ABSTRACT

The Acquisition of Electronic Portfolio Support Staff Expertise: A Theoretical Model

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The purpose of this qualitative case study was to investigate the different methods in which electronic portfolio support staff acquired their expertise. In this study, five electronic portfolio support staff members served as a purposeful sample for analysis. Data were gathered over the course of one semester using individual and group observations, interviews with each study participants, demographic information, narrative prompts, and concept maps. Data were collected from each of the data sources and analyzed using NVIVO 8. Data were then categorized into thirteen different behavioral categories of expertise taken based on the literature. Further analysis revealed four predominant themes of expertise that were observed from each research participant: (a) domain knowledge, (b) performance, (c) problem solving, (d) deliberate practice in the domain over time, and (e) participation in a learning community. Next, a cross-case analysis was used to study the similarities and differences in the experience of each study participant in their journey to acquire electronic portfolio expertise and knowledge. Findings from the within and across case studies indicated that direct experience with the electronic portfolio was a major contributor of acquisition of expertise for each of the

research participants. Domain performance tended to improve as the electronic portfolio support staff member acquired more domain experience through deliberate practice over time. Findings also indicated that problem solving skills improved through direct interaction with the electronic portfolio and through observation of more advanced electronic portfolio support staff members. Within the context of a learning community, the factors of domain knowledge, performance, problem solving, deliberate practice over time, and preservice teacher relationships interacted with one another in producing electronic portfolio expertise.

The Acquisition of Electronic Portfolio Support Staff Expertise: A Theoretical Model

by

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A Dissertation

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GLOSSARY

1. Electronic Portfolio – An online collection of preservice teacher artifacts representing the pedagogical knowledge and skills gained during undergraduate education.
2. Domain – An environment, discipline, or subject matter containing knowledge that an individual seeks to master.
3. Expertise – One who has acquired special skills in or knowledge of a particular subject through professional training and practical experience (Webster, 1976).
4. Learning Community – A group of individuals that share an interest, craft, or profession and work together to further develop the domain.
5. Electronic Portfolio Support Staff Member – The individuals responsible for supporting the electronic portfolio system.
6. Domain Knowledge – The complete body of knowledge that represents a discipline or subject matter
7. Performance – The ability to perform domain related tasks
8. Problem Solving – The skills and strategies used to define the nature and extent of problem and generate a solution to solve the issue
9. Deliberate Practice – A mechanism of acquiring expertise through mastery of ever increasingly difficult activities that an individual must overcome to continue to build expertise.

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CHAPTER ONE

Introduction

Assessment is defined as using multiple methods to understand the overall process of how a goal is reached (Maloney and Ward, 1976). The purpose of assessment is not only to indentify an individual's success in achieving the end goal but also to determine how an individual achieves a specific goal (Cohen & Swerdlik, 2005). Several different techniques are available to the examiner that may be used to gather assessment data. The examiner has the option to use techniques such as formal testing, observations, questionnaires, and interviewing to gather data to answer questions of interest. The type of assessment technique will vary based on the needs of the participants and the assessment environment.

Assessment in Higher Education

In American higher education, the university system uses multiple types of assessment depending on the outcome and the subject area (Hernon, Dugan, & Schwartz, 2004). Typically, faculty members of a university system will use traditional assessment as the typical method to evaluate student performance. Traditional assessment can be defined as an activity that measures one specific outcome for an individual (Montgomery, 2001). This type of student assessment at the university level can involve a norm-referenced measure applied to a large group of students or can be developed by individual professors wanting to measure a specific course outcome (Courts & McInerney, 1993). Traditional assessment uses instruments such as multiple choice tests, which require students to show the knowledge they have learned in class and apply the knowledge to test questions. It typically uses a forced choice instrument such as a multiple choice test, true false, or fill in the blank test to measure student knowledge or skill (Mueller, 2006). The SAT and the ACT, prime examples of this type of assessment, can be used at local, state, and national levels to compare students' performance with others who took the same test. Traditional assessments are somewhat limited in scope because they only provide an evaluation of student performance at one point in time. Critics of these assessment methods argue that traditional assessment practices do not provide a holistic representation of student learning (Kohn, 2000). While traditional assessment is still highly used in the higher education environment, other forms of assessment are available that place the knowledge and skills in a context where it will be used and provide the instructor with a deeper understanding of the student's performance.

Alternative Assessment

Because of the limitations of traditional assessments, another type of assessment, becoming more predominant in higher education, is alternative assessment. Also known as performance and direct assessment, alternative assessment is a task-driven method of assessment that allows a student to demonstrate mastery in a particular content area. The focus of alternative assessment is to evaluate a student's performance on a given task that uses the student's learned knowledge and skills in a realistic setting (Montgomery, 2001). Examples of alternative assessments include: exhibits, writing assignments, reflections, journals, and portfolios (Herman, Aschbacher, & Winters, 1992; Serafini, 2001; Valencia, 1998).

Rather than students simply recalling facts or concepts to answer a test question, instructors using an alternative assessment provide a student-structured task or problem that forces students to create a product or solution with the knowledge and skills learned in their coursework. The student-structured nature of the task allows the student to construct and apply their knowledge and skills in a meaningful way that can illustrate the depth of a student's learning (Newmann, Secada, & Wehlage, 1995). Alternative assessments are also helpful for a dynamic view of the student's learning, rather than a single snapshot of performance. Moreover, alternative assessment is a useful method to evaluate student performance because it provides students with the opportunity to showcase their skills and problem solve in a realistic environment. Using alternative assessment in conjunction with traditional assessment provides a more complete picture of evaluating student performance it its entirety.

The Portfolio in Higher Education

One of the more prominent forms of alternative assessments used in higher education today is the portfolio. The portfolio is a compilation of documents, pictures, art work, and projects that can demonstrate the level of growth is a skill set or knowledge base over a period of time. The portfolio is a performance measure that allows the student to choose the content of the portfolio and arrange the content in such a way that it can display growth in a particular skill set or knowledge and also demonstrate the range of skills that a student possesses (Kohn, 2000).

Multiple disciplines within academia have embraced the idea of using the portfolio as a performance assessment beginning in the mid 1990s (Donnelly, 2005). The portfolio is used in many disciplines within higher education because it could be used to showcase a student's knowledge and skills within a specific domain. The portfolio is also used as a method of assessment to gauge a student's growth in a subject matter over a period of time. Among the disciplines using a portfolio are: teacher education, nursing, business, engineering, and individual faculty members (Bartlett & Sherry, 2006; Ashleman, Dorsey-Gaines, & Glover-Dorsey, 1997; Zalatan, 2001; Fleak, Romine, & Gilchrist, 2003; Scott & Plumb, 2003).

The portfolio has become one of the main types of methods used to assess pre-service teachers in higher education (Grier, Denney, & Clark, 2006). Instructors of pre-service teachers assign the portfolio to their students because it allows pre-service teachers to reflect on the growth and development of their teaching skills and abilities during the pre-service teacher's undergraduate career (Bintz & Shake, 2005). The pre-service teacher's portfolio may also serve as a showcase to potential employers for the skills and knowledge the pre-service teacher acquired during their undergraduate career (Campbell, Cignetti, Melenyzer, Nettles, & Wyman, 2001; Mosely, 2005).

The Electronic Portfolio in Higher Education

With the inception of No Child Left Behind, federal and state governments called for a higher level of accountability from programs training the next generation of teachers. Many of the higher education institutions across the United States use the portfolio as a device to satisfy the accreditation requirements put forth by the government or license granting institutions such as the National Council for the Accreditation of Teacher Education (Wetzel & Strudler, 2005a or b; Thomas, Lamson, & King, 2001). The pre-service teacher's portfolios are used as evidence to demonstrate fulfillment of accreditation requirements**.** The portfolio serves as an alternate method of assessment for a variety of disciplines in higher academia including the field of teacher education.

The availability of technology in higher education institutions provides faculty and students with the opportunity to create electronic portfolios. The electronic portfolio is defined by Kilbane and Milman (2003) as a "…digital teaching portfolio, professional materials, [that] are presented using a combination of multimedia technologies, including, but not limited to, audio recordings; hypermedia programs; and database, spreadsheet, video, and word processing software" (p. 7). The electronic portfolio simply takes the content from a traditional paper portfolio and places the material within a digital media.

In teacher education, pre-service teachers are assigned the task of creating and maintaining a portfolio over a period of time. For the paper portfolio, pre-service teachers collect artifacts that demonstrate a skill or exemplify knowledge that aligns with the purpose of the portfolio. Pre-service teachers using an electronic portfolio duplicate the collection of artifacts process and then digitize the artifacts to be inserted within the electronic portfolio. The electronic portfolio content is managed and stored entirely online for viewing by various stakeholders such as potential employers, pre-service teachers, and evaluators (Lambert, DePaepe, Lambert, & Anderson, 2007). The success of maintaining an electronic portfolio system relies heavily on a well developed technological infrastructure framework. Oftentimes, the electronic portfolio faces a large amount of technological issues that can undermine the potential success of the assessment tool.

Issues in Implementing Portfolio Assessment

Before the technology was available to create and implement electronic portfolios, the use of a paper portfolio was a standard format for students to display a range of work in a particular arena. However, as a medium of conveying information, the paper portfolio can be a cumbersome assessment tool. The paper portfolio grow**s** in physical size as pre-service teachers continually add more artifacts to it. The consistent growth of a paper portfolio make**s** it increasingly more difficult to transport for both the pre-service teacher and the instructor, becoming more inaccessible as time passes (Hewett, 2004). The paper portfolio becomes even more complicated when the instructor has multiple students with the same type of project. Paper portfolios do not have the capacity to be viewed simultaneously from remote locations in contrast to its electronic counterpart and cannot be updated easily (Venezky & Öney, 2004). In addition, the paper portfolio is rather limited in its ability to transmit information to a large party of individuals. The invention of the internet and digital media have revolutionized the transmission of information, making the content of a pre-service teacher's portfolio available instantaneously to any individual wanting to view it.

Like other types of assessments, both the paper portfolio and the electronic portfolio also have reliability and validity issues that must be addressed before they are successfully implemented. The question of reliability arises when a pre-service teacher prepares a paper portfolio because the precision used to create a portfolio varies between pre-service teachers (Baume & Yorke, 2000). Reliability is commonly assessed in a number of different ways. First, consistency in scoring is used to examine items within a portfolio and across multiple portfolios. The reliability of scores can be determined through different statistical methods such as: score reliability, inter-rater reliability, and inter-item agreement (Derham & Disperna, 2007; Cole, Messner, Swonigan, & Tillman, 1991; Naizer, 1997). Second, internal consistency becomes an issue because there is a great variability among artifacts within a single portfolio and across portfolios (Wolf, 1998). While it is possible to determine inter-rater reliability to increase reliability of scores or ratings, more research is needed to determine how exactly internal consistency reliability can be measured in portfolios.

In addition to difficulties with reliability, creating a portfolio that is valid for its purpose poses an issue to any higher education institution using this type of assessment. The heterogeneity of paper portfolios requires a prolonged period of study to determine if the entries within the paper portfolio are representative of actual pre-service teacher tasks (Ediger, 2000). Perhaps the biggest threats to portfolio validity are the variability of pre-service teacher task performance and the inability to capture a representative sample (Maden & Taylor, 2001). The variance of portfolio content between pre-service teachers may also prevent the establishment of a unified standard that may be used to evaluate all pre-service teacher content equally. Deciding which artifacts to collect is paramount to measuring validity because the collected artifacts must truly be representative of a pre-service teacher's work.

The electronic portfolio is a new type of assessment that relies heavily upon the use of technology. Moreover, the support of all stakeholders, such as administration and faculty, involved in the use of the assessment tool must support its usage (Wright & Stallworth, 2002). Implementing an electronic portfolio system is also expensive due to the hardware and software that are necessary to create and maintain an electronic portfolio system. Time is also an issue with the electronic portfolio because users must be trained on the operations of the electronic portfolio (Pecheone, Pigg, Chung, & Souviney, 2005; Cole et al., 2000; Linn & Baker, 1992). Faculty will need extensive training on the assessment and scoring of each electronic portfolio. Investigation of the psychometric attributes of the electronic portfolio must also be conducted to reasonably confirm that the tool is truly representing what it claims to (Whithaus, 2002). However, one significant challenge that electronic users face are problems that are technological in nature.

The ease of use of an electronic portfolio for students seemed to be a top concern (Waters, 2007). Banister, Vannatta, and Ross (2006) found that ease of use for the electronic portfolio was very important to pre-service teachers. The prime obstacle for ease of use is the pre-service teacher's lack of technological knowledge, both definitive and procedural, that prevents the pre-service teacher from building an electronic portfolio (Heath, 2005). Because the electronic portfolio is created entirely with various software applications, the lack of technological expertise inhibits the pre-service teacher from creating an electronic portfolio if they do not possess the knowledge to manipulate the necessary software tools (Fiedler & Pick, 2004). To place the chosen objects within the electronic portfolio, the pre-service teacher must be able to understand and use the necessary software to edit and place artifacts within the electronic portfolio environment (Pardieck & McMullen, 2005).

Pre-service teachers typically face technical difficulties creating the webpages that hold the artifacts, or content, of the electronic portfolio. The pre-service teacher's lack of experience in webpage design prevents the creation of the electronic portfolio if they do not receive some sort of instruction to counteract the problem. Many of the pre-service teachers also lack the necessary knowledge to recreate artifacts digitally from the original, paper artifacts. Electronic portfolios also have the ability to display video clips when inserted into a webpage (Diehm, 2004). Pre-service teachers generally can capture video footage but lack the knowledge to insert, edit, and format video footage for an electronic portfolio (Walker, 2004). With so many potential technological problems facing them, it is necessary to equip pre-service teachers with the resources to solve any challenge they may encounter.

Technical Considerations of the Electronic Portfolio

The success of maintaining an electronic portfolio system relies heavily on a well developed technological infrastructure framework and a highly trained electronic portfolio support staff. The establishment of a permanent technical support team to service the technological problems of pre-service teachers' electronic portfolio is one possible solution for all the technological errors that may occur (Wetzel & Strudler, 2005b). Barrett (2002) writes that teacher candidates need an established support system that they can turn to when encountering difficult technological problems. Fiedler and Pick (2004) wrote that a technical support team was important to help improve the level of pre-service teacher electronic portfolio technical skills and provide technical expertise when needed. In his study, Waters (2007) surveyed a class of pre-service teachers and determined that pre-service teachers were more at ease using an electronic portfolio when technical support was available to answer questions and solve any problems that arose. The research discussed above demonstrates that it is necessary for higher academic institutions to sponsor and support a technical support team when using an electronic portfolio system.

Much of the electronic portfolio literature details the need for any higher education institution using an electronic portfolio system to also create a technical support team (Thomas, Lamson, & King, 2001). The technical support team is responsible for addressing any technical questions pre-service teachers cannot solve themselves and also provide training in the skills necessary to create an electronic portfolio. Individuals that join the technical support team must acquire the necessary knowledge to troubleshoot any problematic situation that a pre-service teacher may bring to the technical support team. No literature exists in the area of electronic portfolio systems that theorizes how members of an electronic portfolio technical support team acquire the experience and knowledge necessary to solve any problem brought to them. An exploratory investigation into the learning environment and contextual factors that influence the learning process of staff members involved in the support of an electronic portfolio system is needed. An exploratory study could possibly reveal a model that discusses the development of expertise in technical support that could be applied and tested in higher education institutions across the United States. The educational implication of training an electronic portfolio technical support team, based on published empirically based research, could affect the quality of electronic portfolios used at various academic institutions.

