohub’s lived experience of assisting peers with instructional technology issues in teacher education courses?

Introduction

I begin the findings by summarizing the prior chapters and describing participant biographies. These first two sections provide context and background for the findings. The participant biographies are discussed individually according to the three technohubs: Alice, Betsy, and Chloe. A descriptive summary of the phenomenological thematic analysis follows the first two sections and presents an overview of the invariant constituents (defined in Chapter 3), the six emergent themes, and the relationships among technohubs. I describe the themes and relationships using excerpts from the technohubs’ interviews. Each time an excerpt is used, I provide a citation that includes the name of the technohub, the interview number, and the timestamp where the excerpt is located in that interview. For example, a citation of Alice-2_05:01 corresponds with Alice’s second interview at the five minute and one second mark. I conclude the chapter with a section describing the triangulation of the findings, and a final section that provides a summary of the chapter.
Summary of the Prior Chapters

In the first four chapters, I established a case for studying the population of prospective teachers who assist peers with instructional technology issues and labeled them as technohubs. I investigated the literature around peer technical assistance and produced a theoretical framework involving sociocultural and social theories of learning. I outlined a way to study technohubs’ experiences by producing an in-depth, rich description of the phenomenon of interest: the experience of assisting peers with instructional technology issues. Using social network analysis theory, I identified three technohubs from a cohort of sixty prospective teachers in a professional development school at the Pennsylvania State University. This chapter presents the findings from a phenomenological thematic analysis of the identified technohubs’ experiences.

Participant Biographies

The three identified technohubs were all senior undergraduate female students in the College of Education at the Pennsylvania State University. The following biographies provide additional details regarding the areas where they grew up, the activities they were involved in during high school and college, the K-3 classrooms where they spent the 2012-2013 year during the PDS, and their career goals and aspirations. The names of the three technohubs have been changed to maintain confidentiality.

Technohub Biography: Alice

Alice wanted to be a teacher when she was in third grade. She grew up in a suburban area outside a large northeastern city, and went to a private high school. She started to think seriously about being a teacher in high school after deciding not to be a pediatric surgeon or social worker.
She remembered her high school peers telling her that she was too smart to be a teacher and other negative comments about teaching. However, a high school English teacher encouraged her to pursue whatever interested her and that gave her the confidence to continue her goal to be a teacher. Her peers took an interest in education after Alice explained why she wanted to become, and how hard it was to be, a teacher. In fact, she remembered that one of her peers, who initially chided her for wanting to be a teacher, decided to become a teacher as well.

Growing up, Alice played softball and continued the sport in high school. During high school, she joined activities that could fit into her softball schedule including the photography club, technology club, the National Honor Society, and an after school tutoring program. In college, Alice joined the undergraduate education association, the college Democrats, and an off-campus tutoring program.

Alice considered a lack of technology in high school as a reason she did not know a lot about technology before she came to college. She recalled two college courses that changed her perception of the difficulty of technology and helped her to play around with different tools. The first was a freshman seminar course that used Mac software for a lot of projects. The second was an introductory educational technology course.

While attending the professional development school, Alice spent time in a second grade classroom in an elementary school comprised of students at the middle to upper socioeconomic levels. She was excited by using the iPad® for writing projects and helped her mentor (i.e. cooperating teacher) think about using different tools in the classroom. Her mentor was considered a leader among the teachers at the elementary school. Alice noticed that her mentor provided advice to other second grade teachers, and Alice considered her mentor a very talented teacher. Alice considered herself a lifelong learner and in the future, she wants to learn a lot
more about using technology in the classroom. She thought that if she were to learn more about technology integration, she would feel more confident using technology in her future classroom.

Alice is planning to teach first or second grade in the near future although she would be interested in teaching anywhere she would be needed. She would like to go home for her first teaching position and would be interested in teaching in a city. If given the choice, she would enjoy teaching the disciplines of Reading, Science, and Writing.

**Technohub Biography: Betsy**

Betsy wanted to be a teacher when she was in first grade because of her teacher. She remembered her first grade teacher building a relationship with her and Betsy continued to talk to her first grade teacher after first grade. Betsy remained in touch with her first grade teacher to the point that Betsy went to her teacher’s retirement party, and her teacher kept in touch with Betsy’s parents. Betsy had the sense that her teacher really cared for her and wanted Betsy to succeed. In the future, Betsy would like to build relationships with her students similar to the relationship that she has formed with her first grade teacher.

Betsy considered herself a very hard worker who excelled in academics throughout elementary and high school. She grew up in a suburban area outside a large northeastern city, and went to a public high school. During high school, her friends told her she could be a doctor and questioned her interest in becoming a teacher. She remembered her mother asking her in college if she were going to change her major, but Betsy wanted to stay with education.

Betsy was involved in track, dancing, the Spanish club, homecoming committee, and neighborhood civics during high school. In college, Betsy joined Penn State’s philanthropic efforts, her undergraduate education association, and danced with Penn State’s dance and ballet
clubs. She met her current college roommate (also a PDS intern) during her involvement with the dance clubs.

During junior year of high school, Betsy’s school received a grant award to purchase interactive white boards for all of the classrooms, but her teachers did not use the boards very much after the beginning of the year. In freshman and sophomore years of college, Betsy used a Dell® laptop while her peers used Macs. She thought that having a Dell® and not a Mac was a reason why she did not help her peers with technical assistance during her first few years of college. However, after purchasing a Mac and getting familiar with it, she helped others with Mac software.

While attending the professional development school, Betsy spent her time in a third grade classroom in an elementary school comprised of a diverse student population with sixteen to twenty languages spoken at the school. The school brought together children of graduate students at the Pennsylvania State University, making it a transitory population and an English language learner population.

Betsy recalled her mentor asking at the beginning of the PDS if she had a lot of technology skill, and Betsy remembered her own reaction to her mentor’s question:

When she had said you know (with) technology, I don't know how to use it. I was sitting there (thinking) well, I don't know how to use it either so (laughing), I don't know how I'm going to help you. (Betsy-2_39:52)

However, Betsy introduced a lot of different tools (e.g., Photobooth, ComicLife) during her time with her mentor, and her mentor acknowledged how much Betsy had brought into the classroom and thanked her for her efforts.

In the future, Betsy would like to teach in any grade level above the second grade. If given the choice, she would enjoy teaching the disciplines of Mathematics and English Writing
in the elementary grades. If she were hired at the middle school level, she would be interested in teaching Mathematics.

**Technohub Biography: Chloe**

Chloe first knew she wanted to be a teacher when she was in first grade. She recalled setting up a play classroom in her basement at home using extra worksheets and tools that her first grade teacher gave to her. Chloe’s parents purchased a chalkboard and Chloe used a toy box for her teacher’s desk and storage boxes for student desks. In high school, she assisted a Chemistry substitute teacher with a task that Chloe understood, but the substitute was having trouble understanding. So, the substitute teacher asked Chloe to teach the class how to do the assignment. Chloe considered herself someone who always had been helpful, taking charge, and assisting peers during classes. She described teaching as “kind of like my niche I guess” (Chloe-1_01:43).

In her childhood, Chloe had a Windows-based computer at home with numerous software tools including games and word processors. Chloe’s father was an engineer and during a “take your daughter to work” day, one of her father’s colleagues taught Chloe how to use Computer Aided Drafting (CAD) software. After learning the software, Chloe realized that she never wanted to be an engineer. In high school, Chloe worked with Apple® computers at school and Windows-based computers at home.

During high school, Chloe was involved in color guard and the marching band, the golf team, the drama department, chorus, and the yearbook staff, where she used a digital camera and Adobe Photoshop® to take and edit photos for the yearbook. Chloe’s aunt was a photographer so Chloe was encouraged to try photography growing up and was given digital cameras as presents.
throughout her childhood. In college, Chloe joined a non-profit philanthropic organization, the undergraduate education association, and an off-campus tutoring program.

While attending the professional development school, Chloe spent her time in a first grade classroom in an elementary school comprised of an ethnically mixed student population with a number of children from first generation Eastern European immigrants. She recalled her mentor having a lot of knowledge about classroom technology, even more than she did coming into the classroom. However, Chloe soon became technology support for her mentor. Chloe described how her mentor would ask her to “fiddle around” (Chloe-2 80:41) with a technology that did not seem to be working correctly.

After spending time in a first grade classroom throughout the professional development school, Chloe realized that she did not want to teach first grade in the future. She did not understand why children at the first grade level did not pick up concepts that were learned in Kindergarten and reinforced throughout first grade. In the future, she would like to teach in Kindergarten, second, or third grade. If given the choice, she would enjoy teaching the disciplines of Reading, Writing, Science and Social Studies.

**Descriptive Summary of the Phenomenological Thematic Analysis**

In the current section, I describe the findings from a phenomenological thematic analysis of the technohubs’ experiences. During the analysis, I identified 413 initial thought-by-thought codes, used abstraction to find 129 meaning units, and combined and eliminated repetitive meaning units to find 70 invariant horizons or constituents of the experience. I analyzed the invariant constituents using imaginative variation (defined in Chapter 3) and triangulation to verify the results of the analysis. I list the seventy invariant constituents in Table 5-1 and cluster
them around six themes: (1) collaborative nature of the teacher education program; (2) prior experience assisting peers; (3) learning and familiarity with tools, (4) views and feelings when assisting peers, (5) getting approached and offering forms of assistance, and (6) personal changes associated with assisting peers. The six themes emerged after applying three levels of abstraction to the initial thought-by-thought codes and checking the themes against an essential theme test (van Manen, 1997). All themes passed the essential theme test because they were necessary aspects of the experience. A sample analysis protocol including examples of initial codes, invariant constituents, and themes, is available in Appendix B. The following six subsections provide a detailed description of each theme. The final subsection, relationships among technohubs, provides a comparison of the technohubs’ experiences using invariant constituents and excerpts from the transcripts.

Table 5-1: Seventy Invariant Constituents Derived from Technohubs’ Experiences.

<table>
<thead>
<tr>
<th>I. Collaborative Nature of the Teacher Education Program</th>
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<tbody>
<tr>
<td>A. Gets help from others in the PDS</td>
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<tr>
<td>B. Provides reason for entering PDS</td>
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<tr>
<td>C. Group cohesiveness of PDS</td>
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<tr>
<th>II. Prior Experience Assisting Peers</th>
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<tbody>
<tr>
<td>A. Learned technology in school</td>
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<tr>
<td>B. Learned technology outside school</td>
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<tr>
<td>C. Previous experience teaching a tool</td>
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<tr>
<td>D. Previous experience with technology support</td>
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<tr>
<td>E. Previous change in technology interest</td>
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<tr>
<td>F. Previous feelings associated with using and learning technology</td>
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<tr>
<td>G. Previous feelings associated with assisting another</td>
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<tr>
<td>H. Previous lack of confidence with technology savvy-ness</td>
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<tr>
<td>I. Previously approached by others between projects</td>
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<th>III. Learning and Familiarity with Tools</th>
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<tbody>
<tr>
<td>A. Explores tool on own</td>
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<tr>
<td>B. Learns technology in methods courses</td>
</tr>
<tr>
<td>C. Learns technology in PDS technology training</td>
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<tr>
<td>D. Learns instructional technology in PDS</td>
</tr>
</tbody>
</table>
E. Familiarity with tool prior to assistance
F. Not familiar with tool prior to assistance
G. Stumbling across technology solutions
H. Group learning
I. Gets help from family

IV. Views and Feelings when Assisting Peers
   A. View of technology integration
   B. View of own expertise
   C. View of teacher leaders
   D. View of intern leaders
   E. View of leadership
   F. View of PDS
   G. Lack of confidence with technology savvy-ness
   H. Reasons for assisting others in PDS
   I. Reason for leading group project
   J. Downgrades difficulty of technology issue
   K. Feelings associated with assisting another
   L. Feelings associated with using and learning technology
   M. Feelings associated with technology integration
   N. Feelings associated with the PDS
   O. Feelings associated with employment
   P. Feelings associated with inservice teachers

V. Getting Approached and Offering Forms of Assistance
   A. Approached while working on project
   B. Approached through conversation
   C. Approached during study session
   D. Approached in group project
   E. Approached after finishing project
   F. Approached at school
   G. Approached late at night
   H. Approached via text message
   I. Approached via phone call
   J. Approached through humor
   K. Did not approach anyone
   L. Assisting as Conversation
   M. Assisting as Demonstration
   N. Assisting as Technology support
   O. Assisting as Teaching a tool
   P. Assisting as Teaching to help themselves
   Q. Assisting as Leading group project
   R. Assisting as Providing explicit directions
   S. Assisting during Group work
   T. Assisting as Meeting another on their level
   U. Assisting as Reassurance
   V. Assisting as Exploration/Troubleshooting
   W. Assisting as Scaffolding
**Theme 1: Collaborative Nature of the Teacher Education Program**

Theme one describes the situation where the experience of assisting peers occurs. A program that encourages collaboration among the members of a teacher education community affords opportunities for technohubs to assist peers. In this section, I provide evidence towards this claim using excerpts from the identified technohubs’ interviews.