Identifying Varying Levels of Expertise

To differentiate the levels of expertise, it is necessary to define the process of acquiring expertise and to identify the difference between the novice and expert levels of performance. According to Ericsson (2003), the acquisition of expertise for an individual is the mastery of a sequence of increasingly challenging events that grants the individual insight and knowledge into a content area. As the individual masters different difficulty levels of problems, the individual learns to think more complexly and draw upon a larger body of knowledge as experience is accumulated. The novice learner will begin to problem solve with a limited amount of experience and information that will yield simple and workable solutions to problems. The novice learner lacks the knowledge and experience to understand the depth and structure of a problematic situation. Through instruction and deliberate practice, the learner will begin to accumulate more information to solve more complex task as time passes (Ericsson, 1993). At each increasing level of mastery, the learner will organize information and solve problems using differing strategies as time passes.

Discriminating Between Novice and Expert Learners

Ericsson (2003) wrote that the identification of expert performance from novice performance is based upon several observable factors. The profile of an expert learner differs greatly from the novice learner in terms of performance. The expert learner possesses the ability to perform a given task at a higher level of difficulty more consistently than the novice learner. For example, an expert chess player will select superior moves that might not have occurred to the novice chess player due to lack of experience and domain specific knowledge (De Groot, 1978). The expert learner also possesses the ability to control and regulate their performance on a consistent basis with very little variation.

The methodology used to problem solve a given situation differentiates novice learners from the expert performers. When given a problem to solve, expert learners draw upon several mechanisms that contribute to finding the solution for a problem that are unavailable to novice learners. Expert learners observe the underlying structure of the problem and attempt to understand the challenges from different perspectives. They are able to discern relationships among elements of the problem and how one element of a challenge may affect other elements. They draw upon previous experience from not only similar challenges but also may draw upon experience from completely unrelated challenges that may share only one or two common elements (Plant, Ericsson, Hill, & Asberg, 2005). Expert learners possess the ability to abstractly transfer knowledge from unrelated circumstances and frame the elements in such a way that may be useful in solving a challenge. Based on a large amount of experience and knowledge, expert learners are able to choose the superior solution to a problem based on the potential consequences that the solution may cause (De Groot, 1978). In summary, expert learners superior problem solving capabilities enable them to construct more thorough solutions to a challenge than novice learners would be able to devise.

The Transition from Novice to Expert Learner

In addition to the identification of novice performance, it is also necessary to understand how an individual transitions from a novice learner to become an expert learner. Primarily, the acquisition of expertise begins with instruction in rules and procedures of the given domain area. Novice learners receiving formal instruction from a more advanced learner begin to expand their limited understanding of the domain area. The traditional theory of skill acquisition states that during the first phase of skill acquisition, the novice learner experiences a cognitive stage of a domain area in which they begin to study its rules and structure (Anderson, 1982, 1987; Fitts & Posner, 1967). The novice learns to avoid common errors within the domain.

The associative phase, the second phase of skill acquisition, finds the learner able to provide a consistent performance in the domain area. As the novice learners begin to understand the intricacies and complexities of the domain area, they begin to understand the underlying structure of potential issues and what information is necessary to provide a solution for that issue. In addition to instruction, the novice learner must also acquire experience in the given domain area to practice the information and techniques provided to him/her during their instruction periods. Remaining actively engaged in the domain area of choice will increase the quality of performance for practicing individuals.

Finally, in the autonomous phase, learners practice in the related domain area with little effort. At the autonomous phase, Ericsson (2003) notes that it is not difficult for potential expert learners to suffer arrested development of domain skills. Learners experiencing arrested development prematurely conclude their training. To avoid arrested development, expert learners must continue to modify existing knowledge structures with new information and experiences that provide a greater understanding of the domain. In conclusion, the process of acquiring expertise requires learners to deliberately practice specific skills to develop new levels of expertise.

Ericsson and Smith (1991) wrote that to understand the process of mastery within a content area, it is necessary to study the cognitive processes and problem solving techniques that are involved in producing expert behaviors. To understand the acquisition of expertise within the electronic portfolio support setting, it is necessary to study both novice and expert portfolio support staff experts and how their problem solving methodology differ. Hopefully, understanding the distinct differences between the varying levels of expertise will highlight the process that the novice portfolio support staff member transitions through to become an expert portfolio support staff member.

Situated Learning

Along with the examination of the transition from novice to expert, it is also necessary to study the learning environment and social processes that the typical electronic portfolio support person experiences. Lave and Wenger (1991) theorize that learning does not occur independently of the learning environment; studying the learning environment may elicit context specific factors that affect the acquisition of expertise. Examining the various circumstances that affect the development of knowledge and skills of the portfolio support staff is central to developing a model that hypothesizes the acquisition of expertise. A model is needed that examines the social and cognitive domains of the learning that a portfolio support staff member experiences. Learning occurs both externally within a learning community and internally through the modification of internal schema (Clark, 2008). An investigation of internal and external learning circumstances is needed to investigate how exactly expertise is acquired (Ericsson, 2003).

Lave and Wenger argue that a systemic view of learning encompassing the agent (learner), the world, and the activity of learning provides the most complete learning experience for an individual. Lave and Wenger's theory of learning extends beyond sole examination of the epistemology to include viewing the agent as a whole person and observing the interaction of the agent with their environment. They propose that the individual learns mastery of a subject matter through interactions within a learning community.

Lave and Wenger's theory of learning creates a sociocultural learning environment in which the novice learner approaches a learning community, a “community of practice” (Lave & Wenger, 1991, p.49). The theory describes the learning trajectory of an individual as transitions from a novice learner to an expert within the community of practice. The learning trajectory the agent traverses is further described as legitimate peripheral participation. “Legitimate peripheral participation is proposed as a descriptor of engagement in social practice that entails learning as an integral constituent” (Lave & Wenger, 1991, p. 35) and is a mechanism that serves as a gateway to belonging to a social structure like a community of practice.

Legitimate Peripheral Participation

The role of legitimate peripheral participation is the central component that enables the novice learner to become a fully participating member and acquire expertise within the community of practice. Lave and Wenger use legitimate peripheral participation as the vehicle to acquire expertise within a community of practice. The agent’s journey begins as an external observer of the community of practice, simply viewing individuals within the community practicing their craft. As the learner becomes a member of the community of practice, he/she is granted novice standing as a peripheral member of the community since he/she is just beginning the process of acquiring the skills and knowledge necessary to operate within the community. During the novice phase of their membership, the learner simply acquires information; they do not contribute to the knowledge or practices of the community.

As a fully vested member of the community of practice, the learner plays the part of a journeyman/master. Fully vested members practice the skills he/she has learned throughout their time in the community while instructing newer members to the community and altering community practices and knowledge to fit new situations.

Finally, the exiting member of the community of practice is no longer involved in the functions of the community of practice. Legitimate peripheral participation is much like an apprenticeship because it is a process in which an individual studies a trade transitioning from the beginner practicing basic technique to total mastery of the knowledge and skills within the domain. Simply stated it is a method of analytic instruction and not meant to serve as a replacement for pedagogical skills.

The construction of knowledge within Lave and Wenger's theoretical communities of practice is entirely built within the learning community. Lave and Wenger theorize that the body of knowledge and expertise exist entirely within the specific context of the community of practice in question. This view is completely contradictory to many of the contemporary learning theories, such as Vygotsky's, that state knowledge is given form and structure internally within the mind (Vygotsky, 1978).

A member of the community of practice takes and contributes pieces of knowledge to the existing body of information at various points throughout membership in the community. As members begin their learning trajectory within the community, novice members take knowledge or skills from the community, acquiring expertise as they practice the knowledge and skills they gained. Fully vested members of the community instruct newer members of the community, providing context of knowledge to the students they teach. Full members of the community also experiment with the current knowledge of the community to make new discoveries and add new knowledge of the community. In summary, Lave and Wenger's learning theory states that members within a community of practice acquire expertise in a socially based environment through exchanges with other members of the community.

Problem Statement

Much of the electronic portfolio literature suggests that the establishment of a technical support team is critical to the success of implementing and maintaining an electronic portfolio system (Wetzel & Strudler, 2005b; Barrett, 2002; Fiedler & Pick, 2004; Water, 2007). The technical support team is responsible for instructing pre-service teachers in the use of the electronic portfolio and for troubleshooting any technical problems that may arise. To successfully support pre-service teachers in their electronic portfolio use, it is necessary for the electronic portfolio support team to possess an extensive knowledge base and skill set to draw upon when asked to solve a challenge involving the electronic portfolio. No electronic portfolio literature exists that describe how technical support staff acquires expertise necessary to support any technological problems that may arise from the use of an electronic portfolio system. The lack of available literature on the acquisition of expertise for electronic portfolio support staff should be a concern to all stakeholders who are involved in the development, implementation or evaluation of an electronic portfolio.

Because the training practices of electronic portfolio support staff are not based on empirically based research, the knowledge base and skill set of each portfolio support staff member is highly variable and individualistic. The heterogeneity of expertise levels could possibly affect the support and the overall quality of pre-service teacher electronic portfolios. If the staff member cannot effectively solve the pre-service teacher's problems, the validity of the electronic portfolio may be affected due to technical errors and may not show the pre-service teacher's acquisition of knowledge and skills. Understanding the process of support staff expertise acquisition and providing research about the topic protects the integrity of an electronic portfolio system from technical errors. Providing training to portfolio support staff that is based on research will assist in creating a uniform system of training that may be used to train novice support staff. An exploratory study is needed to investigate the possible methods that enable electronic portfolio technical support staff members to acquire the necessary expertise that allows them to support an electronic portfolio system and its constituents. The construction of a model that explains the acquisition of expertise for portfolio support staff might provide researchers with a future hypothesis that can be empirically tested.

Research Questions

1. What are the knowledge, skills, beliefs, and dispositions involved in a support staff member's acquisition of expertise in the field of electronic portfolio technical support?
2. What are the contextual factors involved in a support staff member's acquisition of expertise in the field of electronic portfolio technical support?
3. What model can be constructed to explain a support staff member's transition from novice to expert in the field of electronic portfolio technical support?

CHAPTER TWO

Review of the Literature

In the world of higher education today, there is no doubt that technology plays a prominent role in the life of the university. One only has to look around a university campus to witness students chatting on mobile phones or to observe the large number of computer labs available to students across the university setting. Regardless of the discipline of study, university students and faculty will require support for the existing technologies in the form of technical assistance and training. Specifically, university students and faculty involved in teacher education programs require assistance in technological related matters.

Teacher education, like many disciplines, uses a large amount of technology to assist in the training and education of its students. Technology comes in the form of both hardware and software packages that both faculty and students use. For example, learning management systems and electronic portfolio systems both require technical support for training and in the event that technical difficulties arise (Guaglianone, Payne, Kinsey, & Chiero, 2009). Other types of technologies such as classroom response systems (clickers) and mobile devices will all be combined to deliver information and knowledge to the student. As various technologies evolve and intertwine, the appropriate type of support systems will need to be created and implemented to minimize technology related issues.

The idea that technical support is essential to the successful adoption of technology is not a new concept. Ongoing support for a technological tool at both the faculty and preservice teacher level is necessary to facilitate a successful adoption of a new tool and ensure it continued use (Ardley, 2009). Creating a positive, meaningful interaction with a piece of technology is only possible when the user develops confidence that the technology will function as designed and does not produce problematic outcomes. Even at a very basic level, Zambo et al. (2002) report that adequate technical support is necessary for faculty to embrace technology. Jamtsho and Bullen (2007) write that even occasional technical glitches are inevitable and that technical support teams are needed to troubleshoot any issues that may arise.

The consequences of not having a technical support team in place can range from mild, inconvenient disruptions of service to complete unavailability of the technology. For example, a survey found that a lack of technical assistance for malfunctioning technology resulted in the disruption of daily and long-range lesson plans in the classroom (Lim, Pek, & Chai, 2005). The result is a delay in disruption in the learning environment which puts the learning of students at risk. The disruption of technology can change a teacher's lecture and management of the course almost instantaneously (Christianson, Tiene & Luft, 2002). Courses that rely heavily on technology or that are designed with a large technological component are especially affected when technical interruptions occur.

The availability of technical support can highly affect the adoption of technology by faculty and preservice teachers. Blumenfeld et al. (2000) state that the likelihood of faculty actually embedding technology in course curriculum can be reduced by lack of support. Unreliability of a technology can serve as a barrier to widespread use of technology among faculty and preservice teachers (Hill & Reeves, 2004). A low level of technological support can hinder technological integration into the course curriculum and increase the work load of faculty (Molina, Sussex, & Penuel, 2005). The lack of technological support can negate any benefits technology may contribute to the education of preservice teachers by increasing the work for faculty and causing disruptions during time in the classroom. The combination of technical failures and faculty resistance can create a barrier to the adoption of technological resources and hinder the learning potential of preservice teachers.

The existing literature confirms that a technical support team plays a critical role in the successful use of technology in preservice teacher education. Without a support team in place, faculty and preservice teachers would be subjected to technological errors that would eventually lead to disuse of the problematic technology. While the literature does discuss the importance of a technical support team, a review of the preservice teacher literature did not reveal any literature that elaborated on how exactly members of a technical support team develop the necessary expertise to troubleshoot technology related problems. Further exploration of the mediating mechanisms that members of a technology support team use to acquire the knowledge needed for troubleshooting would be insightful in learning about creating successful technical support teams.

Electronic Portfolio

Within the last ten years, the electronic portfolio arrived on the forefront of alternative assessment. Based upon the artist's traditional paper portfolio, the electronic portfolio uses advances in information technology to digitize a paper portfolio in an electronic medium. Generally defined, an electronic portfolio is an electronic collection of artifacts representing an individual's work or knowledge base (Heath, 2005). Artifacts are pieces of work created by an individual that demonstrate development of a particular skill set over a period of time. Examples of electronic portfolio artifacts are essays, reports, assessments, video clips, pieces of multimedia, concept maps, and audio clips (Kimball, 2003; Yancey, 2009).

The electronic portfolio differs from the traditional paper portfolio in that it is completely online. The paper portfolio is restricted to print based artifacts placed on paper documents while the electronic portfolio is created in a medium that offers many more choices in presentation themes and ideas. “Thus, instead of being limited to the confines of a binder, electronic portfolio authors are free to create in a variety of formats, including text, audio, video, graphics, and multimedia. The choice of production tools includes an array of hardware and software [that can be harnessed to create and edit content]” (Heath, 2004, p. 9). The plethora of software applications available in today’s market provides the portfolio creator with the opportunity to create just about any type of artifact digitally.

The Structure of an Electronic Portfolio

The electronic portfolio generally resides “online” so that it is easily accessible. The underlying structure of an electronic portfolio generally is a series of WebPages organizing and containing the user’s artifacts (Kimball, 2003). When encountering an electronic portfolio, the viewer will first come to a homepage which serves as an introduction to the content of the electronic portfolio and as a means of navigation through the content. The homepage provides the overall infrastructure of the electronic portfolio content and arranges it according to a standard usually given by an instructor or the creator of the portfolio.

From the homepage, an individual can peruse the artifacts that make up the content of the electronic portfolio. Typically, the electronic portfolio will contain written reflections, projects, or other artifacts that provide evidence that the portfolio creator learned a useful skill or body of knowledge. The electronic portfolio is not just a random, haphazard collection of artifacts but rather a carefully arranged compilation of works that represent a guided purpose. The artifacts are supported by written narratives that reflect on the work included within the portfolio and how it relates to the purpose.

The structure of the electronic portfolio must be developed before construction and selection of the artifacts begins. Heath (2004) writes that an electronic portfolio is not merely a collection of objects and artifacts but has a purpose, usually to display the skills or knowledge of its creator. Without planning the structure of the electronic portfolio, the collection of artifacts simply looks like a random exhibition of objects presented for a viewer's perusal. The purpose of the electronic portfolio is to demonstrate the creator's development in knowledge and skills over time. The importance of arranging artifacts to demonstrate growth from one point to a more advanced level may be a goal of the portfolio. Planning the structure of the electronic portfolio according to a theme or chronological element will ensure an ease of navigation for the viewer and a communication of the acquisition of expertise as the viewer advances through the collection of artifacts within the electronic portfolio.

Types of Electronic Portfolios

The term 'electronic portfolio' simply refers to the internet based media in which the content of the portfolio resides. Kimball (2003) states that the electronic portfolio can take many forms based on the content of the electronic portfolio. Each type of portfolio has a different functionality based on its purpose and content.

The professional portfolio. The professional portfolio describes the individual as a worker. It can be used to show potential employers in detail the knowledge, skills, and past work accomplishments of the portfolio creator. The portfolio creator can use the professional portfolio as a vehicle to display prior work experience and its relationship to the present context. The potential employer has the benefit of viewing concrete examples of a potential employee's work and how that past experience could be of benefit to the perspective organization.

The underlying structure of the professional portfolio is an important aspect that needs to be considered when organizing and constructing the portfolio. The literature suggests that the foremost consideration to the structure of a successful professional portfolio is that the content must be customized so that it is directly applicable to the desired position. The structure of the professional portfolio should also be arranged in accordance to professional standards or possibly structured similarly to a resume. For example, the professional portfolio of a teacher would contain content related to assessment, knowledge within a specific content area, classroom management, and professional development. If using a structure similar to a resume, the professional portfolio will contain artifacts demonstrating expertise within a particular domain and projects from former employment that display the candidate's expertise. A carefully constructed professional portfolio can augment the traditional resume and highlight to potential employers the benefits that an agency, school, or company might receive from hiring the portfolio's creator.

The capstone portfolio. The capstone portfolio is defined as a project that represents the culmination of a task or body of work in a specific situation. Like other types of portfolios, the capstone portfolio is designed to demonstrate growth in a skill set or a particular knowledge base. The artifacts contained within the capstone portfolio usually are compiled at the end of a program to demonstrate proficiency. The distinct characteristic of the capstone portfolio is that it does not necessarily document the intermittent steps within the journey of acquiring knowledge and skills. The capstone portfolio can also be defined as a collection of artifacts that are created after an individual has perfected a set of skills and acquired the necessary knowledge to create the artifacts.

The most common use of a capstone portfolio is to display a student's best work upon graduation. Assembling the capstone portfolio offers the student the opportunity to reflect back upon the schooling received. Students will often present the capstone project to faculty to prove mastery of a specific domain. The capstone portfolio is created based on external standards given to the portfolio creator by the individuals that will evaluate the portfolio. Since the capstone portfolio is usually a demonstration of acquired knowledge and skills, the portfolio structure will display important artifacts and projects that serve as evidence of achieved standards or benchmarks.

The learning portfolio. The learning electronic portfolio is a portfolio format that is used to demonstrate the creator's development in a domain over a period of time. The learning portfolio is considered to be a work in progress since the portfolio content is constantly evolving and changing. The purpose of the learning portfolio is to examine the changes in skill level or development of a knowledge base. The creator adds artifacts to the portfolio to document specific instances of skills and knowledge acquisition .The use of reflection is a common practice within the learning portfolio as the creator contemplates previous work and experiences and their relationship to development within the domain. The learning portfolio's value is that it is a self-assessment that the creator may use to benchmark current levels of knowledge and skills within a domain.

The underlying structure of the learning portfolio is defined by the standards used to track the portfolio creator's growth in a specific body of knowledge or skill set. A standard practice in the learning portfolio is for the creator to adhere to a developed set of benchmarks when selecting artifacts for the learning portfolio. Content can be arranged according to the portfolio benchmarks and can be revisited at each level of the creator's development. While the requirements of the learning portfolio are static, the content of the portfolio constantly evolves as the creator grows in levels of skill, knowledge, and experiences. Formative and summative feedback given by the evaluators also shapes the content of the learning portfolio.

The Electronic Portfolio in Teacher Education

In teacher education, the electronic portfolio serves as a performance assessment tool that combines attributes of several different types of portfolios. When used in teacher education, the purpose of the electronic portfolio is to document the growth in professional and pedagogical content knowledge and skills such as classroom management, assessment, curriculum, and instruction during the undergraduate career of the preservice teacher. The preservice teacher constantly revises the content of the electronic portfolio to more accurately reflect the preservice teacher's level of skill and knowledge at that point. As the preservice teacher continues through her career, the content of the electronic portfolio will grow and evolve in direct proportion to the preservice teacher's development of pedagogical content knowledge and skills and related field experiences. In teacher education, the electronic portfolio closely aligns with the learning portfolio since the content dynamically shifts to reflect the current level of knowledge and skills of its preservice teacher creator.

The content of the preservice teacher's electronic portfolio is guided by an external set of guidelines, usually referred to as benchmarks or proficiencies. The benchmarks serve as a framework to guide the development and addition of artifacts to the preservice teacher electronic portfolio. The majority of the electronic portfolio content is composed of written reflections and artifacts used as evidence to support the reflections. The preservice teachers may also include written reflections within the electronic portfolio that discuss their experiences in the teaching environment related to a specific benchmark to document specific experiences detailing growth of skills and knowledge related to a benchmark.

The structure of a preservice teacher's electronic portfolio is typically hierarchal in nature. On the highest level of navigation, a navigation page exists that serves as a roadway to access the content of the electronic portfolio. The navigation page contains information about the purpose of the preservice teacher electronic portfolio and directions to access the remaining content of the portfolio. The navigation page links directly to each benchmark of the electronic portfolio. The benchmark pages provide a brief explanation of the corresponding benchmark

Program accreditation. Many teacher education programs in the university setting also use the electronic portfolio as a tool in achieving and retaining program accreditation (Lynch & Purnawarman, 2004; Shannon & Boll, 1996). In the U. S., teacher education programs at the university level are accredited by organizations such as the National Council for the Accreditation of Teacher Education (NCATE) and the Southern Association of Colleges and Universities (SACS). Teacher education programs must also satisfy the standards of quality education as defined by the state in which the program practices. The primary task of these organizations is to ensure the development of competent preservice teachers through the examination of teacher education programs (U.S.D.E., 1997). A teacher education program desiring recognition by organizations such as NCATE are subjected to a rigorous process of accreditation. During the accreditation process, NCATE officials analyze the curriculum of the teacher education program for compliance with accepted teacher preparation standards. Analysis of the curriculum requires that the NCATE officials are presented with data that verifies how preservice teachers are demonstrating required teaching behaviors that define a successful teacher. The electronic portfolio is an assessment that can provide NCATE officials with data demonstrating the requisite teaching behaviors.

The content of an electronic portfolio in teacher education is defined by standards that are based on research of effective teachers. Such standards are created by specialized professional associations (SPAs) and maintained by such organizations as NCATE and agencies at the state and federal level. The standards are then translated into benchmarks that preservice teachers must learn and demonstrate as they continue with their preparation. The ideal preservice teachers' portfolios will display growth and mastery of the benchmarks throughout their undergraduate careers. Artifacts within the electronic portfolio serve as evidence to demonstrate that preservice teachers demonstrate knowledge of the electronic portfolio benchmarks and use benchmark behaviors during their time teaching in the classroom. Each artifact within the electronic portfolio should align directly to a benchmark. Artifacts that directly correlate with the benchmark standards increase the validity of the electronic portfolio itself.

Typically there is an evaluation rubric built into the infrastructure of the electronic portfolio that is used to evaluate preservice teacher knowledge and skills in meeting each of the benchmarks (Barrett, 2004). Faculty members may use the rubric to formatively and summatively assess electronic portfolio artifacts to examine the preservice teacher's competence in meeting individual benchmarks (Rogers, 2003). Faculty evaluation of the artifacts will generate both qualitative and quantitative data that other faculty and program accreditation examiners may use to determine if preservice teachers within the specific teacher education program are displaying behaviors that define a successful teacher. The advantage of using an electronic portfolio system is that program accreditation examiners can use data collected over several years as a performance measure to observe the growth in preservice teacher knowledge and skills over a prolonged period of time (Barrett & Knezek, 2003). They may also compare developing versus competent performance across all of the teacher candidates. Viewing preservice teachers' growth will give the accreditation examiner an opportunity to view the teacher education program curriculum to determine if preservice teachers are developing the knowledge and skills needed to be an effective teacher in the classroom.

A well designed electronic portfolio system will have the capability for accreditation examiners to access student data easily (Wilhelm, 2006) and gather the desired information to answer questions (Wetzel & Strudler, 2005). For example, the query tool within the electronic portfolio has the capability of displaying performance data on the teacher education program as a whole and provides opportunities for the accreditation examiner to view data at the individual level for each preservice teacher. The output appears in a matrix or matrices that accreditation examiners may easily peruse for the information they may require. Ideally, the electronic portfolio contains the necessary structure to provide accreditation officials with direct access to aggregate and disaggregated preservice teacher data that can be used as evidence to demonstrate compliance to accepted teaching standards (Banister, Vannatta, & Ross, 2006).

Alternative assessment. The introduction of the electronic portfolio as an alternate form of assessment arose at a time in which the traditional method of standardized assessment came under fire from researchers in the field of education. They argued that a traditional form of assessment such as a multiple choice exam was only capable of capturing one instance of student performance. The same critics also argued that standardized assessments only measured a student's memorization of decontextualized, abstract information. It did not provide any insight into how a learner, such as the preservice teacher, is able to apply learned knowledge in a realistic environment. The strength of an alternative assessment such as the electronic portfolio is that it provides an opportunity for the preservice teacher to directly apply knowledge in a realistic, learning scenario. Specifically, the electronic portfolio as an assessment tool is designed to assist the instructor in evaluating the knowledge of a preservice teacher in an actual performance scenario.

The preservice teacher can harness the electronic portfolio assessment to demonstrate continuing growth in knowledge using a progressive tool. Using an electronic portfolio assessment tool offers preservice teachers multiple opportunities to showcase their skills, knowledge, and abilities (Desmet et al., 2008). The iterative process of updating the electronic portfolio is, in one sense, a self-assessment tool because the preservice teacher has the opportunity to reflect upon past learning opportunities. Simultaneously, the instructor is able to review the content of an electronic portfolio and review the content of each preservice teacher. With the electronic portfolio, the preservice teacher has the opportunity to revisit the content and be certain they are clearly communicating what was learned inside the classroom environment (Bresciani, 2005). Revisiting electronic portfolio content allows the preservice teacher to develop a better understanding of the progress made over a period of time (Hope, 2005).

An electronic portfolio is composed of benchmarks that dictate the content that that can be added by the preservice teacher. Benchmarks are determined by administration and faculty during the planning phase of electronic portfolio implementation. The benchmarks that represent the content of the electronic portfolio are based on national and state education standards that represent ideal teacher behaviors. Preservice teachers gather artifacts for their electronic portfolio that encapsulate each of the pre-defined criteria. Once standards for the electronic portfolio are chosen, faculty members develop assessment measures that evaluate the content and quality of the electronic portfolio based on the pre-determined benchmarks. The assessments are designed to provide feedback to the preservice teacher and offer insight into areas of possible improvement of teaching skills and knowledge.

The structure of the assessments within the electronic portfolio uses a combination of formative and summative assessment measures to evaluate preservice teacher learning. The purpose of usage for both types of assessment measures correlates directly with the ongoing creation and modification process of the electronic portfolio. Collecting artifacts and expanding the content of the electronic portfolio involves a systematic collection of student artifacts and continuing evaluation of preservice teacher learning (Sunal et al., 2005). The instructor uses formative measures to provide preservice teachers with feedback as the preservice teacher adds content to the electronic portfolio. The formative feedback provides guidance to the preservice teacher in an effort to guide him/her to select electronic portfolio content that validly and reliably represents the purpose of the electronic portfolio. Providing feedback during learning can help focus the preservice teacher to recognize any weaknesses in their knowledge base and/or performance and address them. Formative assessments are a form of quality control that guide preservice teachers to choose artifacts for their portfolios that best represent fulfillment of a particular benchmark.

The electronic portfolio is also used as a summative assessment that measures preservice teacher learning at the end of the created product. The application of a summative assessment presents the preservice teacher with an opportunity to examine the content of the electronic portfolio as a whole and to reflect back upon the progress of their acquired knowledge and skills (Herner et al., 2003). Upon completion of the electronic portfolio, it becomes a summative assessment in that faculty will evaluate the content using rubrics or some type of numeric qualifier (Hackmann & Alsbury, 2005).

Providing the preservice teacher with a summative assessment score imparts the preservice teacher with a measure of performance and quality of their electronic portfolio in the context of their course grades (Rovai, 2000). Using a summative assessment with the electronic portfolio also applies at the institution level. Many higher education institutions across the United States use cumulative electronic portfolio scores for accreditation purposes. Summative assessment data are also used for internal audits to evaluate preservice teacher skills and to provide quantitative proof that preservice teachers are being trained according to federal and state mandates (Basken, 2008). Implementing a summative assessment as one measure of evaluation in an electronic portfolio provides useful information to internal constituents and external accreditation bodies.

The electronic portfolio is designed to be an alternative assessment that evaluates the performance of a preservice teacher. During the development phase of the electronic portfolio, faculty and administrators determine the criteria that serve as the standards used for content selection for the electronic portfolio. The electronic portfolio standards are usually based upon federal and state guidelines of appropriate behavior that define a successful teacher. Preservice teachers select artifacts that demonstrate fulfillment of each electronic portfolio standard which accumulate over a period of time. To evaluate the content of an electronic portfolio, faculty use both formative and summative assessments to gauge the quality of content inside the electronic portfolio. Faculty use formative assessment throughout the development of the electronic portfolio to provide the preservice teacher with feedback and guidance on the content of the electronic portfolio and possible improvements. Summative assessments use rubrics and numeric scores to inform the preservice teacher of the quality of the electronic portfolio after the product is created. Using both types of assessments can more fully assist preservice teachers in developing their electronic portfolio to its full potential.

Technical considerations. The introduction of technology as a means for delivering portfolio assessment content caused a paradigm shift in the very nature of the portfolio itself. Traditionally, the portfolio as an assessment is a collection of work representing accumulated knowledge in a subject area distributed in a limited matter. The inherent limitation of distributing a paper portfolio lay in the limited geographic area in which the portfolio is disseminated. The inclusion of technology into the portfolio assessment erases that particular constraint with the ability to now distribute portfolio assessment content on a global scale using the Internet as a distribution channel. Using technology to deliver portfolio assessment content raises many technological questions of how to delivery content successfully at both the institution and the faculty level.

Instituting an electronic portfolio system at a university requires that faculty, support staff, and preservice teachers learn to use new software to successfully develop an electronic portfolio (Goldsmith, 2007). Questions begin to arise about which university parties are responsible for conducting training for both preservice teachers and faculty that need instruction in the electronic portfolio software package. From a curriculum aspect, faculty members need training in the methods of developing and/or adapting course assignments so that using the electronic portfolio environment retains its validity and reliability (Goldsmith, 2006). Lastly, both preservice teachers and faculty will need technical support at some point to handle future potential problems that may arise after an initial training session using the electronic portfolio software. It will be necessary to assign the responsibility of managing technical support to a party at the institutional level or at the department/college level to ensure successful implementation and continued ease of use for the electronic portfolio system (Garis, 2007). A review of the electronic portfolio literature suggests that a well-developed technical support system can make the difference between a successful embrace or a colossal failure of an electronic portfolio system.