A professional development school, by nature, is structured to provide interns with a “forum for ongoing governance, reflection, and collaboration” (NAPDS, 2008, p. 3). In this study, the technohubs found that the experience of assisting others was aided by the collaborative nature of the program. For example, every Tuesday Alice went to Wegmans, a local grocery market and café, for a study session with a group of interns with whom she was friendly. During the session, there were opportunities for interns to approach Alice for assistance with any technology issues that they had. In the following excerpt, Alice explained how there was always someone available to help during the study session:

Every Tuesday we have a study session before Science, from 2 until 3:10ish, we go to Wegmans and we generally do Science work then but we also just talk about all the projects we have coming up. And we all work on it and it's great 'cuz (sic) if you have a question that comes up within that kind of hour-ish, then there's always people there to help. (Alice-1_36:37)
Betsy perceived the PDS as “more of like a family who does everything together” (Betsy-1_00:05). The collaborative nature of the PDS created opportunities for Betsy to provide help and receive help from interns in her methods courses. In fact, one of the interns to whom Betsy regularly went for help was another technohub, Chloe. She asked Chloe for help when incorporating technology into a lesson.

As it did for Alice and Betsy, the collaborative nature of the PDS offered opportunities for Chloe to help other interns and receive help. She found that among the PDS interns, she had used ideas from Alice, and she often went to Betsy. Also, Betsy was one of the interns whom Chloe tried to sit near during methods courses.

The collaborative nature of the PDS also involved K-12 teachers, mentors, PDAs, and technology coordinators in the district. During Alice’s time at the PDS elementary school, she decided that she wanted to use blogs in her classroom. Her mentor remembered another K-12 teacher who had tried to use blogs and recommended that Alice ask that teacher for assistance. Alice formed a relationship with the teacher who had used blogs previously, and during the unit Alice emailed regularly with that teacher for help with technology integration issues. The following quote from Alice exemplifies the collaborative nature of the PDS:

…in the past I have been in classes where students will have questions. And normally I wouldn't say anything unless it, you know, they were going to fail their project. Because they obviously don't know what they are doing or something like that (sic). I'd normally just keep it to myself. But just because I think of how the PDS is structured and everyone's there to help, and it's not so much of a competition or it's not, you don't feel uncomfortable talking. I mean a lot of times I am worried that the professor will be like, you know, I can give a better explanation than you can. But I know in PDS it seems more like everyone values each other’s opinions… And I think that's what is nice a lot about PDS. It doesn't really seem like lectures so much as more of workshops almost. Like they just present, you know, the subject and then we all kind of talk about it. That's why I think at least in PDS I definitely feel comfortable talking about problems or how you can use certain technologies. (Alice-2_41:32)
Betsy went to a PDA for help with a Rocks and Minerals Unit. The PDA was her science methods course instructor, a third grade teacher at a different school in the district. The following excerpt provides a glimpse of the times Betsy had gone to the PDA for assistance:

I've met with her three times to talk about the next Units. Because a lot of our Units, simple machines in Science, and now what's our Unit now? Oh, rocks and minerals. In methods with her we had done lessons that were in those Units. So I was immediately. We had the other lesson and I was like Oh my gosh, I did this in methods it was so cool let's go to her. So I met with her three times to talk about. Go over how she does her lessons. Because a lot of them were from the Unit but some of them weren't. So I met with her about that. And I emailed her updates, how they like did. I emailed her really happy one day after I did the lesson in my classroom and just sent her this big rant about how it really worked and thank you so much. So I've emailed her updates and those kind of things. (How many people have gone to this teacher?) When I have gone, I have shared with my division. And the first time I think I went by myself. The second time I went with my division but it was only. It was all the third grade teachers. So three of us, plus the other intern, and one of the fourth grade teachers. (Betsy-3_35:57)

Betsy first went to the PDA on her own for assistance with the Rocks and Minerals Unit. When she went back to the PDA a second time, she brought along three third-grade teachers, the fourth-grade teacher, and another PDS intern. The collaborative nature of the PDS allowed Betsy to share her experiences with the other teachers and interns in her PDS elementary school.

Chloe also used the collaborative nature of the PDS to get help from others. Chloe went to the district technology coordinator for help with connecting to the server at school or when she had other issues with technology. Chloe went to her mentor when she was trying to use classroom technology in a specific lesson. She found that her mentor knew how the technology was set up in the room and was able to provide appropriate instructional technology assistance.
Theme 2: Prior Experiences Assisting Peers

Theme two describes prior experiences that contributed to notions of peer assistance and how peer assistance occurs. Technohubs have prior experiences using technology and/or assisting peers with technology. I provide evidence towards this declaration in this section.

For the technohubs in this study, prior experiences helped the technohubs assist peers during the professional development school. In Alice’s case, prior experiences began when she helped another student in third grade. Although she had a poor self-image of her own technical abilities, she remembered helping peers in third grade with PowerPoint. Alice recalled always being interested in learning how to make her presentations better. After she gave a PowerPoint presentation, her peers would ask her for help with their presentations. Alice remembered helping her mother with the aesthetic portions and animations of PowerPoint to make it “cool” (Alice-1_04:16). Alice compared the feeling of helping her mother with the excitement of learning about animations in PowerPoint, and enjoyed helping her mother more than learning new tools. She explained that she enjoyed helping others, almost selfishly, because it increased her own learning, as demonstrated here:

I feel like when you can teach someone else how to use a technology, I think I just learn it better. So it's almost a selfish reason to want to help someone (laughing). (Alice-1_05:20)

Betsy did not have much experience with technology in elementary school except during computer day, when she learned how to use Paint software. In high school, Betsy learned how to use Microsoft® Word and PowerPoint® in the computer lab. Her prior experience assisting others involved helping another student with Word and showing her father how to send an email, both occurring during Betsy’s high school years.
Chloe learned to use the computer for typing and making presentations in elementary school. Also, because her father was an engineer and used computers at work, Chloe grew up with computers at home. Chloe learned how to navigate Windows-based computers at home and both Windows and Mac systems during high school. She remembered helping a peer with a glitch in a program and because of prior confidence in using computers, she thought to herself, “Oh, well let me try and figure it out” (Chloe-1_05:34).

From an early age, she gained an interest in photography from her aunt and that interest contributed to Chloe joining the Yearbook club in high school. During her time with the Yearbook club, Chloe learned Adobe Photoshop from other photographers and used Photoshop to upload and design layouts and edit digital images. As a senior, Chloe taught other students how to use Photoshop.

Alice’s interest in technology grew in high school when the computer lab switched from Windows-based machines to Macs, and she was able to learn about digital art. She remembered helping her peers take photos in digital art class. In college, her interest grew even more when she purchased a Macbook as part of the College of Education’s one-to-one computer initiative. Before switching her computer to a Macbook, Alice found technology boring but once she started using Apple® software, she viewed learning new tools and technologies as engaging and fun experiences.

**Theme 3: Learning and Familiarity with Tools**

Theme three details the ongoing nature of learning that provides technohubs with the knowledge necessary to assist peers. Either before or after assisting peers with instructional technology issues, technohubs are working with tools and spending time learning tools. After a
technohub becomes familiar with a tool, they can assist peers with that tool. The following section provides confirmation of these claims.

All of the technohubs in this study described learning as “messing around,” “playing,” or “fooling around” with tools, a highly exploratory and individualized effort. After learning that the professional development school would be using StudioCode® software during course projects, Alice got a head start on the tool and decided to work with it during the summer leading up to the PDS. Having already been familiar with the tool before the PDS, Alice was ready to help others with the software when the semester started and helped her peers work through issues that she had worked through previously on her own. The following excerpt demonstrates Alice’s exploration and subsequent peer assistance:

In college, for some reason, I don't know how this has happened but, I just feel like whenever I'll mess around with something, I feel like it happens that a couple weeks later we'll haveta (sic) use that for a class or something, and then it's just something that I'm already familiar with, and I'm like, oh, well you just do this. (Alice-1_06:18)

However, Alice is quick to point out that the exploration she describes is more of a “stumbling” over issues than anything else, as described in the following excerpt:

I think for me the biggest thing with technology is that I feel like I've never really learned a lot about it. It’s just more of stumbling across (laughing) different things… I just feel I'm constantly tripping over technology and then going back and trying to figure out what it was that you know, tripped me up in the first place or trying to figure out like, how someone does something. It seems like I'm always working backwards. (Alice-2_51:43)

Betsy and Chloe also had similar experiences with learning tools on their own and having prior familiarity with tools when assisting peers. Betsy played around with technology when she was introduced to it and then in turn, helped others. Although she learned a lot of software and
tools in college courses and how to incorporate technologies during the PDS technology training, Betsy quickly became a technohub, assisting and teaching her peers when issues arose.

During the teacher education courses immediately leading up to the PDS, Chloe spent time exploring new software programs she had never used before and worked through any issues that came up on her own. She described her own efforts exploring tools in the following way:

Some people are really stubborn. I know I am one of those people that I don't necessarily always like to ask for help but then I just try to figure it out on my own, which is, I think, gotten (sic) to me where I'm at with technology, 'cuz (sic) I fool around with things for so long that I'm like, Oh yeah well I remember I did this one time but ok how did I do that again? So, I figured a lot of stuff out that way. (Chloe-2_42:11)

Theme 4: Views and Feelings when Assisting Peers

Theme four explains the perceptions and feelings that technohubs share regarding assisting peers, and using and integrating technology into teaching and learning. Technohubs have a lack of confidence in their own ability to integrate technology into teaching and learning, but they think they either already are leaders or have the capacity to be technology leaders in time and/or with more experience. During peer assistance, technohubs downgrade the difficulty of an issue, have periods of frustration, demonstrate satisfaction and increases in confidence, and have a lack of confidence in their own ability to use technology or help peers. I include evidence towards these claims in the following section.

Alice viewed Chloe as an intern leader who had a grasp on technology and a similar mindset of being willing to try to work through an issue. Alice would like to be a teacher leader with technology integration in the future, but she explained that it would only come with time and more experience in the classroom. Betsy viewed herself as an intern leader and modeled what she thinks every intern should be doing during the PDS. Similar to Alice, Betsy explained
that she would be a teacher leader once she gained knowledge and experience about how technology would help students.

Chloe considered herself an intern leader because she thought she was very straightforward and outspoken and had a “take charge” (Chloe-3_41:45) attitude. Chloe often took control over group projects, as explained in the excerpt below:

I'm very like, take control (laughing) 'cuz (sic) I like making sure that things get done. So I'm normally the person that takes on the most and is in control of everything (laughing) to make sure it gets done and it gets done right. (Chloe-2_72:41)

The sense of control translates into Chloe considering herself as someone whom others went to because she was the first person to be vocal when a question was asked. Betsy also had a need for control and would take control if she thought she could make a group project better.

Chloe offered technology assistance in any way that she could when a peer approached her. An example from Chloe’s second interview, that explained one of the main reasons why she helps a peer, is provided below:

I just think that if somebody needs help or if I needed help I would want somebody to help me (laughing), so I try to be very helpful and I think it's like the teacher instinct to me, like, Oh, but let me just show you how to do it, ok? And I mean, I don't want anyone to be freaking out ’cuz (sic) they can't do something. So yea, I would want someone to help me (laughing) if I needed help. (Chloe-2_35:13)

Chloe considered herself a technology leader but would like to learn more about technology, especial iPads and the SMART Podium™. Of the three technohubs, Chloe felt the most confident and skilled with using her Mac, which could be based on her prior experiences using technology during her childhood.

When helping a peer, Alice considered the two most important things to do as (1) staying positive and (2) focusing on content versus the aesthetics of a project. Previously, she would get
caught up in the aesthetics, but after being in the PDS elementary classroom for the year, she understood the importance of focusing on content first. By the end of the PDS, Alice thought more critically about using technology to support teaching and learning. She recognized occasions where teachers have used technology without an educational purpose. Alice would talk to other interns and demonstrated to them the need for technology to serve a purpose in the classroom.

Like Alice, Chloe understood the importance of having a purpose for using technology in the classroom. Chloe discussed why she did not have an interactive whiteboard in her PDS elementary classroom and explained that it was not important because of her perception that interactive whiteboards were teacher-centered tools. She saw the pros and cons of using technology to enhance a lesson, but explained that any use of technology in the classroom must be thought out so that it is not used just for technology’s sake.