The idea that an infrastructure exists to support electronic portfolio-related activities is a central factor in a successful system. Willis and Wilkie (2009) note that administrative and technical support are necessary for such large scale projects and, without the necessary resources in place, both faculty and preservice teachers would face large obstacles in interacting with an electronic portfolio system. Waters (2007) recommends that any institution with an electronic portfolio ought to keep a technical support team on hand to troubleshoot potential problems and to make any necessary system level changes. Having a strong technical support network will ease the transition for both faculty and preservice teachers and encourage adaption to a new form of technology. The technical support team is a major component for overcoming any type of technical obstacle that might arise that traditionally comes with the implementation of a new type of technology into a new environment or an existing assessment system. In her 2007 study, Barrett found that education institutions with high levels of electronic portfolio usage were characterized by high levels of technological skills and a support system in place for the university's constituents.

Training and technical support issues. When addressing the issue of implementing and developing a reliable technological infrastructure for an electronic portfolio system, existing literature is divided into two categories: training issues and technical support issues (Gathercoal et al., 2002; Jun, Anthony, & Achrazoglou, 2007).

Training. Implementing a successful electronic portfolio system requires a large investment of time and money in planning for all contingencies as it relates to training issues. During the planning process, resources must be allocated to develop and deploy training resources that are continually available to both faculty and preservice teachers in support of electronic portfolio usage. Wilhelm et al. (2006) discusses the importance of developing initial faculty training sessions for electronic portfolio usage but also emphasizes the importance of availability for further training and development as necessary. Sustainability of such training sessions may be challenging but providing opportunities to continually develop electronic portfolio related skills will help contribute to the overall success rate of an electronic portfolio (Herner, Karayan, & McKean, 2003).

While providing training to faculty should be an important consideration, the primary user of the electronic portfolio is the preservice teacher. Significant time and planning need to be used in the development of a strategy for developing a training curriculum for the preservice teacher. Consideration should be given to factors that may affect the ease of usage of an electronic portfolio system. For example, Barrett writes that software packages used to develop electronic portfolios come in a myriad of formats such as commercially built software packages such as Adobe Dreamweaver or TaskStream (Gibson & Barrett, 2003). Other universities across the United States use software developed in-house to develop preservice teacher electronic portfolios. Decisions such as what software package to use have a high level of implication that can mean the difference between success and failure for the preservice teacher.

Choosing a commercial software package to build electronic portfolios have certain advantages in the fact that many technical issues that preservice teachers may experience could be easily resolved by the company's technology support staff. Other issues may arise such as technical issues that would impede the usage of the commercial product such as password resets or technological failure on the part of the company responsible for the commercial product. Training to use a commercial product to build an electronic portfolio may also be limited in scope or even unavailable depending on the product. Commercial products control the content of training curricula for their product and it may lack the specificity needed to address preservice teacher questions in an exact situation. Costs for the commercial software or to receive technical support from the vendor may be prohibitive and force universities to seek a different solution.

Conversely, some universities choose to develop an in-house software package that preservice teachers utilize to author electronic portfolios. This particular approach can be advantageous when the electronic portfolio system is designed and built specifically for the needs of the university. Because the electronic portfolio software is designed in-house, technical support and training resources are more available to preservice teachers at more convenient times and locations. In-house programs can also be easily modified to suit the needs of the constituencies as the developers are employees of the same organization. Like its commercial counterpart, the in-house electronic portfolio system also suffers from several disadvantages. Commercial vendors specializing in electronic portfolio software packages possess a large amount of experience and knowledge which is harnessed into designing a quality product. In-house development teams at the university level are generally responsible for developing software for a large variety of tasks and may not possess the necessary expertise to develop the most valid and reliable electronic portfolio tool. Preservice teachers may also be responsible for learning to use the electronic portfolio software that may be subject to change based on modifications to the software implemented by university software developers. Regardless of the software environment chosen to develop the electronic portfolio, training issues will derive in some manner.

Technical support. In addition to handing training issues, the electronic portfolio system will also be prone to technical errors much like any other piece of technology. In the analysis and design stages of the electronic portfolio implementation, administrators must assign responsibility for maintenance and support of the various technologies that comprise the electronic portfolio system (Meeus, Questier, & Derks, 2006). Adequate time, money, and resources need to be allocated to the planning and continued maintenance of the electronic portfolio, without such planning and resources the electronic portfolio could forfeit any usefulness and cost the university valuable resources (Wiedmer, 1998). All of the technological components that form the technological infrastructure that supports the electronic portfolio will need to continuously be observed to ensure that the electronic portfolio does not fail and become unavailable to preservice teachers. The main difficulty is that the various components that comprise the electronic portfolio work in tandem to make the system available to users. Technical difficulties arising from connecting to the Internet, IP connection problems, hardware and software failure are examples of issues that need to be monitored constantly to avoid disruption of access to the electronic portfolio system (Dornan, Carroll, & Parboosingh, 2002).

The electronic portfolio as an assessment tool is large departure from the traditional, paper portfolio. The transition of assessment material in a digital media environment requires a large investment of time and resources into adequate planning of the entire system. To implement a successful electronic portfolio system, university administrators, faculty, and technical support need to align expectations for the future electronic portfolio system in an unanimous vision that will lead to an eventual, successful implementation of an electronic portfolio. Assessment components need to be defined in such a way that the validity and reliability of the assessment instrument will be unaffected by the new electronic media.

From a technical standpoint, adequate planning is required to develop the technical infrastructure that will support the electronic portfolio. Both preservice teachers and faculty need to be provided with training to learn to successfully use the electronic portfolio. Continuous support, both pedagogical and technological, must be available for both constituency groups to facilitate successful usage of the electronic portfolio. In summary, a successful electronic portfolio system will be the result of extensive planning which is supported by a robust technological infrastructure. Users that receive training and technical support and understand that support is readily available will be more inclined to adapt an electronic portfolio. The successful electronic portfolio will combine sound assessment practices, a well defined technological infrastructure, and available training and support to deliver an easy to use assessment system.

Acquiring technical knowledge. The question remains how exactly does a member of a technical support team acquire the necessary knowledge and experience necessary to combat technical errors. The lack of literature on the subject suggests that an investigation is needed to explore how an individual involved in a technical support environment will attain the required knowledge and skills. A theory is needed that operationally defines the concept of expertise and the mediating mechanisms that are used to gain expertise. Ericsson's theory of expertise concisely describes the nature of expertise and the exact methods needed to increase expertise over a significant period of time.

Ericsson's Theory of Acquisition of Expertise

According to K. A. Ericsson's theory, learners acquire expertise through a "sequence of mastered challenges with increasing levels of difficulty" (Ericsson, 2003, p. 31). Learners receiving instruction acquire knowledge and skills that assist them in the struggle to complete difficult domain-related tasks. Ericsson's acquisition of expertise theory groups learners into one of two distinct levels based upon previous experience and current level of skill: novice or expert learner. Each designation implies differing levels of problem solving abilities, cognitive mechanisms, and knowledge levels (Ericsson, 2003).

Learners are classified as novices if they have limited skills and understanding of the domain (Ericsson, 2003). The role of the novice is to acquire the necessary knowledge, skills, and experience to advance his/her level of mastery within the given domain. Conversely, the expert is one who has acquired the knowledge and skills that are necessary to perform at a higher level of competency. The difference in the level of performance between the novice and expert learner is based on multiple factors which will be described in the next section.

Novice Learner

Ericsson's theory of the acquisition of expertise discriminates between the novice and expert learner. Novice learners are neophytes within a learning domain. They have very limited knowledge and have spent a finite amount of time involved in domain-related activities. Not only do the novice learners possess limited understanding of domain-related activities but also have limited experience in solving domain-related problems.

Indicators of the Novice Learner

Limited knowledge of the domain. According to Ericsson, the novice learner faces the task of mastering the “basics” of a domain. The knowledge base of a novice is not particularly extensive, limited in scope to declarative and procedural information that may be applied to solve basic problems or issues within the domain. In becoming an expert, the learner faces the tremendous and arduous task of first understanding the basic rules and regulations of a domain through instruction from an expert who is more advanced within the given domain. As the novice gains more experience, the learner makes connections between the rules and regulations of the domain that were previously theoretical in nature and links the concepts with real experiences gained from interaction with the domain.

Limited set of problem solving skills. The novice has a fairly limited set of problem solving skills within the domain, which restricts the range of applications and confines the performance of a novice to a basic level. Initially, the novice can only “successfully perform only the most simple tasks and activities” (Ericsson, 2003, p. 62). Novices (a) do not have problem solving experiences in a variety of situation; (b) do not have a range of solutions for a given problem; and (c) are not able to provide a solution for a task that is difficult and above their skill level. The ability to draw upon abstract domain-related concepts to assist in deriving a solution is also beyond the reach of a novice due to the lack of experience and necessary knowledge. In attempting to conquer a domain-related problem, the novice's problem solving skills are limited to a finite amount of time spent in domain-related activity. In summary, the problem solving abilities and skills of a novice are limited in depth and complexity.

Acquisition of knowledge and skills. Ericsson theorizes that the novice learner acquires knowledge and skills in a different manner than that of the expert. A novice can acquire the necessary knowledge within a domain to function on a limited basis fairly quickly, usually within a few months or fifty hours of practice time (Ericsson, 2003). The traditional theory of skill acquisition argues that the novice first enters into the cognitive phase in which the fundamental assumptions and processes that govern the domain are learned (Anderson, 1982, 1987; Fits & Posner, 1967). Ericsson states that during the cognitive phase, the novice learns to avoid any gross errors that would severely hamper performance in the domain in question. Upon mastery of the basic levels of knowledge and skills, the novice transitions to a second phase of mastery; the associate phase. During the associate phase, the novice practices using the knowledge and skills gained in the previous stage "to attain a functional level of performance" (Ericsson, 2003, p. 62).

In the third and final stage, the autonomous phase, the novice learner attempts to practice learned knowledge and skills to a level that the behavior can be performed with very little cognitive effort on the part of the learner. Ericsson notes that many learners may be subject to arrested development, the point of learning in which knowledge acquisition and skill development plateaus and the learner makes no more effort to increase his or her level of domain proficiency. In review, Ericsson classifies the novice as an individual who is at the cognitive, associate, or autonomous phase of development within a domain that may lead him or her to qualifying as an expert.

The Expert Learner

Ericsson categorizes an expert within a domain as an individual that has spent a large amount of time involved in domain-related tasks that contributed to the acquisition of knowledge and skills, usually a time period in excess of ten years (Ericsson, 2003). Within a domain, the expert produces more superior performance than that of a novice (Chase & Simon, 1973, Glaser & Chi, 1988). Experts are also able to reproduce quality performances in public, during practice, and laboratory conditions (Ericsson & Lehmann, 1996). The expert learner possesses a large body of domain specific knowledge that can be used to solve unique and novel problems that the novice would be incapable of. The expert's knowledge of the domain is fairly extensive, consisting of a highly complex neural network of knowledge and mediating mechanisms that comprise all of the expert's domain-related intelligence. "… [Expertise is] primarily attributed to complex, highly specialized mechanisms that allow experts to perform at superior levels in representative domain-specific tasks" (Ericsson, 2003, p. 60).

Indicators of Expertise

In his past investigations of the field of expertise, Ericsson determined that there are at least thirteen indicators that a researcher may use to assess the expert learner. The thirteen expertise criteria can be used as benchmarks to differentiate the performance of expert learners from their novice counterparts. The benchmarks are generalizable across various domains that Ericsson investigated including chess, typing, and music (Ericsson, 2003). Listed below is a discussion of the thirteen benchmarks that Ericsson uses to describe the construct of expertise.

Time involved with the domain. The first major indicator of expertise, which is perhaps the most obvious, is the amount of time that a learner spends within a domain of expertise. "…[E]xpertise evidence strongly implies that even the most 'talented' individuals in a domain must spend over ten years actively engaging in particular practice activities that lead to gradual improvements in skill and adaptations that increase expertise (Ericsson, 2003, 31). Ericsson suggests that expert learners develop their proficiency over a time period of several decades involved in domain specific activities. Through his interviews with experts in the field of chess and music, Ericsson reports that learners dedicated thousands of hours of time to incrementally increasing their performance (DeGroot, 1978; Ericsson, 2003). Depending on the domain, the highest level of superior performance occurs at different ages. "The age at which expert performers typically reach their highest level of performance in many vigorous sports is the mid- to late 20s; for fine-motor athletic activities, the arts, and science, it is a decade later, in the 30s and 40s (Lehman, 1953; Schulz & Curnow, 1988; Simonton, 1997). To achieve superior mastery within a domain, the expert learner must engage in domain-related activities for long periods of time, usually measuring in decades.

Growth in domain mastery. As the novice learner transitions into an expert, the learner grows to master all of the various knowledge and skills within the domain. This extensive knowledge base and skill set separates the expert from the novice. During the decades of practice time, expert learners focus on activities that increase their domain-related abilities and enhance their control over domain-related performance. The large amount of time necessary to devote towards developing expertise will eventually allow the learner to decrease the variability of their performances, such as the ability of musicians to consistently play the same piece of music repeatedly with very little change between multiple performances (Ericsson, 2003). The expert learner that grows in mastery of domain-related activities confronts ever more increasing challenges and solves more complex problems as the learner acquires expertise. “The incremental nature of gaining mastery means that tasks that were initially impossible to perform can be executed effortlessly as increased skill is attained” (Ericsson, 2003, 31).

Level of problem solving ability. As mastery of a domain increases, the problem solving abilities, cognitive mechanisms, and mental representations evolve concurrently to solve ever increasingly difficult problems. “Mastery of very difficult problems, such as unfamiliar technique or developing a better scientific theory…” will signify a growth in the knowledge and skills that allow an expert learner to overcome domain-related problems (Ericsson, 2003, p. 32). The expert learner gains extensive experience and more tools to better solve domain-related problems. Overall, growth in mastery of a domain will equip the expert learner with a complex array of knowledge, experience, and skills to perform in a superior manner or solve complex challenges that would not be available to the novice who is newly invested in the domain. A large amount of time submerged in the domain grants the expert learner knowledge and experience necessary to most effectively solve any domain-related problem that arises. Ericsson argues that when “…experts are given representative [domain-related] tasks that capture essential aspects of their expertise, they can rely on existing skills and will exhibit the same stable performance as they do in everyday life” (Ericsson, 2003, p. 52).

In addition to the extensive array of problem solving strategies, the expert's ability to problem solve also differs greatly from that of a novice's problem solving ability. DeGroot (1978) found that the expert learner consistently selects the superior method to solve a problem than that of the novice learner. In DeGroot's (1978) research, expert learners familiarized themselves with various elements of the problem and any distinctive aspects of the problem that differed from previous experiences when problem solving**.** The expert learner contextualized the current problem with past experiences and synthesized a solution based on previous experience and pertinent factors of the current problem. The novice learner was only able to problem solve using incomplete knowledge of the domain and any haphazard experience gained through limited interaction with the domain environment.

Ericsson hypothesizes that previous experience and associations between patterns found in comparing problems are not the only factors that affect an expert's ability to problem solve (Ericsson, 2003). Another major component of expert learner problem solving ability are the mental structures underlying the extensive knowledge base of an expert. "As [the expert learner's] skill increases, they become increasingly able to encode and manipulate internal representations…to plan the consequences of [their actions when problem solving]" (Ericsson, 2003, p. 56). The expert develops internal representation of domain-related information linking up relevant knowledge, skills, and past experiences.

The expert learner has a complex, yet well-organized network of information to solve new and novel problems. The vast array of interconnected knowledge, skills, and past experience is a tool that the expert learner possesses that the novice learner does not have available. The expert learner has a sizeable advantage over the novice learner because they are able to access the previous knowledge and experience to solve a problem (Ericsson & Kintsch, 1995). The novice learner simply relies on limited interaction with the environment to solve an issue. Problem solving ability therefore differs greatly between the novice and expert because of past experience and extensive domain-related internal representations.

Complexity of portfolio knowledge. During the long exposure to domain-related experience, the expert acquires knowledge of domain concepts that form into internal representations of informational relationships. Prolonged exposure to domain-related tasks will teach the expert how different elements function within the varying domain subsystems and how different subsystems function with one another.

Expert learners will encounter problematic scenarios in which they will apply appropriate domain knowledge and past experience to produce a workable solution. Experts will attempt both successfully and unsuccessfully to apply domain knowledge and experience to solve advanced problems or give performances. Whatever the outcome of the problem solving process, the expert learner derives new internal representations between domain elements and experiences in attempting to solve the problem. Simply stated, the expert will learn what solutions work to solve problems and what solutions fail. The extensive knowledge base that the expert learner develops sets the learner apart from the novice because it provides more resources to apply to a task at hand.

The complexity of mediating mechanisms allows experts to make more informed decisions when problem solving and also generate superior solutions to domain-related problems. The experts' complex knowledge also allows them to contemplate the consequences of their actions and understand the inherent weaknesses to any potential solution to a problem. The expert learners are able to understand rapidly the structure of the problem and analyze the effects of the problem on domain-related processes (Calderwood, Klein, & Crandall, 1988). Having a complex grasp of domain knowledge also allows experts to apply abstract knowledge and/or experience unrelated to the domain that may be useful to the problem at hand. The expert learner understands how knowledge functions within and across domains. This organized knowledge and problem solving base distinguishes the expert from the novice and allows the expert learner to make more informed decisions when problem solving.

Situational factors. Within each domain of expertise, the route to the acquisition of expertise differs greatly. To account for variability across domains of expertise, Ericsson describes within his typology framework of expertise the possibility of situational factors that may affect expertise. Ericsson (2003) states that the expert learner may develop domain expertise based on situational factors that are domain specific. Situational factors that affect expertise may be best described as domain specific activities, systems, and characteristics that in some manner affect the acquisition of expertise.

In the domain of music, an expert musician can replicate a piece of music with the same interpretation multiple times. However, the occasion may arise in which the expert music performer will need to adapt the piece of music to the desire of the captive audience (Ericsson, 2003). The ability to adapt the piece of music to include other thematic elements while maintaining the integrity of the original composition is one such example of a situational factor. For the expert musician to improvise a change to a composition may not be a skill that is applicable to a great many other domains of expertise. Rearranging a piece of music suddenly requires the simultaneous adaptation and manipulation of internal schema and representations. The swift improvisation of a piece of music, or more generally, the sudden adaptation of a solution may not be considered as a necessary requisite for expertise in other domains. The situation factors qualitatively differ across domains and the mastery of such factors may not be relevant to the definition of expertise as defined in separate domains (Ericsson, 2003).

Perception of the structure of the problem. As the expert learner delves more deeply into a discipline, the learner develops an understanding of the underlying systems and components of the domain. Comprehension of the domain grants the learner the ability to perceive structures of problems that may arise. To understand the structure of a problem, the expert learner first observes the environment and the circumstances comprising the problem. DeGroot (1978) suggests that expert learners first familiarize themselves with the various aspects of the existing problematic situation followed by an analysis of any distinctive or salient features that may contribute to the nature of a problem. Upon a due amount of analysis and consideration of the problem, the expert explores the consequences of any potential solutions to the problem and then identifies solutions that offer the best alternatives. Ericsson notes that expert learner will evaluate the consequences of each solution to identify the outcome of each resolution to a problem based on the solution chosen (Ericsson, 2003). Oftentimes, a systematic comparison of alternatives may reveal other solutions that normally might not have occurred to the expert learner.

Understanding the structure of the problem allows the expert learner to understand the inherent weaknesses of the problem and quickly identify various solutions that the novice would not have discovered due to a lack of domain-related activity (Calderwood, Klein, & Crandall, 1988; Ericsson, 2003; Gobet & Simon, 1996). The expert learner is easily able to derive meaningful relationships between elements of the problem at hand. "As the [expert learners'] skills increase, they become increasingly able to encode and manipulate internal representations of [domain-related knowledge] to plan the consequences [of their actions], discover potential threats and even develop new lines of attack" (Ericsson, 2003, p. 56). The experts begin to derive solutions to the presented problem because they are drawing from their large amount of internal representations and domain-related knowledge (Ericsson & Kintsch, 1995). Expert learners will possess the ability to understand the structure of a problem and using their knowledge of domain-related knowledge and systems generate the appropriate solution.

Production of multiple solutions. When provided with a domain-related problem, the expert learner will assess the situation at hand for a potential solution. With a large amount of experience and domain-related knowledge, the expert learner will often discover several alternatives that may serve as a possible solution to the problem. It is this ability to generate multiple solutions and the process in which the expert learner arrives at potential solutions that differentiates the expert from the novice learner. The novice learners attempt to use a single solution to solve a problem based upon their limited experience and knowledge base gained from a short time involved in domain-related activities. With a decade or more of experience and instruction of the domain, the expert learner can create several innovative solutions to a given problem, solving each one quickly and effectively (Ericsson, 2003).

The expert learner can think about previous problems and reflect upon similarities between the current and previous problem situations. Finding commonalities between problems may lead to an innovative, newer solution or the application of an older solution that fits the requisites of the current problem. The role of past experience in problem solving is prominent because the expert learner realizes the applicable approaches to creating a solution, saving time and effort in producing a solution. The ability to generate multiple solutions for a problem is the hallmark of a seasoned expert in the field.

Knowledge of consequences of actions. Ericsson (2003) notes that while expertise can be defined differently across multiple domains; one of the mainstays of an expert learner is the ability to manipulate and plan their performance and actions reliably through various performances. In the field of chess, the expert chess player will analyze all possible moves and select the chess move that aligns the closest with the expert's strategy (DeGroot, 1978). It is the ability to choose a move and foresee the consequences of that move on the expert's stratagem that distinguishes the novice from the expert chess player. In addition, the expert typist will read ahead of the text currently being typed in anticipation of the future text. While reading advanced text, the expert typist will plan which keys will be hit next to maintain a high accuracy of correctly spelled words. Due to a large amount of domain exposure and time spent in the domain, the expert learner can anticipate the outcome of his/her choices and predict how exactly the expert's actions will affect the situation at hand.

Expert learners explore the possible consequences of their problem solving actions by examining the potential effects of a choice and evaluating the resulting outcomes. "During these searches the [expert learners] would identify moves with the best prospects in order to select the single best move" (Ericsson, 2003, p. 55). The expert learner's familiarity with the relationships and systems of the domain is advantageous because the learner can use that insight to mentally analyze the outcome of each consequence (Karpov, 1995; Koltanowski, 1985; Saarilouma, 1991). The result of such reflection is the ability to predict the consequences of an action on a domain-related problem with a high level of accuracy and the ability to retrieve any aspect of the action when asked (Ericsson & Staszewski, 1989). The expert learner has the ability to carefully plan actions and interventions within a domain and successfully predict the consequences of any actions taken.

Identification of problem characteristics and reproductions of solutions. Another indicator of the expert learner is the skill to identify aspects of the problem and then reproduce a solution used in the past. Through the many years of experience in a domain, the expert learner encounters a myriad of different problems that may require novel and unique answers but oftentimes only require a solution used previously. After a certain point, expert learners reach a "saturation point" of involvement within the domain where they very rarely encounter a new problem.

During the analysis of a current problem, expert learners will begin by recognizing characteristics of the problem and any potential relationships between the components. Understanding the systematic relationships between domain components enables the expert learner to begin the process of generating a solution to a problem. The expert learner is able to use extensively developed cognitive mechanisms to recall a solution from a prior similar situation or is able to modify existing schema to accommodate the development of a new solution from several like scenarios. In the end, the expert learner will use experience gained from past interactions with the domain to identify the aspects of a problem that solves the current problem. It is this ability to reproduce a solution for a given set of problem characteristics that sets apart the expert learner from novices in the domain.

Use of metacognition to mediate and modification cognitive mental structures. As a learner becomes an expert in a domain through experience, the expert learner's cognitive mental structures expand and change. With every exposure to domain-related knowledge, the expert learner associates new information into an existing knowledge structure or creates a new schema. This large amount of accumulated domain-related knowledge and experience enables the expert learner to analyze a problem, generate several potential solutions, and apply the quality solution to solve problems consistently. The "experts' ability to generate products of consistent quality, such as superior chess moves, accurate medical diagnoses, and solutions to domain-related problems, requires the mediation of complex cognitive mechanisms (Ericsson, 2003, p. 57). As expert learners continue to grow in skill they also learn the valuable skill of self-evaluation to improve performance and address any hurdle that may exist preventing their growth in domain-related skill (Ericsson, 2003). Simply put, the domain expert learns to self-critique performance and analyze any gaps in performance.

The expert learner improves performance, actively associating new information with existing cognitive mechanisms and reflecting on ways that the new information will change any performance or knowledge in the future. This process is known as metacognition and leads to “new insights into effective strategies for acquiring information and solving problems” (Berk, 2004, p. 365). Metacognition can be colloquially defined as thinking about thinking, or the ability to think about current existing cognitive structures and determine how they might be modified to increase future performance.

The application of metacognition to existing cognitive structures is important in the development of domain-related performance. The assimilation of new knowledge into existing cognitive structures and reflecting upon the changes in associated schema can heavily affect the performance of an expert learner. In the domain of tennis, expert players will possess complicated cognitive mechanisms representing important skills necessary to play tennis successfully. For example, expert tennis players possess a speed advantage that allows them to react quickly to a ball served to them. “These findings suggest that individuals should be able to improve the speed of their reactions by improving their representations so they can anticipate and prepare their actions in advance” (Ericsson, 2003, p.58). As Ericsson cites, the process of metacognition on domain-related mechanisms is important to perfect behaviors that can directly affect superior, consistent performance.

Consistency of task performance. The ability to control one’s performance consistently is an indicator demonstrating that the expert learner possesses the necessary control, domain-related knowledge, and skills to react to stimuli when prompted. As Ericsson (2003) noted, “Within these types of activities individuals reach a stable level of performance when they are able to perform at a consistent level in similar situations” (p.

48). The expert learner develops the skill set to perform consistently in a variety of environments. "Individuals who display superior performance from competition to competition meet the standards of reproducible superior performance" (Ericsson, 2003, p. 49). Ericsson uses the example of a golfer to clarify the concept of consistent performance. Expert golfers are able to putt effectively, making their ball stop closer to the hole. They are also able to drive balls from a long distance to the same general target area consistently. "The performance of dart players, rifle shooters, and archers is directly measured by the ability to reproduce the same identical performance with minimum deviation from the bull's eye (Ericsson, 2003, p. 52). In conclusion, the expert learner performs consistently at an advanced level with minimum differences between performances.

Deliberate practice as a mechanism for the acquisition of expertise. Ericsson's theory on the acquisition of expertise relies on the construct of deliberate practice to serve as the path a learner must transverse to become an expert. Deliberate practice is the method that hones the skills and experience of the novice learner into that of the expert learner. Ericsson theorizes that the learner does not attain high levels of knowledge and performance through accumulating domain-related experience (Ericsson, 2003). "[Conversely], …empirical expertise strongly implies that even the most 'talented' individuals in a domain must spend over ten years actively engaging in particular practice activities (deliberate practice) that lead to the gradual improvements in skill and adaptations that increase performance" (Ericsson, 2003, p. 31).

To demonstrate the role of deliberate practice within a domain, Ericsson studied professional violinists from a music academy in Berlin, Germany. He and several of his colleagues chose to investigate deliberate practice in the domain of music because techniques for training expert musicians have existed for centuries (Ericsson et al., 1993). Ericsson interviewed expert violinists to determine measurable activities that the musicians took part in during their transition to expert learner. Specifically, Ericsson stated he was interested in examining activities designed to improve performance (Ericsson, 2003).

Ericsson's results found that solitary practice played an important role in mastering new music pieces and techniques. Expert violinists met weekly with instructors who assigned exercises to correct any detected weaknesses and refined any weaknesses that the instructor might discover independently. Instructors assigned exercises to correct any detected weaknesses and improve the skill over a period of time. As the student progressed in skill, the exercises were adjusted based on the progress made by the individual musician. Typically, the expert violists were admitted to the music academy in Berlin at the age of 18. "By the age of 20, the best musicians had spent over 10,000 hours practicing, which is 2,500 and 5,000 hours more than two less accomplished groups, respectively, and 8,000 hours more than amateur violinists of the same age" (Ericsson, 2003, p. 66; Krampe & Ericsson, 1996).

Based on the interviews of the expert violinists and analysis of their diaries, a model of deliberate practice emerges that argues that not only time engaged in the mastery of domain-related tasks but also deliberate practice leads to an increase in the level of expertise as measured by consistent, superior performance. The expert violinist will devote thousands of hours to increasing their domain-related skills and knowledge by mastering increasingly more difficult tasks to expand his or her cognitive mediating mechanisms. In summary, the acquisition of expertise depends on the learner's ability to continually master challenges that force the expert learner to constantly test his/her domain skills level and increase the level of domain-related performance.

Ericsson describes deliberate practice as a consistent theme throughout the acquisition of expertise. Ericsson theorizes that improvements brought about by deliberate practice grow incrementally smaller as the learner increases in expertise (Ericsson, 2003). While the average learner's growth in expertise generally plateaus early, the expert learner has the fortitude to continue striving for perfection in the domain, expecting only small, finite improvements to performance otherwise known as deliberate practice (Ericsson, Krampe, & Tesch-Römer, 1993).

Ericsson warns that the expert learner must avoid the pitfalls of prolonged exposure to the domain in which he/she interacts. During the acquisition of expertise, the expert learner may become subject to arrested development. Operationally defined, arrested development is when a learner ceases to deliberately practice challenging, novel domain problems and succumbs to the automaticity of his or her current level of skill and knowledge. The learner therefore terminates any effort to continue his development and growth in the domain. To avoid the arrested development phenomenon, the expert learner must actively continue to practice within the domain and refine any existing cognitive mechanisms. Growth in domain-related mechanisms will enhance expert performance control and ability to monitor performance (Ericsson, 2003). It is important for those involved with developing expertise of learners to develop training curriculum that continues to stimulate growth in the domain.

A Summary of Ericsson's Theory of Acquisition of Expertise

Ericsson's theory of the acquisition of expertise rests on the assumption that learners derive their expertise from deliberate practice in domain-related activities. Based on his research in the domains of chess, music, and sports, Ericsson developed a framework that details a theory of expertise. By examining these details, an observer is able to distinguish the expert learner from his/her novice counterparts. The expert learner develops expertise based on a subsequent mastery of ever increasing tasks that expands the knowledge structure, skills, and problem solving skills using deliberate practice. The expert learner does not simply maintain a static level of domain-related skills but continuously challenges herself or himself withy new problems and tasks to force an evolution of superior performance. Through this method of continuous testing, the expert learner develops outstanding expertise within a domain that sets him/her aside from peers in the field.

Situated Learning

Ericsson's theory of the acquisition of expertise describes a typology useful in classifying the differences between a novice and an expert learner within a domain of activity. Ericsson's framework is useful in defining and explaining expertise attributes in the study of the pathways that the novice learner uses to transcend to expert learner status. His theory details an expert's interaction with the domain environment and attempts to detail the transition from one level of learning to the other. In essence, Ericsson's theory attempts to explain how interactions with a domain environment will modify an expert's cognitive mechanisms, level of expertise, and knowledge base. Ericsson's theory does not place a heavy emphasis on the environmental factors that contribute to the development of an expert learner. The theory of situated learning argues that the environment will directly affect how an individual acquires expertise and becomes known as an expert within a community.