Each technohub downgraded the difficulty of technology issues they described during the experience of assisting peers. The following excerpt from Betsy’s interview explained this feeling:

I guess that in my mind what I was doing to help them wasn't like a huge. I wasn't like Oh I know so much about this. Like you know I didn't think it was like, Oh she really knows how to do it. I thought it was just like Oh well you just do this and move on kind of thing. So I mean it's nice that I can help other people and that they do see that I can do some things. But it is surprising 'cuz (sic) I, you know. I felt like my contribution wasn't like this thing that nobody else in the world knew how to do, you know what I mean?
(Betsy-2_47:46)

Frustration was a common feeling for each technohub. Alice felt frustrated and upset at times if she could not figure out an issue at first glance, or if time was running out before a project was due. When communicating with a peer and articulating a solution over text messages, Alice had trouble providing the solution in a coherent manner. At other times, when
Alice saw her peers in a state of frustration, she became frustrated herself if she could not relieve the stress immediately.

Betsy also found it hard to articulate solutions when she was not physically with a peer. Whereas Alice helped many peers through text messages, Betsy would help through phone calls. Betsy would get frustrated if she could not articulate the right set of directions or if she told a peer what to do to solve an issue but they did not do it in quite the same manner. When her peers did not follow her directions, Betsy got frustrated because she had to spend more time with the peer to ensure they followed the right steps. The times where Chloe felt frustrated were when she could not figure out an issue on her own, and she would need to get help from someone else such as her father or the technology coordinator in the district.

In terms of satisfaction and confidence, Alice felt happy and more confident when helping others. Helping another intern allowed Alice to understand technology better, what she described as “somewhat selfishly” (Alice-2_19:17). When Chloe was able to help someone fix an issue, she felt satisfied with herself and her own abilities.

Two of the technohubs had a lack of confidence in their own technology savvy-ness when they assisted peers. At the start of the PDS program, Alice worried about making a mistake or messing up. She did not feel knowledgeable about different tools but knew enough to help her peers. She felt like she was the “annoying girl in class” (Alice-2_28:06), not a person who peers would go to for technology assistance.

For Betsy, a lack in confidence was present at the beginning of the PDS. Upon discovering that she would be working with her mentor, Betsy stated that she did not know how she was going to assist her mentor with technology, because she did not feel that she was savvy.
When explaining to her mentor what she knew about technology, Betsy mentioned that they would learn from their elementary students, as described in the following excerpt:

Oh well I'm still learning and I know that these kids have had iPads from K-2 and they're getting laptops. So I think I said something like I'm learning, you know, they probably know more than I do, but you know, they'll help me with it. (Betsy-2_39:52)

Betsy was under the impression that elementary students knew more about iPads, Photobooth, and other tools than she. Although, by the end of the PDS program Betsy thought that she did help her mentor, and her confidence changed (as described in theme 6).

**Theme 5: Getting Approached and Offering Forms of Assistance**

Theme five describes how technohubs are approached and how technohubs provide peer assistance. The lived experience of assisting peers involves having conversations, offering step-by-step directions, and exploring an issue with a peer or student. Each experience of assistance is related to the technohub’s teaching philosophy and prior experiences. In this section, I verify these assertions using excerpts from technohubs’ interviews.

In this study, technohubs were approached through text messages and/or phone calls, in the middle of conversations, or during individual or group projects. For Alice, peers often approached her while she was working on projects at Wegmans. At the study session, she was working individually on a project and a peer came up to her, sat down, and asked her for assistance. Alice provided an explanation of getting approached in the following excerpt:

(Can you talk a little more in detail about, like how do any of your peers approach you and what that conversation is like and how does it end, how does it get resolved?) It's actually, I think (laughing) it's always really funny how it generally happens is either we are all together doing a study session, or, you know, we're at Wegman's working and they'll see me working on something and then they just bring their computer over and plop down and they'll say, I don't understand what you're doing or I don't understand how to use this program. (Alice-1_30:33)
Alice provided assistance in the form of conversations. Alice was keen to discuss what she was doing for a particular project but hesitated giving step-by-step instructions to her peers because she either perceived that she did not know much about the program or she wanted to learn from her peers while she was helping them. The following excerpts demonstrate what Alice tried to accomplish during assistance:

I think that a lot of times it starts out that for me like a conversation because I want to know more from them about technology. And a lot of times I second guess myself when I'm doing things. Or because all I did was play around or stumbled across something, I'm not sure if it's right. So then normally if I ask a question they'll be like, oh I didn't even know how to do that so how did you do that and I think we kind of backtrack back to their question and kind of work through the technology that way. But I don't know, it's always more I think, a conversation. I feel like I learn something from them and get to see their projects. It's more collaboration I think. (Alice-2_15:23)

On the other hand, Betsy often assisted peers by helping them through explicit step-by-step instructions, as evidenced in the following excerpt:

(Can you think of any examples from the PDS coursework where you helped someone find a solution themselves as opposed to just teaching them the right trick?) (laughing) I don't know. I mean there have been times when I have said. Like someone has asked me a question and I was like Oh well I just did this. And didn't really go into detail or show, I guess. So telling them that it can be achieved if you do this. And then they kind of figure it out. But I guess that's the only thing that I didn't like sit down and step by step do. (Was there a reason why you laughed when I asked that question?) 'Cuz (sic) normally I will just tell people what to do. (Betsy-2_14:08)

Chloe provided a third perspective. This excerpt is from a description of the type of support she offered her first graders during her PDS elementary class:

Well, a lot of the times (sic) I've played around with things and tried to anticipate the problems that they were gonna (sic) have. Or another student that already said, I don't know how to do this, I didn't listen to directions. And I have to go back through and tell them. And just then figuring out like if we do iMovie in steps, so they do one part. And then we go back to the carpet and we teach them another step. And they go back. So it's a very long process, but I'll go around and check their iPads. 'Cuz (sic) even if they said they didn't have any problems some of them still do it wrong and they weren't listening to directions. So I check to make sure they're all right. And then, if one is wrong I play
around with it first. And then I undo what I just did so that way I can tell them how to fix it. And once they come back to do the next part I say Oh we have to fix this before you move on and show them how to do it. (Chloe-3_22:56)

When looking closer at the three previous excerpts from technohubs’ interviews, it is possible to make sense of the differences in technohubs’ assistance and uncover possible differences in teaching philosophies among the technohubs. Combined with information from theme three, learning and familiarity with tools, and theme four, views and feelings when assisting peers, the excerpts demonstrate a difference among the three technohubs in teaching philosophies around assisting others. Alice was much more reserved with assisting others based on a lack of confidence in her own technology savvy-ness and wanted to learn as much from others as they learned from her. Betsy also was reserved but learned a lot of technology knowledge from her coursework, giving her a step-by-step perspective on technology assistance. Chloe was different than both Alice and Betsy in that she expressed a positive sense of her own technology savvy-ness and often explored tools on her own, leading to an exploratory perspective when assisting others.

**Theme 6: Personal Changes Associated with Assisting Peers**

Theme six identifies the personal changes that are associated with assisting peers. After helping peers, technohubs increase their confidence and ability to use technology, and think of new ways to help others and use technology in the future. The following section provides evidence of this claim.

After assisting peers in this study, technohubs exhibited changes in how they helped others, how confident they felt with technology, and how they viewed and used instructional technology. For Alice, the changes were present in how she helped others during the spring
semester. Before the PDS, she was very direct when telling peers what to do to solve an issue. However, after the experience of assisting peers, she changed her explanations of solutions to be brief and less detailed so her peers would not follow her exact steps but rather, would have more creativity in their own solutions.

I think before I'd be very explicit but in kind of the way I think. So I'd be like, well I tried these things and it didn't work. And now I think I'm more aware of that ok, you should, I should probably start off the first step rather than the twentieth step and then back them up. You know, I should tell them this is what I did and like, here's where, you know, I went on. I guess I'm a little bit more concise with my explanations. And also I think I'm also telling them a little bit less. And then, I don't mean that as I'm withholding information but I think more of being you know, do what you think you should do, this is what I did. Because I realized in the beginning I would say well, this is how I think you should do the project. (Alice-2_26:25)

After helping others during the PDS, Alice felt more aware of others’ technology problems and how her peers thought through problems. Whereas when previously assisting peers in the PDS Alice would shy away from helping someone if she did not know the answer, now she felt as though she could help a peer explore and investigate the solution even if she did not know the tool (as described in the following excerpt):

I know before if someone had a question I didn't really know all the way, I would be like, I can't even help you with a little. But now I feel like even if I don't know the whole thing, we can sit down and I can help you with what I do know. And then we can see if we can experiment and figure out the rest. (Alice-2_47:51)

Alice exhibited changes in her confidence with technology after helping peers in the PDS. She changed from being hesitant before the PDS to becoming willing to troubleshoot a program on her own without getting nervous if she could not figure out the solution right away. Although helping others built her confidence with using technology, she felt confident because she was not afraid to use technology, not because she thought that she now knew a lot about technology. Chloe got a boost of confidence when she was able to figure out something that was
troubling others. She felt that she had increased her skill with technology during the PDS, especially when helping her mentor. As a result of helping peers and using technology in the PDS, Chloe became more motivated to learn about iPads and technologies that can be used to support elementary students. After helping others with technology issues, Betsy felt more competent in her own use of technology. She recognized that helping peers had changed because of her own knowledge of a tool, as described in the following excerpt:

[What do you think has changed in the way you help others with technology issues since you first started the PDS? I'm able to say a lot more now than I used to, to (peers). And make it a little easier for them to understand when they do ask me. In the beginning I was kind of trying to figure things out. And I think that because that I liked the program, like I like using StudioCode® and so I chose, we were going to have options to do our projects in different ways. And because I like StudioCode®, I chose to do it every time. And by doing that I was able to find out more about it and I can fly through it now. Whereas my roommate who had to do the final project, they made us do that in StudioCode®, I was able to tell her a lot more about it in a lot more easier way because I was using it. So, I think that I was becoming more familiar so I was able to help them a little easier through it. (Betsy-2_16:03)

Betsy described wanting to use technology a lot more in teaching in the future. She explained how the PDS afforded her opportunities to use technology herself and help others with issues. She stated that she would like to use software she was introduced to during the PDS (i.e. ComicLife, StudioCode®) in her future classroom.

**Triangulation of the Findings**

Triangulation of the findings occurred through observations, peer debriefing, and member checks. Observations provided verification of the experience in the context in which it occurs, the PDS methods courses. Peer debriefing and member checks enabled the analyzed data to be verified for meaning and structure. Both of these methods are described in the following subsections.
Observations

On November 13, 2012, I observed two PDS methods courses from 11:30-2:30 p.m. and 3:30-6:30 p.m. The activity for the day revolved around working on Engineering Design Units and Lessons in the Elementary Science Classroom. During the visit, I observed patterns of seating arrangements, whom technohubs talked with, what types of technological affordances the space allowed, and whether any experiences of assisting peers occurred. I observed that two of the technohubs, Betsy and Chloe, often sat together at a table of six, while Alice had her own group of friends across the room. When class started, I soon noticed the personalities of the three technohubs. Whereas Chloe was assertive and talkative, Alice was direct and polished. Betsy was talkative but reserved.

The methods course space was a third grade classroom with small chairs and small desks. Although there weren’t opportunities to collaborate during class on projects, I could sense the collaborative nature of the PDS based on the respectful and friendly discussions during class. About 30 minutes into the start of the class, one of the interns asked the PDA leading the discussion if there were a reason a certain movie file type would not be imported into StudioCode®. Immediately, Alice turned to the intern with the question and provided a brief explanation of the problem and a possible solution. The PDA, knowing the gist of my study, looked at me and smiled. Although short in length, this episode details the kind of help that technohubs often provided during the PDS program. Through multiple occasions of turning to peers and providing thoughtful suggestions, Alice became known as a “go-to” person for technology assistance.

Although I was unable to observe any other sessions during the semester, I am confident that this one episode provides evidence towards the findings that I discovered during analysis of
the interview data. Other modes of triangulation are detailed below in peer debriefing and member checks.

**Peer Debriefing**

Lincoln and Guba (1985) suggest that qualitative researchers use peer debriefing and member checks to confirm the findings of a study. In this study, I chose two graduate students that were on a similar trajectory to myself and had completed advanced qualitative analysis of data courses. I used them to confirm the appropriateness of my techniques and to provide credibility in regards to my research findings.

Peer debriefing involved sending my analysis files and analysis protocol to my colleagues. Each colleague looked over each of the techniques I used and explored my data analysis to see if there was anything that they would do differently, or if there was anything troublesome about my analysis. Both colleagues verified and confirmed the appropriateness of my research methods, techniques, and the credibility of the findings in the study.

**Member Checks**

I also contacted the three technohubs, Alice, Betsy, and Chloe, to provide credibility regarding my interpretations of their experiences. For each member check, I emailed a copy of Chapter 5 for them to read and confirm the credibility of my interpretations. Before sending the chapter, I removed all passages that did not directly correspond with their experience. For example, when sending the chapter to Chloe, I only included passages with her pseudonym and interpretations of her experiences and removed discussions of Alice and Betsy. Each technohub
responded to my inquiry and expressed positive signs that the interpretations put forth in this study are indeed the correct understandings and interpretations of the participants’ experiences.

**Summary of the Findings**

In this chapter, I presented background narratives for each identified technohub. The technohubs came from similar backgrounds. All were white females who grew up in suburban areas close to large northeastern cities. Two of the technohubs went to public school while the third went to a private high school. Each of the technohubs remembered wanting to be a teacher when they were students between the first and third grades. Two of the technohubs remembered having friends and family members attempt to persuade them to choose different careers, but they stayed committed to teaching as a profession.

The first technohub, Alice, described limited experience with technology in elementary school and at home, but her interest grew in high school in a technology club. When she purchased an Apple® Macbook for college, she started to experiment with different software tools and realized that technology was not as difficult as she had perceived.

The second technohub, Betsy, remembered seeing technology tools during her schooling but not getting the chance to use them very much. Betsy brought a Dell® laptop to college, and felt like an outsider in the Apple® heavy College of Education. She always considered herself a high achiever but did not consider herself a technohub until she purchased an Apple® Macbook and became acclimated with the tools.

The third technohub, Chloe, grew up with technology in school and in the home. Her father worked in a computer profession (i.e. engineer) and her aunt worked as a photographer.
This translated into Chloe having had many experiences using technology during her childhood and the experiences led to her having a positive sense of her own tech-savvyness.

The phenomenological data analysis process produced six essential themes related to assisting peers with instructional technology issues:

(1) **The collaborative nature of the teacher education program.** A program that encourages collaboration among the members of a teacher education community affords opportunities for technohubs to assist peers.

(2) **Prior experiences assisting peers.** Technohubs have prior experiences using technology and/or assisting peers with technology. Prior experiences influence technohub’s ability to assist peers.

(3) **Learning and familiarity with tools.** Either before or after assisting peers with instructional technology issues, technohubs are working with tools and spending time learning tools. After a technohub becomes familiar with a tool, he/she is able to assist peers with that tool.

(4) **Views and feelings when assisting peers.** Technohubs have an inferior view of their own ability to integrate technology into teaching and learning, but they think they either already are leaders or have the capacity to become technology leaders in time and/or with more experience. During peer assistance, technohubs downgrade the difficulty of an issue, have periods of frustration, demonstrate satisfaction and increases in confidence, and have a lack of confidence with their own ability to use technology or help peers.

(5) **Getting approached and offering forms of assistance.** The lived experience of assisting peers involves having conversations, offering step-by-step directions, or exploring an issue with a peer or student. Each experience of assistance is related to the individual technohub’s teaching philosophy and prior experiences.
(6) **Personal changes associated with assisting peers.** After helping peers, technohubs increase their confidence and ability to use technology, and think of new ways to help others and use technology in the future.

These six themes provide insights into technohubs experiences by explaining how technohubs are approached, what they feel during assistance, and how they assist peers in different situations. I highlight the relationships between the findings and current empirical literature in the field in the final chapter.
CHAPTER 6
DISCUSSION AND IMPLICATIONS

In this chapter, I will draw from my theoretical framework to discuss the findings, research outcomes, implications, and possible avenues for future research.

Discussion of the Findings

A discussion of the six emergent themes provides an answer to the research question: What is a technohub’s lived experience of assisting peers with instructional technology issues in teacher education courses? In the subsequent discussion of themes one through four, I identify factors that contribute to technohubs getting approached and offering assistance. In theme five, I discuss what is involved in the assistance of peers with instructional technology issues. In theme six, I demonstrate how technohubs are changed through the experience of assisting peers. I also situate the discussion of each theme in relation to recent empirical findings in teacher education.

Theme 1: Collaborative Nature of the Teacher Education Program

A collaborative nature of a teacher education program was a contributor to any and all technohubs’ experiences assisting peers. The technohubs in the present study described the professional development school as a forum where they felt comfortable and respected, where everyone was willing to lend a helping hand when someone was in need, and where there was always someone available to help. For one technohub, the collaborative nature of the program involved regular study sessions outside of methods courses and classroom experiences. Alice
would meet a few fellow interns at a local grocery market and café, creating a venue to assist peers with instructional technology issues. This finding is consistent with Dexter, Anderson, and Becker (1999) and Clark (2013) who suggest that the collaborative nature of a teacher network supports teachers’ experiences with instructional technology. Specifically, collaborative school networks (Dexter, Anderson, & Becker, 1999) and learning in collaborative networks (Clark, 2013) provide opportunities for teachers to increase their capacity to integrate technology.

In a study of forty-seven teachers’ uses and views of technology in education, Dexter, Anderson, and Becker (1999) found that a support network provided avenues for teachers to develop notions of technology integration. The support network included “rich professional development experiences and a professional culture that encourages reflection and trying new approaches” (p. 237). They framed technical assistance as important, but only in the broader context of a collaborative school network that encouraged professional development and reflection. Clark (2013) explored the experiences of third through fifth year teachers around technology integration in a rural public school district in North Carolina. He discovered that collaborating with peers and participating in technology integration support increased beginning teachers’ confidence- and comfort-levels with technology integration.

In the present study, the collaborative nature of the teacher education program supported prospective teachers’ experiences with peer assistance. Collaborative opportunities included events outside of the methods courses including study sessions at local cafés.

The PDS research setting was focused on fostering and maintaining an intern-centered environment that promoted student inquiry and student wonderings (J. Nolan, personal communication, April 3, 2013). The emphasis on interns’ questions created an atmosphere that
was ideal for interns’ explorations of learning technologies. This is similar to the notions of learning community (Wenger, 1998; Bransford et al., 1999) discussed in Chapter 2.

The technohubs who emerged from the participant population were interns who had experience exploring learning technologies (as described in themes 2 and 3). The technohubs also explained wonderings about technology integration (as described in theme 4). Finally, they demonstrated a motivation to explore tools in the future and to work towards technology leadership (as described in theme 6).

**Theme 2: Prior Experience Assisting Peers**

Another precursor to technohubs’ experiences assisting peers was prior experience. The three technohubs in this study described prior experiences with learning technology in and outside of school, teaching a technology tool to either peers or family members, providing technology support to others, having positive feelings when using technology, and having positive changes with their own interest in technology. These findings are in line with previous research about beginning teachers’ prior experiences. Elliot (2011) identified work experience, high school coursework and projects, and exploration on one’s own as three prior experiences with technology that impact beginning teachers’ ability to integrate technology.

In the present study, technohubs’ prior experiences included working with technology in school coursework and projects. Technohubs had prior experiences exploring technology on their own, which is discussed further in theme three, learning and familiarity with tools.

Theme two also introduced the notion of a technohub’s lack of confidence with their technology expertise. One of the three technohubs exhibited a lack of confidence with her own technology savvy-ness prior to entering the Pennsylvania State University. In theme four, two of
the technohubs described an ongoing or continuous lack of confidence with technology savvy-ness, suggesting that technohubs question their own expertise even when helping others.

Elwood-Salinas (2001) studied prospective teachers’ views of technology integration experiences and the need for technology integration in methods courses. Elwood-Salinas (2001) found that a negative view of technology expertise in using technology was a barrier to prospective teachers’ successful integration of technology in the classroom. The results in the present study contradict Elwood-Salinas’s (2001) findings and show that technohubs are able to assist others with instructional technology, even when they question their own sense of technology savvy-ness. A positive view of technology expertise is not a precursor to assisting peers with instructional technology issues, and may not be a barrier to technology integration.

**Theme 3: Learning and Familiarity with Tools**

In addition to learning to use technology in school (e.g., methods courses; technology training), technohubs’ explored tools on their own. Technohubs described their explorations as “messing,” “playing,” and “fooling around” with tools. This finding builds upon the discussion of prior experience in theme two, and it is consistent with previous research around beginning teachers’ exploration of technology. Both Elliot (2011) and Sandholtz (2001) found that beginning teachers who explored tools on their own were able to transfer knowledge of technology to multiple situations and contexts.

In the present study, technohubs demonstrated a capacity to build technology knowledge and skill on their own. For example, Alice and Betsy described helping peers with a specific software tool after learning how to use the software on their own, outside of school. I provide
practical examples of offering prospective teachers opportunities to learn and become familiar with tools later in this chapter (in the section titled Implications).

Theme 4: Views and Feelings when Assisting Peers

The technohubs viewed either themselves or other technohubs as intern leaders, and used their experiences assisting peers as evidence. This finding is promising considering that views and feelings around technology are contributors to future technology use (Marcovitz, 2000). Although the technohubs viewed themselves or others as leaders, they expressed an uncertainty about how to successfully integrate technology in the classroom. The technohubs suggested that in time and with more experience, they could become teacher leaders with technology integration.

Throughout the process of assisting peers, technohubs had experiences troubleshooting technology issues with peers. The experience of troubleshooting issues is something Kopcha (2010) describes in a model of training technology leaders. The goal of the model is to have teachers learn how to troubleshoot issues as they occur (Kopcha, 2010, p. 185).

Technohubs also demonstrated a student-centered view of instructional technology. For example, when talking to others about technology integration, Alice described the need to prompt others (interns and mentors) around the reason for bringing technology into the classroom. Alice wanted to ensure her peers and colleagues were using technology to support students and the instructional goals of the lesson. Chloe described an interactive whiteboard as a teacher-centered tool, meaning that only one person can use the board at a time. For this reason, she rarely used the whiteboard in her mentor’s classroom and instead suggested that technology integration must be thought out to enhance a lesson.
Recent empirical literature (Elwood-Salinas, 2001; Sadera, 2001) found that prospective teachers came into teacher education with teacher-centered views of using technology from the apprenticeship of observation (Sadera, 2001), or with a lack of confidence with their own expertise in using technology (Elwood-Salinas, 2001). Sadera (2001) found that prospective teachers demonstrated teacher-centered views of instructional technology before entering teacher education programs. He called for research in ways to change prospective teachers’ views early in their teacher education programs.

Although the technohubs in the present study had a lack of confidence with their own expertise, they were able to move past the apprenticeship of observation and towards student-centered views of instructional technology during the PDS. It is unclear why technohubs expressed student-centered views of instructional technology. Perhaps the collaborative nature of the PDS contributed to their views, or the fact that the PDS program occurs during the last year of the four-year teacher education program. Regardless of the reason, technohubs demonstrated views consistent with the Cognitive Apprenticeship Framework (Collins et al., 1991), moving away from ideas learned during the apprenticeship of observation.

Technohubs described reasons for helping others. For example, Chloe and Betsy explained that they help others because they would want someone to help them if they needed assistance. This line of reasoning suggests that technohubs see themselves as more capable peers (Vygotsky, 1978), who have the responsibility to help those who are less capable.

Technohubs expressed feelings of inadequacy around their technology savvy-ness. Although they were identified as the peers that others went to the most for assistance, they were to deflect any praise or attention. Rather, technohubs described peer assistance in the PDS as serving as a more capable beginner, not someone who had expertise. This finding is consistent
with Montgomery (2000). In a study of intern-mentor relationships, Montgomery (2000) found that prospective teachers were their own worst critics. Prospective teachers had more negative views of their own knowledge of science teaching than the mentors who were assessing them. In other words, prospective teachers had different views of their own expertise than those around them.

Technohubs often downplayed the difficulty of technology issues that they solved during the PDS. They did not think the technology issues were difficult or complex in any way. This finding is similar to the notion of complexity described previously. Prospective teachers entering a teacher education program often view teaching as a fairly simple process (Darling-Hammond, 2006), and they are unaware of the complexities involved in teaching. The same might be said about technohubs’ feelings of difficulty and understandings of complexity when assisting peers with instructional technology issues.

**Theme 5: Getting Approached and Offering Forms of Assistance**

Getting approached by others was the first step of assistance and created an opportunity for technohubs to provide mediation and/or scaffolding. In sociocultural theory, interactions are classified as mediation when they are intentional, purposeful, and transcend time and culture (Feuerstein, 1990), and interactions can include scaffolds such as question prompts or guided peer interactions (Ge & Land, 2004). In the present study, technohubs often were approached by peers rather than seeing a peer frustrated and offering assistance. Technohubs were approached while working on an individual or group project, while in a study session or at school, after finishing a project, or through a face-to-face or distance conversation.
After getting approached, technohubs offered support in many different ways. For example, technohubs offered support through explicit step-by-step directions, demonstrations of their own solutions, or hands-on technology support of an issue. Differences were present in how technohubs offered support. For example, Alice had a lack of confidence with her own technology savvy-ness. She also had an intense desire to learn as much from others as they learned from her. Both of these factors probably contributed to her talking to others about possible solutions (as opposed to showing explicit answers).