Lave and Wenger's (1991) theory of situated learning emphasizes the importance of environment on the acquisition of a learner's knowledge and skills. Lave and Wenger's theory requires a paradigm shift from an examination of acquisition of expertise at the epistemological level and instead focuses on the social construction of knowledge within a learning community. Previously in Ericsson's theory, the construction of knowledge and expertise lies within the modification of knowledge and skills internally. Lave and Wenger's theory of situated learning calls for a shift from internal knowledge and schema creation to the importance of environment in the establishment of meaning and knowledge externally within a separate social context.

The acquisition of expertise within Lave and Wenger's theory is based on the metaphor of a journey for the learner. The learner journeys from an external position outside of a community of learning with very little knowledge of the chosen domain. Acceptance within the community of practice gives the novice learner with the opportunity to begin learning at the foot of a master and eventually rise to the status of journeyman. As time progresses, the novice learner develops knowledge and skills that allow him/her to begin contributing to the problem solving practices within the learning community and eventually ascend to the level of expert. Upon maturation in the learning community, the learner directly affects policy and knowledge creation with the domain. Eventually, the expert learner leaves the domain to younger colleagues that rise to manage the community of practice. The journey of the learner in becoming a full-fledged member of a learning community is a symbol of how a learner interacts with the environment in becoming an expert in the field.

An Explanation of Nomenclature in the Theory of Situated Learning

Situated learning theory. Lave and Wenger's (1991) theory of situated learning developed out of past research studying the acquisition of knowledge in a work place environment. The theorists observed during their research that workplace learning was not occurring individually within a vacuum but rather groups of colleagues collaborating on a common goal. The theory of situated learning postulates that the learner does not acquire knowledge individually in a decontextualized manner. As a member of a community, the learner collaborates with his/her peers to construct context specific knowledge that defines the scope of the learning community. The instructional implication is that the learner subscribes to a body of knowledge and skills created specifically within a community of learning. Any knowledge acquired that is too specific to the learning environment in which it was originally learned may not be applicable in other circumstances.

It is important to note that Lave and Wenger (1991) specifically state that situated learning is simply a method of knowledge acquisition and not a learning theory. "[Social learning theory] implie[s] emphasis on comprehensive understanding involving the whole person rather than 'receiving' a body of factual knowledge about the world; on activity in and with the world; and on the view that agent, activity, and the world mutually constitute each other" (Lave & Wenger, 1991, p. 33). It is at the crossroads of the aforementioned factors that learning occurs. Situated learning theory states that learning is affected by the learner, learning related activities, and the environment of the learning opportunity the learner experiences (Lave, 1988). In Lave and Wenger's (1991) terminology, the three components of situated learning are defined as: practice, person, and social learning, which will be discussed in a later section. The theory is described as situated because learning occurs in a specific contextualized location and manner, i.e. situated in a location. Within the specific learning context, all knowledge is defined and the learner will acquire expertise in the specific learning environment.

Community of Practice. The community of practice is a central component in Lave and Wenger's theory of situated learning. Broadly defined, the community of practice is the environment in which individuals come together to form a community for the process of learning. Referred earlier in this work as a learning community, the community of practice is essential in the construction of knowledge and acquisition of expertise for the learner. "A community of practice is a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice" (Lave & Wenger, 1991, p. 98). Simply stated, the community of practice is a shared activity among community members to develop domain related knowledge and expand expertise of its members. The expert's participation within the community of practice is necessary to successfully hone skills and knowledge related to his/her domain of expertise.

The idea of a community of practice as a domain refers to the idea that a community of practice is more than a casual group of friends but rather an association of individuals sharing an identity based on a shared interest (Wenger, 2009). It is within this domain that community members share a competence of a particular interest or area of knowledge. Coming together to share experiences and skills allows learners to build a community around a common interest. Through interactions with their peers, new knowledge is constructed and best practices are shared between members. When the members of a community of practice congregate, knowledge is shared and community practices grow and evolve based on the experiences of its members. The individuals with a shared sense of identity build a community through interactions with one another and the existing domain knowledge communally shared by all legitimate members.

Wenger states that a community of practice is composed of much more than just a group of individuals that share a common interest in a topic or domain. Members of a community of practice are in reality practitioners, actively interacting in a shared topic in which they are working to enhance their domain related skills. Wenger maintains that participants within a community of practice work to develop resources, tools, and best practices in a collaborative effort to enhance community and domain related knowledge. There is a sense of mutual engagement between members of a community that facilitates the development of new knowledge through interaction with one another (Wenger, 1998). The idea of qualified professionals collaborating together in the generation of new knowledge bases and the development of domain related resources are two of the major assumptions that the theory of situated learning rests on.

Wenger discusses that there are several attributes that do not define a community of practice. Foremost, groups of friends that may share a basic interest or networks of friends do not constitute a community of practice. As noted earlier, a community of practice is comprised of actual practitioners of a craft, not individuals that just have a basic interest in a subject matter. Wenger makes another distinction that individuals that are employed within the same corporation or geographic area are not necessarily members of a community of practice unless they interact with one another and learn together; generating new knowledge or improving the community. Intrapersonal rituals in which information also does not qualify as a community of practice (Wenger, 1998). Finally, Wenger states that "membership [in a community of practice] is not just a matter of social category, declaring allegiance, belonging to an organization, having a title, or having personal relations with some people" (Wenger, 1998, p. 74). What defines a community of practice is activity within a domain consisting of mutual engagement, a shared repertoire, and joint enterprise. When of the categories just mentioned is not occurring within activity of a group of individuals, a community of practice does not exist.

Legitimate Peripheral Participation. In his book, Wenger (1998) introduces the concept of communities of practice and their importance in creating new domain specific knowledge and resources. Comprising each community of practice are its incumbent members that congregate in order to share knowledge and experiences related to their interactions with the domain. Each member of the community, whether a newly admitted novice or the experienced mentor, offer their resources to further develop the community of practice as a whole. Each community member, in accordance to their place in the community of practice, offers something different to the community and also has different domain specific tasks. The novice "sits" at the seat of masters learning to cultivate his craft; the expert reviews current practices within the community and offers his expertise to the younger generation. Each member of the community of practice contributes to the growth and maintenance of the community of practice.

Lave and Wenger (1991) pose the construct of legitimate peripheral participation as the process of acquiring domain related knowledge in a community of practice. They further describe legitimate peripheral participation as a journey in which the novice learner will travel to become a full vested member of the community. During the journey, the novice will begin to partake in rudimentary and low risk domain related tasks that are essential in the maintenance and upkeep of the community of practice. The low risk activities may almost seem minor or tangential to the upkeep of the community of practice but nevertheless are important in teaching the novice the basic knowledge and skills required to become a fully participating member of the community. It is also during this time that the novice becomes familiar with the organizational practices of the community and their relation to that organization.

After participating in the community of practice for a significant period of time, the novice transitions to the rank of journeyman within the domain. The journeyman in a community of practice has developed enough skill to negotiate through the community and possesses an intermediate level of problem solving experience acquired through a limited time in the domain. The journeyman is able to solve basic issues and assist in the maintenance of the community of practice through their basic level duties. Journeymen may be used to solve minor tasks and used to instruct novices in the basic operations of the community of practice. The journeyman is also considered an advanced student and continues to learn from the experts within the domain. Lave and Wenger use the term "apprenticeship" to describe the journeyman's continuing education in becoming a full master within the community of practice. While solving basic level problems, the journeyman is continuing to study with the master and also assisting the master in handling more complicated problem solving tasks. It is through working with the master that the journeyman comes to grasp the nature of complicated domain relationships and acquiring the necessary expertise to combat advanced domain related problems.

Upon completion of the journeyman process, the learner will attain the rank of master or expert in the community of practice. The rank of master within the community of practice is the pinnacle position in which a community member may achieve. The profile of an expert within the context of a community of practice is an individual that holds mastery of knowledge, experience, and skills within said community. The expert learner has spent the prerequisite amount of time involved in the day to day affairs of the community to understand the complex nature of a majority of relationships between domain related functions.

Throughout their time in the community, the expert will have faced a significant number of challenges in which he would have been able to apply his problem solving abilities towards. Mastery of any domain related challenge would only assist the expert in the acquisition of expertise which may usefully be applied to guide the community of practice as a whole. It is during this time that the expert learner may begin to modify the community of practice at an organizational level. The expert will begin to contribute to the policy that guides the direction and actions of the community of practice. The expert will also be responsible to some degree of educating more junior members in the community. Dictating curriculum and training practices for novices will be one of the many educational duties that the expert will influence.

It will also be crucial for the expert to act as a mentor to the journeymen of the community. Much like the relationship a faculty member shares with a doctoral student, the expert learner will provide opportunities for the journeymen to apply their knowledge and grow into mastery on their own. The expert learner should also facilitate opportunities for journeyman to expand their knowledge and collaborate in the production of solution for novel problems at the community level. Continuing the cycle of learning opportunities will enable the journeyman to next inherent the leadership mantle within the community of practice and insure the continuation of the community of practice.

Conceptual Components in a Community of Practice

Learning as a process of internalization. Lave and Wenger (1991) challenge the assumption that learning occurs exclusively within an individual with no consideration given to external factors. "This focus of internalization does not just leave the nature of the learner, of the world, and of their relations unexplored; it can only reflect far-reaching assumptions concerning these issues" (Lave & Wenger, 1991, p. 47). The authors confront contemporary learning theories with the argument that the process of learning not only requires the transmission of facts and concepts but also needs to consider the broader social context of a learning environment. Even some social learning theories such as Vygotsky's only examine the social environment as a process of social transformation. Lave and Wenger write that it is necessary to "…place more emphasis on connecting issues of sociocultural transformation with the changing relations between newcomers and old-timers in the context of a changing shared practice" (Lave & Wenger, 1991, p. 49). Simply stated, Lave and Wenger (1991) believe that it is necessary to include external, social relations as factors that influence knowledge acquisition.

Participation in social practice as a means of learning. Lave and Wenger also argue that learning occurs within the broader general context of a community of practice (i.e., by participating with other individuals, a person grows in domain-related skills and knowledge). The concept of social practice states that the learner must interact with the community of practice and its constituents to truly learn. "Briefly, a theory of social practice emphasizes the relational interdependency of agent and world, activity, meaning, cognition, learning, and knowing" (Lave & Wenger, 1991, p. 50). Within social practice, the acquisition and the ability to understand knowledge is generated among relations occurring from a socially structured world. Knowledge is almost completely structured with meaning of domain-related concepts and systems derived from the social context in which it occurs. Knowledge therefore is open-ended and can continue to grow and be restructured based on domain-related discoveries.

The person in identity and learning. Lave and Wenger (1991) write that the individual learner is not at the epicenter of their learning theory as opposed to other contemporary learning theory. They propose, rather, that the learner is one factor of many others in a system of learning taking place in a community of practice. "In reality, however, participation in social practice--subjective as well as objective--suggests a very explicit focus on the person, but as person-in-the-world, as members of a sociocultural community" (Lave & Wenger, 1991, p. 52). Lave and Wenger postulate that learning occurs not only in the relations between members of a community of practice but also other elements in the learning community. The learner moves through a community of practice as a vested member participating in varying types of activities. Within the domain-related activities, the learner begins to understand the domain as a whole through interaction with new activities. Performing various domain-related activities leads to mastering new understanding of system relationships and knowledge. Lave and Wenger (1991) state that domain related understanding does not occur in isolation but through interaction within broader systems inside the community of practice. System relations are reproduced within the context of social communities, leading to interactions with other community members defining bodies of knowledge.

The identity of each community member is predicated on the idea that interaction with other members is foundational to establishing an identity. Through interactions with other members, Lave and Wenger argue that a person's identity is defined in didactic relationships with others and in turn other members establish their identity through the same interactions. "Learning thus implies becoming a different person with respect to the possibilities enabled by these systems of relationships. To ignore this aspect of learning is to overlook the fact that learning involves the construction of identities" (Lave & Wenger, 1991, p. 53). The identity of community members is constantly evolving through legitimate peripheral participation; sharing in the experiences and tasks necessary for the continuation of a community of practice. The establishment of a community member's identity is an ongoing, dynamic, systemic, long-term process in which that identity constantly evolves through shared interactions with the environment and other members of a community of practice (Lave & Wenger, 1991).

The social world. Lave and Wenger argue that a global, systemic understanding and awareness of a learner's environment is necessary for true learning to occur. Possessing a complete understanding of a community of practice's cultural system of meaning encourages the learner to begin building knowledge that will allow them to contribute to the learning community. The social world system of learning encompasses the community of practice as one large system of learning opportunities. It is through legitimate peripheral participation that a member of a community will learn about the community and eventually begin to modify the domain as he/she becomes more central within that community.

Legitimate peripheral participation serves as the bridge to access a community of practice. Through interactions with the community of practice, or the social world, the learner begins to form identities and foundational domain-related knowledge. Legitimate peripheral participation functions as the gateway in which a learner acquires knowledge, skills, and experience within the domain. “Legitimate peripheral participation is intended as a conceptual bridge – as a claim about the common processes inherent in the production of changing persons and changing communities of practice” (Lave & Wenger, 1991, p. 55). The learner that participates in legitimate peripheral participation modifies the social world through interaction.

Lave and Wenger suggest that legitimate peripheral participation transforms the very reality of the social world in a community of practice. “Legitimate peripheral participation refers both to the development of knowledgeably skilled identities in practice and to the reproduction and transformation of communities of practice” (Lave & Wenger, 1991, p. 55). New identities emerge through the interaction of members with one another. Each individual’s relationships and learning trajectory modifies the social world with the addition of new knowledge, advances in technology, and new best practices. Every new member brings new experiences and information that shift identities in a very dynamic process that leaves the domain as a whole changed. When the identity of the social world constantly changes, learning itself continues to affect each member of a community of practice because their identities are changed. The idea that identity constantly evolves is the important reason why the social world is a major component in learning. Learning is therefore defined socially if the domain related identity and knowledge are constantly evolving. The implication for a constantly evolving identity is that members must stay continuously involved with their domain if they wish to understand the complex nature of their community of practice. How are the community of practice, the social world, and social practice similar or different?

The community of practice provides the context of a learning environment. It is a specific instance in which members of the community collaborate to further develop a body of knowledge. Within the community of practice, each member participates in activities that contribute to the development of that individual. Social practice refers to the idea that learning is not strictly internalization of information but rather praxis; the application of knowledge within a particular context (Lave & Wenger, 1991). The social world refers to the idea that it is necessary to analyze each component of the community of practice to determine its relationship in the context of learning. The community of practice is the specific environment in which the learner experiences the social world and has the opportunity to actively learn and apply knowledge using social learning. Ideally, the learner within the community of practice should be able to learn experientially interacting with various elements of the social world. The relationship between the elements is such that the social world and social learning occur within the community of practice.

Examples of Legitimate Peripheral Participation

The latter portion of Lave and Wenger's (1991) published work details research conducted in several different occupations that detail their theory of situated learning. Hutchins (1996) discusses his research on the acceptance of new members into the U.S. Navy Quartermaster corps which serves as the community of practice. His research details the process of new members of the Quartermaster corps as they embrace new tasks and over time move to completing tasks that are essential to the mission of Quartermaster corps in the operation of a ship. "[Hutchins] describes the process by which new members of the quartermaster corps move from peripheral to key distributed tasks in the collaborative work of plotting the ship's position" (Lave & Wenger, 1991, p. 73). The process of training a new member of the corps involves exposure to the tasks involved in a community of practice.