Betsy, on the other hand, offered demonstrations and explicit step-by-step directions to her peers. She had learned a lot of her technology knowledge and skill from tutorial-oriented course projects. It is possible to think that she offered assistance in the same way that she was taught. Chloe was the most confident of the three technohubs, and her assistance demonstrated this confidence. She often would explore and solve peers’ problems for them when they asked for assistance.

In all of the examples above, there was resolve on the part of the peer to seek help from a technohub. Likewise, each technohub was invested in assisting the peer in any way she could (i.e. intentionality). Each technohub provided assistance that was situated within the PDS program and appropriate for her peer (i.e. purposeful). For example, technohubs provided scaffolds, met a peer on the peer’s level, or attempted to teach a peer how to assist him/herself. Betsy explained scaffolds as “giving (peers) some kind of prompts (sic) to get them to where they need to be. Kind of building on what they know and pushing them a little bit (sic)” (Betsy-2_12:50). This notion of assistance as scaffolds is in line with Ge and Land’s (2003) notion of unguided interactions as scaffolds, where “members offer suggestions, negotiate ideas, and share experiences” (p. 23). In addition, meeting a peer on the peer’s level demonstrates a technohub’s
propensity to have an understanding of her peer’s preconceived notions of the content, further emphasizing similarities between technohubs and more capable peers in the ZPD (Vygotsky, 1978). However, even with intentionality and purposeful conditions of mediation met, it is unclear if the last condition (i.e. transcendence) was met because technohubs’ descriptions did not include recognitions of different perspectives or barriers to assistance.

Empirical studies have encouraged peer assistance in teacher networks (Toma, 2007; Bryant, 2008). Bryant (2008) looked at how sixteen teachers experienced instructional technology support during a professional development program in a suburban, southeastern school district. Findings demonstrated the value of peer support, and how formal support staff work on issues through reassuring and constructive feedback. Additional findings suggested that teachers that entered the professional development program were comfortable sharing with teachers in their schools. Also, teachers in the program worked together collaboratively because of their desire to have a “tech buddy” (Bryant, 2008, p. 182). Toma (2007) found that mentoring, especially formal peer mentoring, helps beginning teachers through the stressful first, few years of teaching.

In the present study, technohubs provided assistance to reassure peers. For example, Alice and Chloe reassured peers and told them if they were on the right track. This is consistent with Bryant’s (2008) finding that teachers rely on peer support for reassurance and constructive feedback and extends Toma’s (2007) study of formal peer mentoring to suggest that informal peer assistance, as described in the present study, can help decrease peers’ stress levels.
Theme 6: Personal Changes Associated with Assisting Peers

Technohubs exhibited changes in technology confidence and an ability to assist peers after going through the PDS and helping many of their peers with instructional technology issues. This finding is consistent with Botha and Onwu (2012) and Clark (2013), who found that collaborating with peers increased beginning teachers’ confidence- and comfort-levels with technology integration. In the present study, technohubs demonstrated personal growth, satisfaction with helping others, and reflection on the role of technology in teaching after assisting peers. Technohubs learned just as much from the experience of helping a peer as their peer learned from them. This finding is expressed in the following excerpt from Alice:

By helping others, by talking people through the technology problems they're having or any problem they're having, I tend to work out my own problems. And figure new things out along the way (sic). So I think I've learned that I'm a little selfish when it comes to helping others. (Alice-3_36:10)

Ehrich, Hansford, and Tennent (2004) found similar outcomes with teachers in mentoring roles. There are four positive outcomes of peer mentoring:

1. benefits with collaborating, networking, or sharing ideas with colleagues,
2. reflection or reappraisal of beliefs, practices, ideas, and/or values to mentoring,
3. facilitation of the professional development of mentors,
4. and satisfaction, reward, or growth after mentoring peers.

(2004, p. 522-525)

It is unclear if technohubs exhibited changes in their identity. According to Saka (2007), identity change can occur if and when teachers receive feedback, validation, and recognition from others for their efforts and practices. Saka (2007) studied two beginning science teachers around their identities as beginning teachers and how notions of identity shaped their practice. Receiving feedback, validation, and recognition from others for teaching practices positively shaped their identities as teachers.
In the present study, two of the technohubs (i.e. Betsy and Chloe) identified themselves as intern leaders, and subsequently embraced an identity of a “go-to” peer for instructional technology issues throughout the PDS. However, the third technohub’s (i.e. Alice) experience could not have been more different. Alice did not think she was someone whom others went to for assistance, and in fact, thought it was crazy that anyone would “go-to” her for support. Even though Alice described experiences that suggested she was in fact a technohub, she was unable to view herself as a “go-to” peer. Her lack of confidence with technology savvy-ness was a barrier to her seeing herself in this light.

**Research Outcomes**

The goal of this study was to develop a deeper understanding of the experience of assisting peers in teacher education by investigating technohubs’ lived experiences. Throughout this study, I designed and developed three tools that could be modified and used in future research. The first, a peer-reporting questionnaire to identify technohubs, could be modified and used in other research. The questionnaire could be used to identify technohubs in other teacher education programs. Once identified, technohubs could be used by teacher educators to provide peer assistance either before, during, or after class (although I present problems with this idea in the Implications section). The questionnaire also could be used to determine the social network within a community around any experience, not just peer assistance with technology issues. Possible extensions include using the questionnaire to ask questions about where prospective teachers go to for teaching ideas, discovering more about the information economy around teaching.
The second is the theoretical framework for studying technical assistance in teacher education. The theoretical framework could be modified and used as a lens to understand notions of assistance between teacher educators and prospective teachers, mentors and prospective teachers, and/or teacher leaders and colleagues.

The third tool involves the discussion of the six emergent themes and subsequent presentation of implications. The discussion of the themes and implications could be applied to teacher education programs. The present study developed a deeper understanding of the experience of assisting peers with instructional technology issues, and the new knowledge could inform the efforts of teacher education programs to focus on technical assistance and/or technology leadership.

**Implications**

The findings from this study demonstrate the opportunities that arise when creating a collaborative teacher education program. One way to create a collaborative teacher education program is to focus on fostering and maintaining a prospective teacher-centered environment that emphasizes inquiry and wonderings, much like the PDS research setting in the present study. The PDS program sought to prepare interns to have a disposition and a mindset of continually asking questions around the effectiveness of teaching practices. A teacher education program that can embrace this type of mindset and goal and subsequently support it with resources and tools, including opportunities for peer assistance, has a chance to become a collaborative teacher education program.

Technohubs entered the PDS program having engaged in experiences with technology and assisting peers with technology. Even though it is not possible to modify prior experiences of
prospective teachers, teacher education programs could apply some of the key findings from this theme to develop activities. First, technohubs had ample opportunities to use technology during projects. Teacher education programs could promote student-centered uses of technology throughout the coursework by asking prospective teachers to support their projects with technology. Second, technohubs explored technology on their own. They described “messing,” “playing,” and “fooling around” with tools. Teacher education programs could provide prospective teachers with access to instructional technology and allow them to “play” with the tools. Although it wasn’t discussed in this study, time of play may contribute to how valuable an experience can be. For example, there may be a difference between having a prospective teacher “play” with an iPad for two hours every week versus giving the prospective teacher an iPad to take with them everywhere and “play” with it whenever.

In the following list, I provide three practical examples of exploring technology that could be used by any teacher education program:

- Offer weekly opportunities for prospective teachers to learn about iOS apps that support teaching and learning. This could be described as “Friday App Days” and run by other prospective teachers (e.g., technohubs).

- Help prospective teachers play (and be supported by technology support) long-term with the latest emerging tools (e.g., Swivl Video Recording; Google Glasses; Raspberry Pi). This could be an opportunity for a prospective teacher to use a tool for the duration of a semester, during which she/he could focus on an inquiry or wondering about how the tool could support teaching and learning.

- Instead of offering courses on educational technology separate from practice or teacher-centered workshops on classroom tools (e.g., interactive white boards,
iPads®), teacher education programs could give prospective teachers the experience of observing and recording an authentic teaching practice involving the tool in K-12 education. After the lesson, the K-12 teacher could describe the thoughts and decisions that she/he made throughout the lesson while reflecting on the video with the prospective teachers. This example builds upon ideas from the ACOT program, which involved “observing and learning in real classrooms where teachers could experience firsthand how technology could be integrated into classroom instruction” (Sandholtz, 2001, p. 372), and the Cognitive Apprenticeship Framework (Collins, Brown, & Holum, 1991), where thoughts are made explicit.

Technohubs did have a favorable view of their emergent, organic leadership capacities, but did not view themselves as experts with technology. The implication here speaks to the importance of teacher education programs in the development of prospective teachers’ confidence- and comfort-levels with technology. Also, it may be important to develop leadership capacities in every prospective teacher. The role of a teacher demands that he/she become a leader of students. We could embrace leadership as an important part of teacher education programs.

One technohub, Alice, demonstrated changes in how she viewed instructional technology before and after the PDS. During the process of enculturation into teaching practices (in the PDS), Alice expressed student-centered views of instructional technology, meaning that she understood and promoted meaningful uses of technology to support multiple student viewpoints and instructional goals. Teacher education programs could offer experiences early in their program that will help modify any teacher-centered views of instructional technology. A possible
course that could facilitate this process could follow a field-based Cognitive Apprenticeship Framework that directly spoke against the apprenticeship of observation and teacher-centered views of instructional technology.

Technohubs downplayed the difficulty of issues and deflected praise that was sent their way. In other words, technohubs did not need to be recognized for their efforts. They understood that they were helping others in much the same way that they would want others to help them. Teacher education programs could take this advice when deciding how to reward and identify success stories. A successful technology leadership story may look like a prospective teacher behind the scenes that no one knows about and who prefers to remain anonymous to the administration.

Getting approached involves phone calls, text messages, group projects, and every possible combination in between. Teacher education programs could embrace social networking and communication technologies and view them as appropriate tools (and not disruptive devices). However, technohubs did not go out of their way to offer assistance to peers. Rather, peers approached technohubs and knew whom to “go-to” for assistance. This dynamic, getting approached rather than approaching others, implies that helping others was not a top-down approach. A teacher education program could foster a bottom-up approach to technical assistance by fostering a community of prospective teachers during a teacher education program. This community could take the form of a cohort of prospective teachers that have the same classes together from day one of the program. By creating a coherent community, prospective teachers may know whom to “go-to” because they have known the “technohubs” for 3+ years. This is in contrast to the fractured programs where prospective teachers have different peers in each of their courses.
Peer assistance was related to the technohubs’ prior experiences and philosophical approaches to teaching. For example, while Alice wanted to learn through conversations with peers, Betsy taught in the same way she learned, through explicit step-by-step directions. Chloe helped others by doing a majority of the assistance on her own, similar to what an Information Technology support person might do. If teacher education programs want prospective teachers to offer assistance in similar ways, they could provide opportunities for prospective teachers to think about and modify their apprenticeship of observation early in the program. Further, teacher education programs could facilitate prospective teachers’ changes in philosophical approaches by strongly linking theory to practice. If a course is offered on how students learn, that course could offer field-based experiences in classrooms that demonstrate the desired type of learning theories and practices.

Finally, technohubs exhibited changes in how they approached technology and assisted peers after the PDS program. They demonstrated personal growth, satisfaction with helping others, and a reflection on the role of technology in teaching. This finding demonstrates the value in enabling opportunities for prospective teachers to assist peers with instructional technology issues and to have prospective teachers explore technology on their own.

**Limitations of the Study**

Many of the limitations of the study were presented previously at the end of chapters two and three. For example, in Chapter 2, I discussed limitations with the translations, extensions, and understandings of Vygotsky’s work in the Sociocultural Theory of Learning. In Chapter 3, I drew attention to limitations in my methodological orientation and research methods and techniques. In this section, I will provide a few additional limitations of the study.
One limitation with the study was the timing of the study and collection of data. The study was conducted over one and a half semesters and the interns were followed from the beginning of the PDS program through the middle of their spring “student teaching” experiences. The limitation is in the ability to understand changes in peer assistance with instructional technology issues. The technohubs’ descriptions of peer assistance were collected between August 2012 and April 2013. In an ideal setting, I would use a time-lapse study to follow the technohubs across semesters to understand how the experience of assisting peers developed and changed over the course of the four-year teacher education program. If the goal was increased to understand experiences of peer assistance in beginning teacher induction practices, I could expand the time-lapse to start at freshman year and run through the first three years as a beginning teacher.