The novice quartermaster begins his tenure within the community of practice with little understanding of the terminology and concepts involved in plotting a ship at sea or navigating inside a harbor, tasks representing social learning. The novice quartermaster will conduct training exercises and read through workbooks in the pursuit of acquiring the necessary knowledge and skills to perform domain-related tasks on an individual basis. Hutchins (1996) indicates in his research that the typical novice quartermaster begins his or her training on the job accomplishing tasks that a seasoned quartermaster also performs, albeit under a high level of supervision. The novice quartermaster participates in six activities as a fathometer operator or bearing taker that will assist him in the development of necessary knowledge and skills to become an expert quartermaster.

During the introductory tasks, novices are highly supervised by more experienced members of the community in the event that a difficulty arises.

The novice quartermaster begins an apprenticeship as a fathometer operator and/or a bearing taker. These functions are designed to assist the novice quartermaster in learning the procedures necessary to identify the location of a ship. The apprentice quartermaster moves through six different positions within their introductory role in order to learn information needed to become a member of the community of practice. The novice quartermaster begins working with the sensors of the ship, cultivating an understanding of the data provided. After accumulating enough experience and knowledge about sensor-related information, the novice quartermaster learns to integrate the data from the sensors into a chart that combines all of the sensor information into a physical location. During this process, the novice quartermaster learns to identify concepts and procedures to successfully plot the location of a ship. The learner's exposure to the opportunities of applying knowledge directly to community of practice tasks is an example of Lave and Wenger's concept of social learning.

The direct exposure of novice quartermasters to domain-related tasks is a hallmark of the situated learning theory. Interacting directly with community of practice tasks in an effort to learn the necessary skills to function even as a basic member in a learning community prepares the novice to become a vested member within the community. Hutchins (1996) mentions periodically in his research that novice quartermasters are frequently supervised by expert quartermasters to ensure the smooth continuation of the community. The novice quartermaster works with his superiors in the domain to cultivate an understanding of concepts and procedures necessary to plot a position of the ship in which they reside.

Knowledge about ship function and location is constructed in a social atmosphere in which expert quartermasters work with their novice counterparts to help them identify proper practices that ensure successful performance. The novice quartermaster is expected to master basic tasks such as reading a sensor to cement understanding of the equipment that they use and the information that the equipment provides. Upon mastery of basic directional knowledge and sensor usage, the novice is tasked with learning to integrate information from all directional devices to determine a location of the ship. Throughout the learning process, the novice works with domain experts to answer questions and receive tutoring in the proper operation of their duties. As the novices grow in knowledge and experience, less supervision is necessary and the novice quartermasters can independently complete their duties. Exposure to multiple duties and understanding how tasks relate to one another ties directly into the concept of the social world. The quartermaster that understands the global relationships between all duty related tasks and bodies of knowledge and uses them effectively to complete duties illustrates the concept of the social world. The end result of the quartermaster learning trajectory is an accomplished quartermaster that can effectively use the proper instrumentation and apply domain related knowledge to perform their duty of plotting ship location.

A Summary of Lave and Wenger's Theory of Situated Learning

Lave and Wenger's theory of situated learning theorizes that a learner enters into a community of practice as a novice member. The novice learner develops domain-related knowledge and skills through interactions with the community of practice. Working with journeyman and experts, the novice learner begins to complete basic domain-related tasks to develop the necessary knowledge to further understand the community of practice. After a prolonged period of time involved in the community, the novice becomes a journeyman within the learning community.

As a journeyman, the learner expands his/her knowledge through mastery of more difficult domain-related problems. Working with experts, the journeyman will hone his knowledge and experience within the domain to become an expert. The journeyman is responsible for instructing novices in the basic skill sets of the domain and working as support for the domain experts. In the journeyman stage, the learner is given opportunities to practice what they have learned to solve more advanced levels of problems while also continuing to learn from the experts. The journeyman is learning how to apply his or her knowledge beyond the basic novice.

Finally, the domain expert is responsible for making decisions and completing any tasks that are related to the continuation of and innovation within the domain. Exploring new methods of creating domain-related knowledge or innovating new techniques to replace older ones are some of the roles that the expert accomplishes. Working with and instructing younger members of the community of practice are also fundamental to developing new resources for the domain. All three groups of members within a community of practice are necessary for the continuation and expansion of the community.

The theory of situated learning rests on the premise that learning occurs within a social context. When an individual interactions with the community, new knowledge and expertise are learned through the completion of domain-related tasks. Working with peers and/or superiors will generate new experiences and identify opportunities to improve the domain. The learner creates an identity within the community of practice through didactic learning encounters with other individuals in the community. Sharing and exchanging knowledge shapes the learner as they discuss the domain with other individuals and interact in learning opportunity within a community of practice. Contrasting with other contemporary learning theories, the learner as an individual is but one variable that must be taken into consideration when discussing what it means to learn. Based on the theory of situated learning, learning occurs when the individual is involved within the context of a community of practice completing domain-related tasks and interacting with other community members. Learning is an interactive activity requiring active participation in meaningful, domain-related tasks that build knowledge within a specific context such as a community of practice.

There is a need to examine the development of expertise within a specific context to support the development of the electronic portfolio. The electronic portfolio literature argues that technical support is needed to facilitate a successful electronic portfolio system. No literature addresses an exact methodology for training a technical support team in this context. The need to investigate the acquisition of expertise in this specific context is great because a successful electronic portfolio system relies on knowledgeable problem solvers to address any issues that arise. To successfully address said issues, the support staff members need to be trained in an effective manner to support the electronic portfolio system. Currently there is no method that is identified to fill this need so the purpose of this study is to investigate the acquisition of expertise for electronic portfolio support staff. After identifying factors that influence the acquisition of expertise in this contact, future research could investigate different effective methods for training electronic portfolio support staff.

CHAPTER THREE

Methods

Introduction

The primary goal of this study was to explore the transition of a portfolio support staff member from a novice to an expert in the field of electronic portfolio technical support. The study attempted to carefully detail the process and investigate the changes that occur in the types and levels of learning that the portfolio support staff member experiences. Little literature exists that described an individual's acquisition of expertise in managing and supporting an electronic portfolio system. The secondary goal of this study was to generate a model that explains the change in expertise for portfolio support staff members. The following research questions were the focus of this study:

1. What are the knowledge, skills, beliefs, and dispositions involved in a support staff member's acquisition of expertise in the field of electronic portfolio technical support?
2. What are the contextual factors involved in a support staff member's acquisition of expertise in the field of electronic portfolio technical support?
3. What model can be constructed to explain a support staff member's transition from novice to expert in the field of electronic portfolio technical support?

Rationale for Qualitative Design

A qualitative research design was selected because the study's research questions are exploratory in nature. Creswell (1997) wrote that a qualitative study should be used when attempting to answer research questions that are initial explorations within a topic area. The study sought to explore and describe the process of acquiring expertise within a specific learning community. The researcher wished to more fully understand the underlying skills, beliefs, and dispositions in a unique environment and how they might influence the acquisition of expertise for electronic portfolio support staff members. Qualitative research methods were useful to investigate the research questions of this study because the methods were used to illustrate a detailed view of the distinctive case that exists and can provide a close up view of the phenomenon in a specific context.

The Specific Design Employed

The specific qualitative approach was a combination of the case study and narrative inquiry methodologies. A case study methodology was appropriate for this study because the study was conducted within a specific bounded area as defined by Creswell (1997). Patton (2001) defined a case study as the examination of a singular entity such as an individual, a family, or an organizational unit. In this study, the researcher investigated each individual's acquisition of knowledge and skills related to electronic portfolio expertise. Research was limited to a subgroup unit, which was one small part of a much larger organization. The interactions of that subgroup with a larger organization were not studied.

The narrative inquiry methodology was also incorporated into this study because of its exploratory nature. Patton (2001) defined the narrative inquiry as composed of "personal narratives… [and] life histories… that can reveal cultural and social patterns through the lens of individual experiences" (p. 115). The narrative inquiry methodology can be used to interpret experiences from multiple viewpoints and recontextualize the information into a generalizable theory (Josselson & Lieblich, 1995). To identify the knowledge and processes that helped each individual make the transition from novice support to expert support staff, an inquiry methodology drew upon participants' past life experiences expressed in the narrative format. The research participants were asked to specifically detail any stories regarding the learning process of portfolio support job tasks. The interpretation of information from the narratives and interviews of the research participants revealed common elements and themes regarding the transition from novice portfolio support staff to expert. It was the plan of the researcher to identify common elements and themes that were used to construct a theory that explained the acquisition of expertise in the transition from novice portfolio support staff to that of an expert.

Role of the Researcher

In this qualitative research study, the role of the researcher was that he served as the instrument. The researcher served as the mechanism that aggregated the data needed in the study. It was the obligation of the researcher to understand his position in the study so that the data were collected with integrity. The researcher conducted himself in such a way that any data gathered could be subjected to rigorous standards of the qualitative version of validity and reliability. According to Creswell (2002), a researcher that incorporated the narrative inquiry methodology in a study must use "empathetic neutrality." Creswell wrote that empathetic neutrality is an attitude that the researcher should embrace as he studies the question at hand.

Empathetic neutrality provided a middle ground that allowed the researcher not to become so involved with the research participants that personal biases prevented the gathering of useful information (Creswell, 2002). It was also an attitude that prevented the researcher from becoming too distant from the research. which could possibly prevent the establishment of rapport with the research participants and not yield the specific information in which the researcher is interested. To be successful in conducting this particular study, it was necessary for the researcher to facilitate a relationship with the subject participants to a degree that allowed for the useful acquisition of information but that also did not harm the integrity of the data.

The researcher possessed a large amount of experience in educational technology and information systems. The researcher's education provided a comprehensive background to understand a system of technology and its interaction with the research participants involved in this study. Moreover, the researcher's doctoral program included courses about the different theories of human learning and interaction with the learning environment. Understanding the knowledge, skills, and dispositions among participants was critical to study the transition from novice to expert in electronic portfolio technical support.

The researcher worked in the organizational unit that was the focus of this investigation. Over three years of work experience granted the researcher understanding and knowledge of the various functions and processes at work within the proposed research environment. The challenges that the researcher faced during the investigative process was his lack of experience in conducting qualitative studies. To solve this challenge, the researcher familiarized himself with qualitative procedures through the study of the literature that related to the methodology used in the study and drew upon the expertise of the methodologist serving on the researcher's dissertation committee. The researcher also faced the challenge of over familiarity with the research participants because they were work colleagues. A large amount of work experience and prior research of the proposed learning community provided additional challenges of bias for the researcher. It was necessary for the researcher to triangulate his data and observe the experiences described by research participants because their experiences elicited information that granted greater understanding to the environment and processes of acquiring expertise.

Design Specifics

Context

The setting for the study was chosen because it was the location of the phenomenon that interested the researcher. The location of the electronic portfolio support staff was a media lab, called the Media Center, which served the technological needs of the School of Education. The lab was the best location to conduct the research study because it was the environment in which the research participants interacted and developed their expertise. The researcher entered into the research setting because it was his place of employment. The researcher secured permission to study the questions posed in this study from the research participants and from the individuals responsible for the direction and operation of the Media Center.

The Media Center was housed on the second floor of an academic building in a private university. It was a rectangular room that contained a large amount of technological equipment in addition to supplies like lamination that the preservice teacher was able to use for their class work. The Media Center was staffed by five graduate students and two undergraduate student workers. Generally, two staff members were present at any one time to support any individual that may need assistance. Multiple types of technological equipment such as computers, scanners, printers were available for use by faculty and students in the Media Center. The Media Center was the central hub for any technological need within the School of Education. In addition to providing equipment for faculty and student needs, the Media Center staff also provided technical support and electronic portfolio consulting services for the faculty, staff, and students members of the School of Education. Any faculty member or student with a technological question could approach a member of the Media Center staff for assistance at any time.

The faculty required undergraduate preservice teachers at the university to create and maintain an electronic portfolio as part of their coursework. The Media Center offered electronic portfolio consulting services to any undergraduate preservice teacher that experiences any type of technological difficulty with their electronic portfolio. At least one Media Center staff member was available Monday through Friday from 7:30 am to 6:30 pm to assist preservice teachers with any electronic portfolio problem they might experience. Preservice teachers that sought assistance from electronic portfolio support staff signed up for individual sessions using an Internet calendar. Preservice teachers seeking technical assistance for their electronic portfolio received individual support in thirty-minute allotments. During that time a Media Center staff member diagnosed the nature of the problem and provided the preservice teacher with the necessary instruction to solve the problem.

Participants

The portfolio support staff members were deliberately chosen as a purposeful sample for this study because they were the students that populated the area that will be researched. The electronic portfolio support staff consisted of five graduate students and two undergraduate students. Of the available staff, four graduate students and one of the undergraduate students were asked to participate in the study. One graduate student was not eligible for the study because he was the author of this study and one undergraduate was not asked to participate because he was not trained in the usage of the electronic portfolio system. Of the four graduate students, one was a Hispanic female, age 23, and three were Caucasian males with ages ranging from age 37 to age 55; the undergraduate student was a 20 year old Caucasian male. Three of the graduate students pursued doctorates**,** one in educational technology and two in educational psychology. The remaining graduate student pursued a master's degree in educational technology. The undergraduate student pursued a baccalaureate degree in accounting.

Data Collection

Data were collected through a combination of instruments that ideally captured the information related to the researcher's questions. The following instruments were used to collect the data for this study:

1. Observations of group technical support sessions
2. Observations of individual technical support sessions
3. Concept Mapping
4. Narrative Prompts
5. Semi-structured Interviews
6. Demographic information

To examine the knowledge and skills in the acquisition of expertise, the researcher drew upon data collected from all six instruments.

Group and individual observations provided data on the knowledge and skills that each participant possessed by capturing interactions between the participant and the individuals they were helping. Each research participant was required to use a concept map to illustrate the complexity of their mental model of expertise in the area of the electronic portfolio, thereby illustrating their current level of electronic portfolio expertise. The narrative prompts were designed to examine the knowledge and skills of each participant as they drew upon past experiences and knowledge to solve hypothetical problems offered in the prompts. The semi-structured interviews contained questions that examined the knowledge and skills of the participant but also examined the beliefs of the research participants in the field of expertise. Finally, the demographic form each research participant completed was designed to capture former expertise that may have contributed in some manner to their current level of expertise. To examine context in the acquisition of expertise, group and individual observations captured interactions within the study environment that affected the acquisition of expertise. The researcher constructed a model that explained the acquisition of electronic portfolio expertise, data gathered from all six instruments was examined for any pertinent information that affected the acquisition of expertise.

The researcher approached the support team students involved in the operation of the School of Education Media Center to explain the purpose of the study and if willing to participate, he asked them to sign the consent form. The informed consent form explained the parameters of the study and the student's rights as a potential research participant. The researcher also informed the research participant that any data collected throughout the study would remain anonymous. Data were collected in two separate phases using six different data collection methods.

During the first phase of the study, the researcher unobtrusively studied the support team participants through observation. The researcher sought to study the level of expertise for each support team member in their natural setting without any type of prompting. Support team participants were first studied while they conducted group electronic portfolio training sessions for undergraduate education. Observations were conducted with a video camcorder and the camcorder was positioned to solely capture research participant performance; undergraduate education students were captured in the video footage. A second set of observations were conducted as each support team participant conducts electronic portfolio training sessions with individual undergraduate education students. Each observation was filmed with a camcorder to capture the interaction of both research participant and the preservice teacher he or she was helping. The researcher also created an additional consent form apprising the undergraduate student receiving electronic portfolio training of their rights and the content of the study.

Each support team participant was observed conducting electronic portfolio training on three separate occasions at one-hour iterations in the Media Center. Finally, the researcher provided all of the participants with a concept map prompt which asked them to detail how they conceptualized the electronic portfolio. The concept map was completed in a location of the participant's choice. The concept map was an independent data collection activity that related to the complexity and structure of each support team participant's knowledge of the electronic portfolio.