Another limitation includes the descriptive emphasis of phenomenological qualitative research and participation selection. The goal of the research was to provide rich descriptions of specific experiences in a highly contextualized environment. Essences of experiences described in this study are specific to interns in a PDS program at the Pennsylvania State University where the socioeconomic and class relations are primarily middle-class Caucasian. Also, the male-female ratio of the sixty interns in the PDS program was 1:59 (males to females). It is not possible to generalize the study to any population for a lot of the reasons described above. Rather, the value of this study lies in the ability to understand the phenomena in a particular context and with a specific population. In other words, although generalizability is not possible, the rich descriptions of the research setting, participants, and phenomenon of interest provide opportunities for transferability to similar contexts and situations.
**Future Research**

There are a few possible avenues for future research based on the discussion of findings from this study. First, because of the conflicting descriptions of identity from the participants, a follow-up study could help to understand the role that identity plays in technohubs’ experiences. A possible research question for this endeavor would be as follows: **How does the identity of a prospective teacher change during the experience of assisting peers with instructional technology issues?**

One of the limitations of this study was around the unit of analysis on the individual. A subsequent study could shift the unit of analysis towards the interaction between the technohub and the peer. In the interest of time and resources, the unit of analysis could still be the individual, but the participant pool could include both technohubs and the peers whom they help during assistance. The possible research questions for this avenue for future research start with the same question from this study and also could include the following: **What is the experience of getting assisted from a peer for an instructional technology issue?**

A third possible avenue for future research involves the information economy. The tensions elaborated on in the theoretical framework suggest that prospective teachers should have experiences in enactment, linking theory to practice. The research setting used in the present study provided the technohubs with opportunities to have experiences in enactment. However, it is unknown to what degree the different members within the professional development program (e.g., teacher educators, PDAs, mentors) played a role in technohubs’ understanding of enactment and experiences with peer assistance. For this reason, an additional line of research could look at technohubs’ experiences in relation to all of the members of a professional
development school. One possible research question for this pursuit could be as follows: **How is technology support shared among the members of a professional development school?**

A final possible avenue for future research could look at how technohubs compare to their peers around notions of computational fluency and information and communication technology skills. A possible question in this research could be as follows: **What are technohubs’ capacities for informal technology leadership?** Although the emphasis on the current study was on using rich description to uncover insights into the experiences of technohubs, future research utilizing mixed methodologies could uncover additional information about technohubs’ capacities and knowledge for peer technical assistance and/or informal technology leadership.
APPENDIX A

SAMPLE INTERVIEW PROTOCOL

Interview 1: Focused Life History

1. How did you come to be involved in the professional development school?
2. How did you get involved in your major, in education?
3. What is your history with using technology and learning technology?
4. What is the earliest you can remember helping someone else with a technology question or support?
5. Can you discuss your activities that you were involved in, high school activities, extracurricular, any type of activities?
6. Were you involved in any activities that used any type of technology?
7. Can you discuss your activities in college prior to the PDS?

Interview 2: The Details of Experience

1. Can you talk about your relationships with other students in the professional development school?
2. Can you reconstruct a day in your professional development school from the moment you woke up until the time you fell asleep?
3. Can you briefly describe a situation where another student in the PDS asked you for help in solving a technology issue? What happened? What did you do?
4. Can you briefly describe a situation where you had difficulty helping another student in the PDS with technology? What happened? Why was it difficult?
5. Who do you go to for advice with technology issues?
6. Can you talk about your experience with giving technology advice to other students in the PDS?
7. Are there any metaphors, stories, or examples that you use to help other students in the PDS with technology issues?

Interview 3: Reflection on the Meaning

1. Given a specific example… What do you think you did well in that situation? What did you think you did not do well in that situation?
2. Why do you help other students in the PDS with technology?
3. How does someone go about helping another student with technology issues?
4. How important is it for you to teach others how to find solutions themselves with technology issues?
5. What do you think is important when helping another student in the PDS with technology issues?
6. What do you think has changed in the way you help others with technology issues since you first started the PDS?
7. Do you consider yourself someone whom others go to for advice with technology? Explain why?
8. How do you understand instructional technology in the professional development school?
9. What does the experience (i.e. assisting peers with instructional technology issues) mean to you?
10. Is there anything else about the experience that you want to talk about?
11. Can you describe any feedback from your instructors about the experience?
12. Do you have plans to maintain relationships you have started in the PDS Interns?
### APPENDIX B

**SAMPLE ANALYSIS PROTOCOL**

<table>
<thead>
<tr>
<th>Alice’s Narrative</th>
<th>Initial Thought-by-Thought Codes</th>
<th>Invariant Constituents</th>
<th>Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>With StudioCode® with (my peer), she's actually really good with technology but</td>
<td>Helps intern solve issue in StudioCode® involving linking movie and codes</td>
<td>Assisting as Technology support</td>
<td>Getting Approached and Offering Forms of Assistance</td>
</tr>
<tr>
<td>she just, she's like always really hesitant to try things. So, she wasn't sure if</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>she had linked her movie up correctly and she didn't want to actually test it out</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>and then she was having trouble, getting her codes to be in time with her, like</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>when she actually saw them, and it was really just a matter of, for one thing, she</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>just needed to link the movie to the timeline and then she also just needed to hit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>the, just on to the live button of like lag 2 seconds or we kind of figured out 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>seconds was actually not enough she needed a little bit more time because she was</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>just hitting it slower. And then also she didn't want to put her whole lesson in,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>she wanted to chunk it up and she didn't know how to do that in StudioCode® which</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I found that when you chunk a video in StudioCode® it's really kind of messy and it</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>doesn't always flow really smoothly. So, I ended up showing her how to cut different</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>segments, from iMovie. And then we moved them into iMovie and then I just said, <strong>you</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>know, just cut them in iMovie and put them together.</strong> Also, I think in Science</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>class she had a question about how to link movies into your Word document and she</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ended up not doing Word® because it was actually, I felt like it was kind of hard.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More difficult than StudioCode® but, she just wasn't</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Sure how to do it in. That was again, you go to insert a movie, and you insert the clip and you can make it smaller, and all that kind of stuff. So, it was just simple things like that where if you don't try it then you don't, you wouldn't know how to do it. (How did she react to your suggestion to, to cut it in iMovie first?) (laughing) She was not happy, she was pretty mad because it was, you know, one more step that she was going to have to take before she could finish it. I think she actually ended up not cutting it, I can't remember if she did, but I showed her how to with a movie that I had on my computer, but yea, she wasn't super happy about that because it was just something extra she had to do. (How did you work through that, when she gave you that first..?) Frustration? (frustration?) I just kind of laughed and I said, yea, I know, it's kind of dumb, but, you know, if the, I didn't, I didn't say this but I didn't know how to explain to her that if, you know, you recorded the movie and it's not in separate, like you recorded it as one continuous piece of time then you have to cut it and there's no way to do that in StudioCode®. So I said, the only way you could is if you do clips. Which she didn't do clips, so, it was, just like, I think she was just frustrated that it wasn't working. (How did she approach you?) We were just talking, I think in the room at lunch, and she was just like, I kinda (sic) don't want to use my whole video, what do I do? and I said, well you have to do this, this, and this, I said, I can show you, and then I just happened to have iMovie open because I had to download, something in Taskstream, and I was like, look, see I have to look at how I'm like cutting this, I like just only need this portion, and she was like, ugh that's so much work.

<table>
<thead>
<tr>
<th>Found peer's issue as something simple that they could try on their own to figure out</th>
<th>Downgrades difficulty of technology issue</th>
<th>Views and Feelings when Assisting Peers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laughed and pointed out software limitations when intern expressed anger and frustration</td>
<td>Assisting as Humor</td>
<td>Getting Approached and Offering Forms of Assistance</td>
</tr>
<tr>
<td>Demonstrated solution to issue using own personal computer and peer expressed how much work it was</td>
<td>Assisting as Demonstration</td>
<td>Getting Approached and Offering Forms of Assistance</td>
</tr>
</tbody>
</table>
The technohub questionnaire included the following five questions:

1. Which prospective teachers do you go to for technology support (e.g., fixing a computer problem, installing a program, connecting to the internet, finding a saved file, etc.)?

☐ Aaliyah ☐ Audrey ☐ Blossom ☐ Carina
☐ Abigail ☐ Autumn ☐ Bonnie ☐ Carly
☐ Addison ☐ Ava ☐ Brenna ☐ Caroline
☐ Alexa ☐ Avery ☐ Bria ☐ Cassidy
☐ Alexandra ☐ Barbara ☐ Brian ☐ Catherine
☐ Alexis ☐ Beatrix ☐ Bridget ☐ Cecilia
☐ Alice ☐ Bella ☐ Brielle ☐ Charlee
☐ Allison ☐ Belle ☐ Brooke ☐ Charlotte
☐ Alyssa ☐ Beth ☐ Brooklyn ☐ Chelsea
☐ Amelia ☐ Betsy ☐ Cadence ☐ Cheyenne
☐ Anna ☐ Bette ☐ Caitlyn ☐ Chloe
☐ Arianna ☐ Beverly ☐ Callie ☐ Christina
☐ Ariel ☐ Bevin ☐ Camila ☐ Claire
☐ Ashlyn ☐ Bianca ☐ Camille ☐ Clara
☐ Aubrey ☐ Blakeley ☐ Camryn ☐ Cora

2. Which prospective teachers do you go to for help and/or advice with instructional technology issues? Instructional technology issues might refer to determining how to use technology resources to support learning goals/outcomes in a lesson, learning how to use a software program like iMovie or StudioCode® for a project, learning how to use a classroom technology like an interactive whiteboard, completing a technology project, etc.

☐ Aaliyah ☐ Audrey ☐ Blossom ☐ Carina
☐ Abigail ☐ Autumn ☐ Bonnie ☐ Carly
☐ Addison ☐ Ava ☐ Brenna ☐ Caroline
☐ Alexa ☐ Avery ☐ Bria ☐ Cassidy
☐ Alexandra ☐ Barbara ☐ Brian ☐ Catherine
☐ Alexis ☐ Beatrix ☐ Bridget ☐ Cecilia
☐ Alice ☐ Bella ☐ Brielle ☐ Charlee
☐ Allison ☐ Belle ☐ Brooke ☐ Charlotte
☐ Alyssa ☐ Beth ☐ Brooklyn ☐ Chelsea
☐ Amelia ☐ Betsy ☐ Cadence ☐ Cheyenne
☐ Anna ☐ Bette ☐ Caitlyn ☐ Chloe
☐ Arianna ☐ Beverly ☐ Callie ☐ Christina
☐ Ariel ☐ Bevin ☐ Camila ☐ Claire
☐ Ashlyn ☐ Bianca ☐ Camille ☐ Clara
☐ Aubrey ☐ Blakeley ☐ Camryn ☐ Cora
3. Which people in the social studies methods course do you go to for help and/or advice with instructional technology issues that occur in the course?

| ☐ Aaliyah | ☐ Audrey | ☐ Blossom | ☐ Carina |
| ☐ Abigail | ☐ Autumn | ☐ Bonnie | ☐ Carly |
| ☐ Addison | ☐ Ava | ☐ Brenna | ☐ Caroline |
| ☐ Alexa | ☐ Avery | ☐ Bria | ☐ Cassidy |
| ☐ Alexandra | ☐ Barbara | ☐ Brian | ☐ Catherine |
| ☐ Alexis | ☐ Beatrix | ☐ Bridget | ☐ Cecilia |
| ☐ Alice | ☐ Bella | ☐ Brielle | ☐ Charlee |
| ☐ Allison | ☐ Belle | ☐ Brooke | ☐ Charlotte |
| ☐ Alyssa | ☐ Beth | ☐ Brooklyn | ☐ Chelsea |
| ☐ Amelia | ☐ Betsy | ☐ Cadence | ☐ Cheyenne |
| ☐ Anna | ☐ Bette | ☐ Caitlyn | ☐ Chloe |
| ☐ Arianna | ☐ Beverly | ☐ Callie | ☐ Christina |
| ☐ Ariel | ☐ Bevin | ☐ Camila | ☐ Claire |
| ☐ Ashlyn | ☐ Bianca | ☐ Camille | ☐ Clara |
| ☐ Aubrey | ☐ Blakeley | ☐ Camryn | ☐ Cora |

4. Which people in the science methods course do you go to for help and/or advice with instructional technology issues that occur in the course?

| ☐ Aaliyah | ☐ Audrey | ☐ Blossom | ☐ Carina |
| ☒ Abigail | ☐ Autumn | ☐ Bonnie | ☐ Carly |
| ☐ Addison | ☐ Ava | ☐ Brenna | ☐ Caroline |
| ☒ Alexa | ☐ Avery | ☐ Bria | ☐ Cassidy |
| ☐ Alexandra | ☐ Barbara | ☐ Brian | ☐ Catherine |
| ☐ Alexis | ☐ Beatrix | ☐ Bridget | ☐ Cecilia |
| ☐ Alice | ☐ Bella | ☐ Brielle | ☐ Charlee |
| ☐ Allison | ☐ Belle | ☐ Brooke | ☐ Charlotte |
| ☐ Alyssa | ☐ Beth | ☐ Brooklyn | ☐ Chelsea |
| ☐ Amelia | ☐ Betsy | ☐ Cadence | ☐ Cheyenne |
| ☐ Anna | ☐ Bette | ☐ Caitlyn | ☐ Chloe |
| ☐ Arianna | ☐ Beverly | ☐ Callie | ☐ Christina |
| ☐ Ariel | ☐ Bevin | ☐ Camila | ☐ Claire |
| ☐ Ashlyn | ☐ Bianca | ☐ Camille | ☐ Clara |
| ☐ Aubrey | ☐ Blakeley | ☐ Camryn | ☐ Cora |
5. Whom in the mathematics methods course do you go to for help and/or advice with instructional technology issues that occur in the course?

| ☐ Aaliyah   | ☐ Audrey   | ☐ Blossom   | ☐ Carina |
| ☐ Abigail  | ☐ Autumn   | ☐ Bonnie    | ☐ Carly  |
| ☐ Addison | ☐ Ava      | ☐ Brenna    | ☐ Caroline |
| ☐ Alexa    | ☐ Avery    | ☐ Bria      | ☐ Cassidy |
| ☐ Alexandra | ☐ Barbara | ☐ Brian     | ☐ Catherine |
| ☐ Alexis   | ☐ Beatrix  | ☐ Bridget   | ☐ Cecilia |
| ☐ Alice    | ☐ Bella    | ☐ Brielle   | ☐ Charlee |
| ☐ Allison  | ☐ Belle    | ☐ Brooke    | ☐ Charlotte |
| ☐ Alyssa   | ☐ Beth     | ☐ Brooklyn  | ☐ Chelsea |
| ☐ Amelia   | ☒ Betsy    | ☐ Cadence   | ☐ Cheyenne |
| ☐ Anna     | ☐ Bette    | ☐ Caitlyn   | ☐ Chloe   |
| ☐ Arianna  | ☐ Beverly  | ☐ Callie    | ☐ Christina |
| ☐ Ariel    | ☐ Bevin    | ☐ Camila    | ☐ Claire  |
| ☐ Ashlyn   | ☐ Bianca   | ☐ Camille   | ☐ Clara   |
| ☒ Aubrey   | ☐ Blakeley | ☐ Camryn    | ☒ Cora    |
APPENDIX D

RELATIONSHIPS AMONG TECHNOHUBS

In Appendix D, I compare individual technohubs’ experiences using descriptive data from the invariant constituents. I use tables to split the constituents by theme and discuss similarities and differences among the technohubs. The section is divided into six subsections to discuss themes one at a time.

It is important to note here that I include all of the invariant constituents in the tables, even the constituents that have few occurrences in the data, or are present in only one of the technohubs’ experiences. The rationale for including all of the invariant constituents even those that occur sparingly in the transcripts is based on the goal and nature of qualitative analysis. Qualitative analysis involves the valuation of every constituent with equal weight, regardless of how many times a particular constituent occurs in the data.

Theme 1: Collaborative Nature of the Teacher Education Program

For the first theme, I list each individual invariant constituent in the left column of Table D-1, and I provide the number of times that invariant constituent was coded for each technohub. I provide the number of times the constituents were coded to demonstrate the similarities and differences among technohubs. I include the corresponding percentages of coded constituents based on each technohub’s total invariant constituents to draw comparisons among participants.
Table D-1: Invariant Constituents for Theme 1.

<table>
<thead>
<tr>
<th>Invariant Constituent</th>
<th>Alice</th>
<th>Betsy</th>
<th>Chloe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gets help from others in the PDS</td>
<td>7</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>43.75%</td>
<td>83.33%</td>
<td>88.89%</td>
</tr>
<tr>
<td>Provides reason for entering PDS</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>6.25%</td>
<td>8.33%</td>
<td>11.11%</td>
</tr>
<tr>
<td>Group cohesiveness of PDS</td>
<td>8</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>50.00%</td>
<td>8.33%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Total Invariant Constituents</td>
<td>16</td>
<td>12</td>
<td>9</td>
</tr>
</tbody>
</table>

During her interview, Alice discussed the group cohesiveness of the PDS (50.00% of coded constituents) and whom she went to for help within the PDS (43.75%) when discussing the PDS program. Betsy also described the group cohesiveness of the PDS, but it was only a small percentage of the interview (8.33% of coded constituents), while Chloe did not discuss the PDS in that way. Betsy and Chloe spent a majority of the interview discussing to whom they went for help in the PDS (83.33% for Betsy and 88.89% for Chloe), demonstrating the collaborative nature of the PDS.

**Theme 2: Prior Experience Assisting Peers**

Theme two is comprised of Alice, Betsy and Chloe discussing prior experiences assisting peers and learning technology before they began the teacher education program and professional development school (see Table D-2). All three technohubs demonstrated that they learned technology in school during their childhood (11.11% for Alice; 50% for Betsy; and 45.45% for Chloe) and that they helped a peer learn how to use a tool prior to their teacher education program (16.67% for Alice; 50% for Betsy; and 9.09% for Chloe). Alice also described changes
in her technology interest (22.22% of coded constituents), and previous feelings associated with using technology (22.22%) and assisting others (16.67%). Alice was the only technohub who vocalized a previous lack of confidence with her own technology savvy-ness before the PDS program began (5.56% of coded constituents). Chloe also discussed experiences where she helped support others with a technology issue (27.27% of coded constituents), and Chloe was the only technohub who mentioned prior experiences learning technology outside of school (9.09%).

Table D-2: Invariant Constituents for Theme 2.

<table>
<thead>
<tr>
<th>Invariant Constituent</th>
<th>Alice</th>
<th>Betsy</th>
<th>Chloe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coded %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learn technology in school</td>
<td>2 11.11%</td>
<td>2 50.00%</td>
<td>5 45.45%</td>
</tr>
<tr>
<td>Learn technology outside school</td>
<td>0 0.00%</td>
<td>0 0.00%</td>
<td>1 9.09%</td>
</tr>
<tr>
<td>Previous experience teaching a tool</td>
<td>3 16.67%</td>
<td>2 50.00%</td>
<td>1 9.09%</td>
</tr>
<tr>
<td>Previous experience with technology support</td>
<td>0 0.00%</td>
<td>0 0.00%</td>
<td>3 27.27%</td>
</tr>
<tr>
<td>Previous change in technology interest</td>
<td>4 22.22%</td>
<td>0 0.00%</td>
<td>1 9.09%</td>
</tr>
<tr>
<td>Previous feelings associated with using and learning technology</td>
<td>4 22.22%</td>
<td>0 0.00%</td>
<td>0 0.00%</td>
</tr>
<tr>
<td>Previous feelings associated with assisting another</td>
<td>3 16.67%</td>
<td>0 0.00%</td>
<td>0 0.00%</td>
</tr>
<tr>
<td>Previous lack of confidence with technology savvy-ness</td>
<td>1 5.56%</td>
<td>0 0.00%</td>
<td>0 0.00%</td>
</tr>
<tr>
<td>Previously approached by others between projects</td>
<td>1 5.56%</td>
<td>0 0.00%</td>
<td>0 0.00%</td>
</tr>
<tr>
<td>Total Invariant Constituents</td>
<td>18</td>
<td>4</td>
<td>11</td>
</tr>
</tbody>
</table>
Theme 3: Learning and Familiarity with Tools

Theme three involves learning technology on one’s own, in methods courses, in PDS trainings, in groups, and with family. The theme also provides a first glimpse of why our technohubs might be in a position to help their peers because of a familiarity that they have with the tools that are used during coursework and other education experiences. Table D-3 provides an overview of the differences among technohubs in their types of learning experiences around technology tools.

Table D-3: Invariant Constituents for Theme 3.

<table>
<thead>
<tr>
<th>Invariant Constituent</th>
<th>Alice</th>
<th></th>
<th>Betsy</th>
<th></th>
<th>Chloe</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coded</td>
<td>%</td>
<td>Coded</td>
<td>%</td>
<td>Coded</td>
<td>%</td>
</tr>
<tr>
<td>Explores tool on own</td>
<td>5</td>
<td>50.00%</td>
<td>1</td>
<td>7.69%</td>
<td>5</td>
<td>62.50%</td>
</tr>
<tr>
<td>Learns technology in methods courses</td>
<td>1</td>
<td>10.00%</td>
<td>3</td>
<td>23.08%</td>
<td>2</td>
<td>25.00%</td>
</tr>
<tr>
<td>Learns technology in PDS technology training</td>
<td>0</td>
<td>0.00%</td>
<td>2</td>
<td>15.38%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Learns instructional technology in PDS</td>
<td>0</td>
<td>0.00%</td>
<td>1</td>
<td>7.69%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Familiarity with tool prior to assistance</td>
<td>2</td>
<td>20.00%</td>
<td>3</td>
<td>23.08%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Not familiar with tool prior to assistance</td>
<td>0</td>
<td>0.00%</td>
<td>1</td>
<td>7.69%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Stumbling across technology solutions</td>
<td>1</td>
<td>10.00%</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Group learning</td>
<td>1</td>
<td>10.00%</td>
<td>1</td>
<td>7.69%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Gets help from family</td>
<td>0</td>
<td>0.00%</td>
<td>1</td>
<td>7.69%</td>
<td>1</td>
<td>12.50%</td>
</tr>
<tr>
<td>Total Invariant Constituents</td>
<td>10</td>
<td></td>
<td>13</td>
<td></td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>
Alice often explored tools on her own (50% of coded constituents) and had familiarity with many of the tools prior to assistance (20%). Alice identified learning as part of a group (10%), and in methods courses (10%). Later in our interview, Alice mentioned that she found herself stumbling across technology solutions (10%).

Betsy was more intentional with her technology learning, with 46.15% of coded constituents (combining three codes: learns technology in methods courses; in PDS training; and learns instructional technology in PDS) corresponding with formal learning, compared to informal learning: exploring a tool on her own (7.69% of coded constituents), learning as part of a group (7.69%), and getting help from a family member (7.69%). Like Alice, Betsy had familiarity with many of the tools she was using in her courses (23.08% of coded constituents), but Betsy mentioned that she found herself helping a peer with a tool that she might not have been familiar with (7.69%). Chloe overwhelmingly explored a tool on her own (62.5% of coded constituents). Although Chloe learned technology in methods courses and got help from family members, these areas were much smaller percentages of the invariant constituents during our interview (25% for methods courses and 12.5% for getting help from family).

Theme 4: Views and Feelings when Assisting Peers

In theme four, the technohubs provided descriptions of their views and feelings when assisting peers during the professional development school. As demonstrated in Table D-4, the most popular views that technohubs discussed were a view of technology integration (60.71% for Alice; 30% for Betsy; and 30.77% for Chloe) and their own expertise with technology and instructional technology (17.86% for Alice; 35% for Betsy; and 15.38% for Chloe).
Table D-4: Invariant Constituents for Theme 4: Views when Assisting Peers.

<table>
<thead>
<tr>
<th>Invariant Constituent</th>
<th>Alice</th>
<th>Betsy</th>
<th>Chloe</th>
</tr>
</thead>
<tbody>
<tr>
<td>View of technology integration</td>
<td>17 60.71%</td>
<td>6 30.00%</td>
<td>8 30.77%</td>
</tr>
<tr>
<td>View of own expertise</td>
<td>5 17.86%</td>
<td>7 35.00%</td>
<td>4 15.38%</td>
</tr>
<tr>
<td>View of teacher leaders</td>
<td>4 14.29%</td>
<td>2 10.00%</td>
<td>1 3.85%</td>
</tr>
<tr>
<td>View of intern leaders</td>
<td>2 7.14%</td>
<td>1 5.00%</td>
<td>1 3.85%</td>
</tr>
<tr>
<td>View of leadership</td>
<td>0 0.00%</td>
<td>0 0.00%</td>
<td>1 3.85%</td>
</tr>
<tr>
<td>View of PDS</td>
<td>0 0.00%</td>
<td>0 0.00%</td>
<td>3 11.54%</td>
</tr>
<tr>
<td>Reason for assisting others in PDS</td>
<td>0 0.00%</td>
<td>4 20.00%</td>
<td>4 15.38%</td>
</tr>
<tr>
<td>Reason for leading group project</td>
<td>0 0.00%</td>
<td>0 0.00%</td>
<td>4 15.38%</td>
</tr>
<tr>
<td><strong>Total Invariant Constituents</strong></td>
<td>28</td>
<td>20</td>
<td>26</td>
</tr>
</tbody>
</table>

All three technohubs discussed their view of teacher and intern leaders, and how their own expertise fit into this view. Chloe included a description of her view on leadership in general (3.85% of coded constituents), her view of the professional development school (11.54%), and her reason for leading group projects (15.38%). Chloe and Betsy also gave reasons for assisting others in the PDS (15.38% for Chloe and 20% for Betsy).

I provide an overview in Table D-5 of the similarities and differences among the feelings that the three technohubs had when assisting peers. There is a similarity across technohubs in feelings associated with assisting another (43.9% for Alice; 37.5% for Betsy; and 46.67% for Chloe).

Differences are observed around a sense of technology savvy-ness. For Alice and Betsy, a lack of confidence with technology savvy-ness during the PDS program took up a sizeable
percentage of their invariant constituents (19.51% for Alice and 25% for Betsy) while Chloe did not demonstrate a lack of confidence with technology savvy-ness. In fact, parts of Chloe’s interview led one to believe that she had a positive sense of her own technology savvy-ness given the fact that her feelings associated with employment (6.67% of coded constituents) involved feeling “undermined” (PDSChloe-2_76:05) at the off-campus tutoring program. She felt like she “could be doing a lot more with the computers there” (PDSChloe-2_76:05).

Table D-5: Invariant Constituents for Theme 4: Feelings when Assisting Peers.

<table>
<thead>
<tr>
<th>Invariant Constituent</th>
<th>Alice</th>
<th></th>
<th>Betsy</th>
<th></th>
<th>Chloe</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coded</td>
<td>%</td>
<td>Coded</td>
<td>%</td>
<td>Coded</td>
<td>%</td>
</tr>
<tr>
<td>Lack of confidence with technology savvy-ness</td>
<td>8</td>
<td>19.51%</td>
<td>2</td>
<td>25.00%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Downgrades difficulty of technology issue</td>
<td>8</td>
<td>19.51%</td>
<td>2</td>
<td>25.00%</td>
<td>2</td>
<td>13.33%</td>
</tr>
<tr>
<td>Feelings associated with assisting another</td>
<td>18</td>
<td>43.90%</td>
<td>3</td>
<td>37.50%</td>
<td>7</td>
<td>46.67%</td>
</tr>
<tr>
<td>Feelings associated with using and learning technology</td>
<td>2</td>
<td>4.88%</td>
<td>1</td>
<td>12.50%</td>
<td>1</td>
<td>6.67%</td>
</tr>
<tr>
<td>Feelings associated with technology integration</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
<td>2</td>
<td>13.33%</td>
</tr>
<tr>
<td>Feelings associated with the PDS</td>
<td>4</td>
<td>9.76%</td>
<td>0</td>
<td>0.00%</td>
<td>2</td>
<td>13.33%</td>
</tr>
<tr>
<td>Feelings associated with employment</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
<td>1</td>
<td>6.67%</td>
</tr>
<tr>
<td>Feelings associated with inservice teachers</td>
<td>1</td>
<td>2.44%</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td><strong>Total Invariant Constituents</strong></td>
<td><strong>41</strong></td>
<td></td>
<td><strong>8</strong></td>
<td></td>
<td><strong>15</strong></td>
<td></td>
</tr>
</tbody>
</table>
All three technohubs downgraded the difficulty of technology issues they encountered (19.51% for Alice; 25% for Betsy; and 13.33% for Chloe) and had feelings associated with using and learning technology (4.88% for Alice; 12.5% for Betsy; 6.67% for Chloe). Alice and Chloe had feelings associated with the PDS (9.76% for Alice; 13.33% for Chloe). In addition, Alice had feelings about inservice teachers (2.44% of coded constituents) and Chloe had feelings about technology integration (13.33% of coded constituents).

**Theme 5: Getting Approached and Offering Forms of Assistance**

In theme five, technohubs discussed getting approached by their peers (Table D-6) and offering types of assistance (Table D-7). Technohubs discussed getting approached by their peers in numerous ways. Alice was approached the most via text messages (33.33% of coded constituents). She also mentioned getting approached late at night (8.33%), which is when she would receive a lot of text messages from peers desperate for help.

Betsy was approached equally from phone calls, by a peer that knew she had finished a project, or at her PDS elementary school (each 25% of coded constituents). Chloe was approached the most at her PDS elementary school (40% of coded constituents). All of the technohubs were approached either while working individually on a project, working in a group project, or after finishing a project (16.67% for Alice; 37.5% for Betsy; and 40% for Chloe, when combining the three invariant constituents). Chloe also discussed not approaching anyone (20% of coded constituents) because she did not recall seeing anyone frustrated during the methods courses.
Table D-6: Invariant Constituents for Theme 5: Getting Approached.

<table>
<thead>
<tr>
<th>Invariant Constituent</th>
<th>Alice</th>
<th>Betsy</th>
<th>Chloe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coded</td>
<td>%</td>
<td>Coded</td>
</tr>
<tr>
<td>Approached while working on project</td>
<td>2</td>
<td>16.67%</td>
<td>1</td>
</tr>
<tr>
<td>Approached through conversation</td>
<td>1</td>
<td>8.33%</td>
<td>1</td>
</tr>
<tr>
<td>Approached during study session</td>
<td>2</td>
<td>16.67%</td>
<td>0</td>
</tr>
<tr>
<td>Approached in group project</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
</tr>
<tr>
<td>Approached after finishing project</td>
<td>0</td>
<td>0.00%</td>
<td>2</td>
</tr>
<tr>
<td>Approached at school</td>
<td>0</td>
<td>0.00%</td>
<td>2</td>
</tr>
<tr>
<td>Approached late at night</td>
<td>1</td>
<td>8.33%</td>
<td>0</td>
</tr>
<tr>
<td>Approached via text message</td>
<td>4</td>
<td>33.33%</td>
<td>0</td>
</tr>
<tr>
<td>Approached via phone call</td>
<td>0</td>
<td>0.00%</td>
<td>2</td>
</tr>
<tr>
<td>Approached through humor</td>
<td>2</td>
<td>16.67%</td>
<td>0</td>
</tr>
<tr>
<td>Did not approach anyone</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Invariant Constituents</strong></td>
<td><strong>12</strong></td>
<td>8</td>
<td><strong>5</strong></td>
</tr>
</tbody>
</table>

Alice was approached while working individually during a group study session at a local grocery store/restaurant (16.67% of coded constituents). This finding fits well with the group cohesiveness mentioned in theme one because it identifies a meeting of interns outside of methods courses. Alice also was approached after teasing a peer led to questions about a project (16.67% of coded constituents) demonstrating the type of relationships she had formed with other interns.
In Table D-7, all of the invariant constituents for offering types of assistance are listed by the number of times coded for each technohub. The findings suggest that there are a lot of differences in how technohubs provide assistance. For example, Alice spent a majority of her assistance in back-and-forth conversations with a peer (41.18% of coded constituents) and spent considerably less time demonstrating (13.73%) and supporting an issue (15.69%). Betsy, on the other hand, spent the majority of her assistance demonstrating what she did (20.59% of coded constituents) and teaching a feature of a tool (17.65%), with providing explicit directions to solve an issue (11.76%) and having a conversation (11.76%) close behind demonstration and teaching. Although Chloe spent the most of her time assisting in conversation form (17.65% of coded constituents), she also used demonstration (14.71%), exploration/troubleshooting (14.71%), and teaching a feature of a tool (11.76%) almost as much.

Other types of assistance, that have yet to be mentioned, included assisting as teaching to help peers help themselves (7.84% for Alice; 2.94% for Betsy; 8.82% for Chloe), assisting as leading a group project (3.92% for Alice; 5.88% for Betsy; 2.94% for Chloe), assisting during group work (8.82% for Betsy; 5.88% for Chloe), assisting as meeting them on their level (5.88% for Alice; 2.94% for Betsy), assisting as reassuring another of an answer (1.96% for Alice; 5.88% for Chloe), assisting as scaffolding another (5.88% for Betsy), assisting as humor (1.96% for Alice), assisting as inquiry (1.92% for Alice), assisting as individualized support (2.94% for Chloe), helping family (2.94% for Chloe), and assisting by teaching a tool turns into having a conversation (1.96% for Alice; 2.94% for Betsy).
Table D-7: Invariant Constituents for Theme 5: Offering Forms of Assistance.

<table>
<thead>
<tr>
<th>Invariant Constituent</th>
<th>Alice</th>
<th></th>
<th>Betsy</th>
<th></th>
<th>Chloe</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coded</td>
<td>%</td>
<td>Coded</td>
<td>%</td>
<td>Coded</td>
<td>%</td>
</tr>
<tr>
<td>Assisting as Conversation</td>
<td>21</td>
<td>41.18%</td>
<td>4</td>
<td>11.76%</td>
<td>6</td>
<td>17.65%</td>
</tr>
<tr>
<td>Assisting as Conversation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assisting as Demonstration</td>
<td>7</td>
<td>13.73%</td>
<td>7</td>
<td>20.59%</td>
<td>5</td>
<td>14.71%</td>
</tr>
<tr>
<td>Assisting as Technology Support</td>
<td>8</td>
<td>15.69%</td>
<td>3</td>
<td>8.82%</td>
<td>2</td>
<td>5.88%</td>
</tr>
<tr>
<td>Assisting as Teaching to help themselves</td>
<td>4</td>
<td>7.84%</td>
<td>1</td>
<td>2.94%</td>
<td>3</td>
<td>8.82%</td>
</tr>
<tr>
<td>Assisting as Leading group project</td>
<td>2</td>
<td>3.92%</td>
<td>2</td>
<td>5.88%</td>
<td>1</td>
<td>2.94%</td>
</tr>
<tr>
<td>Assisting as Providing explicit directions</td>
<td>0</td>
<td>0.00%</td>
<td>4</td>
<td>11.76%</td>
<td>2</td>
<td>5.88%</td>
</tr>
<tr>
<td>Assisting during Group work</td>
<td>0</td>
<td>0.00%</td>
<td>3</td>
<td>8.82%</td>
<td>2</td>
<td>5.88%</td>
</tr>
<tr>
<td>Assisting as Meeting another on their level</td>
<td>3</td>
<td>5.88%</td>
<td>1</td>
<td>2.94%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Assisting as Reassurance</td>
<td>1</td>
<td>1.96%</td>
<td>0</td>
<td>0.00%</td>
<td>2</td>
<td>5.88%</td>
</tr>
<tr>
<td>Assisting as Exploration/Troubleshooting</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
<td>5</td>
<td>14.71%</td>
</tr>
<tr>
<td>Assisting as Scaffoldung</td>
<td>0</td>
<td>0.00%</td>
<td>2</td>
<td>5.88%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Assisting as Humor</td>
<td>1</td>
<td>1.96%</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Assisting as Inquiry</td>
<td>1</td>
<td>1.96%</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Assisting as Individual technology support</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
<td>1</td>
<td>2.94%</td>
</tr>
<tr>
<td>Assisting as Individual technology support</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
<td>1</td>
<td>2.94%</td>
</tr>
<tr>
<td>Helping family</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
<td>1</td>
<td>2.94%</td>
</tr>
<tr>
<td>Teaching a tool turns into conversation</td>
<td>1</td>
<td>1.96%</td>
<td>1</td>
<td>2.94%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Total Invariant Constituents</td>
<td>51</td>
<td></td>
<td>34</td>
<td></td>
<td>34</td>
<td></td>
</tr>
</tbody>
</table>
Theme 6: Personal Changes Associated with Assisting Peers

In theme six, the three technohubs described a change in confidence with technology after assisting another (57.14% for Alice; 20% for Betsy; and 66.67% for Chloe) as shown in Table D-8. After assisting peers, Alice reflected and changed how she provided assistance (42.86% of coded constituents) compared to 10% for Betsy and 0% for Chloe. Betsy demonstrated a change in view of technology integration (30% of coded constituents) and instructional technology (40%). Chloe demonstrated a change in view of technology integration (16.67% of coded constituents) and change associated with the PDS (16.67%) after assisting peers with instructional technology issues.

Table D-8: Invariant Constituents for Theme 6.

<table>
<thead>
<tr>
<th>Invariant Constituent</th>
<th>Alice</th>
<th>Betsy</th>
<th>Chloe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coded</td>
<td>%</td>
<td>Coded</td>
</tr>
<tr>
<td>Changes in confidence with technology</td>
<td>8</td>
<td>57.14%</td>
<td>2</td>
</tr>
<tr>
<td>Changes in how to assist another</td>
<td>6</td>
<td>42.86%</td>
<td>1</td>
</tr>
<tr>
<td>Changes in view of technology integration</td>
<td>0</td>
<td>0.00%</td>
<td>3</td>
</tr>
<tr>
<td>Changes in use of instructional technology</td>
<td>0</td>
<td>0.00%</td>
<td>4</td>
</tr>
<tr>
<td>Changes associated with the PDS</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
</tr>
<tr>
<td>Total Invariant Constituents</td>
<td>14</td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>
REFERENCES


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MICHAEL MONTALTO ROOK

EDUCATION

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*Saint Michael Elementary School, Loretto, PA*

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SELECTED HONORS

Cochran Intern, ECT Foundation 2010
*Association for Educational Communications and Technology*

Paul W. Welliver Outstanding Graduate Student Award 2010
*Pennsylvania Association for Educational Communications and Technology*