The second phase of the study was designed with more structure and direction to ensure that each support team participant was required to respond to a range of technology problems to demonstrate expertise. The support team participants were given four different narrative prompts (e.g. problem solving scenarios) that they completed. Responses to the narrative prompts were used to assist the researcher in assessing the current level of expertise for each support team participant. The narrative prompts were also completed in a location of the participant's choice. Next, support team participants were interviewed using a semi-structured format. The purpose of semi-structured interview format was to capture any pertinent information that relates to the research questions and clarify any information gleaned from the narrative prompts. The researcher scheduled interviews with each research participant and the interviews were conducted in an empty classroom. Finally, demographic information was collected from research participants regarding their past teaching and technical experiences. The following sections will provide an explanation for each instrument and discusses measures taken to ensure the accuracy and comprehensiveness for all data collection instrument.

Group Observations

To begin the study, the researcher observed the study participants as they conducted group technical support sessions for undergraduate education students. At the beginning of each semester, each of the research participants was assigned a group technical support session in which they instructed preservice teachers in the content and procedure of the electronic portfolio. The content of each group instructional session was standardized so that each instructional group received the same information regarding usage of the electronic portfolio. The rationale for observing each research participant as they taught was to determine if there was a variation in the pedagogic and instructional practices of each research participant. One limitation with this instrument was that Participant 4 was not assigned to lead a group training session during data collection so no group observation data were available for Participant 4. The group observations served as a baseline to assist the researcher in determining the expertise level of each research participant. To ensure the accuracy of the group observations, the researcher filmed each participant using a video camcorder as they conducted the group technical support session. Each participant's video footage was exported onto a DVD, creating an archive of the observations in the event that the observations needed to be viewed again.

Individual Observations

The researcher conducted observations of the research participants as they conducted individual electronic portfolio training sessions with undergraduate education students. Research participants conducted technical support sessions with individual electronic portfolio users on a daily basis. During the school semester, electronic portfolio support staff members were inundated with requests for technical support on preservice teacher electronic portfolios. Undergraduate students scheduled electronic portfolio support appointments on the Internet and the researcher viewed this schedule to determine when each research participant could be observed. Each research participant was observed on three separate occasions in one-hour intervals to ensure the consistency and accuracy of each research participant's performance. Observations were conducted in the community of practice to be sure the portfolio support staff was situated within the learning environment. Field notes were used to collect any data that the researcher determined as significant to the research goals of the study. Each observation session was videotaped to add validity to the written observations the researcher captured.

The researcher observed different research participants and compared their interactions with the undergraduate students they supported. The rationale for this observation was to determine if similar support problems were handled in specific ways based upon the level of expertise. Like its group observational counterpart, the individual electronic portfolio session was filmed using a video camcorder and the video footage was exported to DVD for archival purposes to ensure accuracy of the data.

Concept Mapping

Each research participant was asked to complete a concept map detailing their perception of expertise in the subject matter of electronic portfolio technical support. A concept map was an independent data collection activity that related to the complexity and structure of each support team participant's knowledge. Theoretically, the complexity of the diagram that each individual research participant created presented an accurate representation for the mental model that each research participant possessed of the electronic portfolio. Research participants completed the concept map independently, but were asked to complete the concept map in a period of two weeks. Each research participant was given identical instructions to complete the concept map to maintain accuracy and comprehensiveness of the data collected via the concept map. The directions were as follows:

> You are to construct a concept map that demonstrates the complexity of your knowledge on the subject of the electronic portfolio. In the center of this page, draw a circle around the phrase, "Electronic Portfolio Knowledge." Draw spokes from this circle to other circles and label those with aspects of the electronic portfolio. From these smaller circles, draw other smaller circles until you are satisfied with your map. After you are

finished, please explain the reasons for selecting the categories and subcategories on the back or on a separate sheet of paper. This assignment is to be completed individually without communication from your peers.

The research participants were also instructed to complete the concept maps individually with no collaboration with their peers to maintain comprehensiveness of the concept map data.

Narrative Prompts

Research participants responded in the form of a narrative to four problem solving scenarios. Based on their experiences and their current level of knowledge, the research participants responded to the problem solving scenarios that were posed in four hypothetical situations. The narrative prompts were designed with just enough structure to provide the research participant with a general understanding of a problem but contained enough flexibility to allow the research participant to determine exactly how the problem might be solved. There were a number of different possible solutions to each of the narrative prompts and the complexity and number of solutions the research participant offered provided the researcher with an understanding of the expertise level of each research participant. The narrative prompts were designed to investigate the amount of technical skill and knowledge and instructional strategies held by each research participant and ensured that each participant responded to a similar set of problems with similar levels of complexity. The narrative prompts are listed below:

1. Imagine that you are helping four different individuals simultaneously; you have no assistance from your colleagues so you are solely responsible for these students completing their electronic portfolios. Describe how you would manage supporting four different students with the following electronic portfolio issues at the same time so that they finish their work.
    A. The first student has not established a presence on the Internet and must complete two benchmarks.

B. The second student has lost her flash drive and needs a new copy of her electronic portfolio in addition to learning how to duplicate evidence pages and hyperlinks
C. The third student is a Teaching Associate but does not remember anything about using her electronic portfolio because it has been a year since she used it.
D. The fourth student has multiple pictures that are not showing up on her electronic portfolio site when viewed through the Internet.

2. An intern arrives at the Media Center asking for help 15 minutes before closing time. She has no flash drive, no appointment, all paper materials, and her completed electronic portfolio is due at 8am the next morning. She must place three benchmarks consisting of three narratives and pieces of evidence out on the Internet. How would you solve this problem? What would your reaction be to this situation?
3. You are working with an individual student on her electronic portfolio. She has changed her template files so that they no longer duplicate the correct form when opened. Multiple pictures, evidence pages, and narrative pages have been duplicated and are no longer in their proper folders. Finally, somehow random files are located outside each of the benchmarks near the index webpage. How do you handle this situation?
4. You are assisting a student with his electronic portfolio because he cannot solve several of the technological problems independently. Symptoms of the problem(s) include long upload times, pictures not showing up on the web and previously made hyperlinks that no longer work. Define the problem(s) and provide a solution to the problem(s) you defined earlier.

The researcher instructed each participant to spend approximately two to three hours writing the narratives and asked that the narratives be completed at the home of the participant or in a location that the participant was most at ease to begin writing; each participant was given identical instructions to preserve reliability and validity. In addition, the prompts were revised by experts in the field and pilot tested on former employees of the Media Center. Research participants were instructed to complete the narrative prompts individually with no collaboration from fellow research participants to maintain the validity of their answers. The directions were as follows:

> Carefully read the following prompts and answer each one completely on a separate sheet of paper. Each prompt should be answered in approximately 30 minutes. Please complete the concept map in a quiet location that allows you

focus entirely on this exercise. Complete this exercise individually and do not discuss with your peers.

Completing the narrative responses individually with no aid from other participants ensured that the responses were original and a true measure of each research participant's knowledge and skill level.

Interview

In developing the interview, the researcher designed the questions to differentiate two levels: novice level questions and expert level questions. The interview questions were pilot tested on former Media center employees with electronic portfolio experience. The interview questions were also reviewed and revised by an expert in qualitative methods. The researcher differentiated research questions into two levels: novice level questions and expert level questions.

During the interview, the researcher looked for commonalities consistent throughout each interview. The questions that were addressed in the initial interview were created to help answer the research questions. The following initial interview questions will be asked:

- Do you consider yourself a novice portfolio support staff member, an expert, or somewhere in between? Why do you place yourself in such a category?

Novice Portfolio Support Staff Questions

- When you encounter a problem you have never seen before, how exactly do you go about solving it?
- Being new to the area of portfolio support, what factors do you think determine if an individual is an expert electronic portfolio support staff member?
- Did you receive any training before you became portfolio support staff? If so, describe the training process. If not, how did you acquire your current level of knowledge?
- In your opinion, what factors will contribute to you becoming an expert in the area of portfolio support?

- What factors do you consider when a student approaches you with a problem regarding their electronic portfolio?
- Do you notice a difference between how you would go about solving a portfolio problem and how an expert might go about solving a portfolio problem?
- Do you think there are any environmental factors that will contribute to you becoming an expert in portfolio support?
- Is there any information that you would like to add to the interview that shaped your expertise level that the researcher did not mention?

Intermediate/Expert Portfolio Support Staff Questions

- When you encounter a problem you have never seen before, how exactly do you go about solving it?
- Do you approach problems differently at your current level of expertise than you did as a novice? How so?
- Did you receive any training before you became portfolio support staff? If so, describe the training process. If not, how did you acquire your current level of knowledge?
- Is there a difference between the level of knowledge you possess now than you did when you were a novice? How has that level of knowledge changed? How did you acquire that knowledge? Do you arrange your knowledge differently now than you did as a novice?
- Explain your experiences in transitioning from novice to your current expertise level now. What factors influenced your change from the novice stage to your current level of expertise?
- In your opinion, what is the difference between a novice portfolio support staff member and an expert portfolio support staff member?
- Can you think of any significant information or experiences that shaped your level of expertise or affected it in any way?
- What factors do you consider when a student approaches you with a problem regarding their electronic portfolio?
- Is there any information that you would like to add to the interview that shaped your expertise level that the researcher did not mention?

Interviews were taped using one digital tape recorder and one analog recorder for the purposes of redundancy and trustworthiness. In addition to asking the questions written above, the researcher also fostered a didactic interaction with the research participants if he/she mentioned information that was relative to the study but was not initially covered by the researcher. The purpose for the semi-structured interview methodology was to encourage the research participant to include information that the researcher did not mention directly.

Demographics Sheet

The researcher provided each research participant with a demographic form to be completed. Research participants were asked to designate the amount of time that they had worked in the Media Center as a student worker/graduate student and the degree being sought. The demographic sheet also asked each research participant to describe any past work experience in the areas of teaching and technology. The demographic sheet used several Likert scales to determine the extent that technology was integrated within each research participant's life. The research participant was asked to rate the amount that they use technology in their personal, professional, and academic life using a scale from 1 to 10. The demographic form was simply used to gather background information on prior technology use and experience.

Post Activity Data Management

The researcher assigned a folder for each individual participating in the study. Narratives were inserted into the folder based on the name of the participant. Interviews were taped on digital and analog tapes and stored inside the folder of the corresponding research participant; tapes were labeled with the participant's name to assist in maintaining data integrity. Interviews were transcribed at the completion of each interview session and inserted into each participant's folder along with any necessary forms. Field notes were taken from observations and were filed according to name of the participant. All observations were videotaped with a camcorder to supplement any observations that the researcher notes.

Data Analysis Methods

The researcher began the data analysis process by looking for common themes and elements within the data provided from the gathered observations, interviews, concept maps, and the narratives prompts from each individual research participant. The data analysis process began simultaneously with the data collection process using the constant comparison data analysis method as described by Patton (2002).

Observations. During each observation of a research participant, the researcher took field notes to attempt to categorize the level of expertise for each research participant. Field notes were analyzed simultaneously with the corresponding video footage in attempt to classify the expertise level of the research participant. The researcher attempted to discern the level of expertise from the level of knowledge and skills displayed during the observation times. Each research participant's observation was compared to the other participants' responses in order to create a metric that might define levels of expertise.

Concept Map. Once the research participants completed a concept map, the researcher examined the complexity and completeness of each concept map using a modified version of Trent and Dixon's (2004) analysis rubric. Each element drawn on the concept map representing a conceptual growth or linking multiple concepts of expertise was worth one-half of a point each. The researcher summed the total amount of points on each participant's concept map to create a numerical score that was used to rank each participant's level of expertise; thereby representing the complexity of expertise held by each participant. The researcher also examined research participant concept maps for data that was useful in creating a model that theorized the acquisition of electronic portfolio expertise.

Interviews. The researcher gathered all of the data recorded during research participant interviews and transcribed the data. The researcher grouped and organized participant responses according to the corresponding research question. The responses from each interview question were analyzed for contextual factors that affected the acquisition of expertise and for any information that was useful in developing a model that explained the acquisition of expertise for a portfolio support staff member. The researcher located contextual factors affecting expertise within the interview data by looking for factors that correlated directly to the specific environment of the Media Center or that were not mentioned specifically within the expertise literature. Information was coded according to any common themes that the research participants elicited.

Demographic Form. Each demographic form was examined for relevant past experience in the areas of teaching or technical support. The demographic form also detailed how often technology was used in different aspects of each research participant's life (e.g. personal life). The demographic form was also useful in capturing academic backgrounds on each participant.

Narrative Prompts. The researcher examined the narratives for information that indicated the level of expertise each individual research participant possessed. Once the elements of expertise were pulled from each individual narrative, the researcher began to group the entries by common theme. The analysis of data provided from the prompts revealed differences between research participants in the area of mastery of electronic portfolio content knowledge, level of problem solving abilities, and the perception of the underlying structure of the listed problems.

Cross-Case Analysis. Upon completion of coding each piece of data using pattern matching, the researcher aggregated data into five different categories based on Ericsson's (2003) model of expertise and Lave and Wenger's (1991) theory of community of practice for each case. Data were aggregated into the following categories: Domain Knowledge, Performance, Problem Solving, Deliberate Practice in the Domain Over Time, and the Learning Community. Once each case was analyzed individually, a cross-case analysis was used to examine similarities and differences between each case (Yin, 1984). The purpose of the cross-case analysis was to divide the data by type across the various cases to further investigate similarities and differences. Cross-case analysis provided an opportunity to look for patterns across the different cases. Finding multiple instances of recurring themes corroborated researcher findings, strengthening the findings of the study (Yin, 1984).

A modified Constant-Comparative Analysis was used to search for similarities and differences across the cases. Glaser and Strauss (1967) stated that this method of analysis is inductive as it is used to examine each piece of data looking for differences and similarities with other pieces of data. This inductive process was used to classify data based on different perspectives on central issues given by each participant and defined by the Lave and Wenger's (1991) and Ericsson's (2003) theoretical frameworks. The purpose of using this analysis approach was to search for common answers to the research questions based on the experiences of each study participant.

The outcome of the study was to describe that details the process of acquiring expertise for the portfolio support staff. The researcher identified the knowledge, skills, beliefs, and dispositions of each support staff member. The researcher also described the transition of the novice to the expert portfolio support staff member based on a synthesis of the interviews, observations, and narratives written by the research participants. The second outcome of the research study was a graphic depiction of the model that the researcher created using the information received from the study.

CHAPTER FOUR

Results

Introduction

The findings of five case studies that comprise this study are discussed below followed by a cross case analysis. According to Creswell (2007), "case study research involves the study of an issue explored through one or more cases within a bounded system" (p. 73). The analysis below is a discussion on data collected from the following sources: interviews, single observations, group observations, concept maps, narrative prompts, and demographics. Initially, each case study will be discussed followed by each case's contribution to the entire study. The following questions that guided the study are addressed following the analysis of each case and the cross-case study analyses:

1. What are the knowledge, skills, beliefs, and dispositions involved in a support staff member's acquisition of expertise in the field of electronic portfolio technical support?
2. What are the contextual factors involved in a support staff member's acquisition of expertise in the field of electronic portfolio technical support?
3. What model can be constructed to explain a support staff member's transition from novice to expert in the field of electronic portfolio technical support?

Method for Analysis

The initial analysis of the data was conducted by reading through all gathered data to establish a basic comprehension of the scope of accumulated data. Conducting this process provided the researcher an opportunity to preview the data and extrapolate any potential themes that could be useful at a later point in the data analysis. This process was replicated through all five cases in their entirety. Next, the software package Nvivo 8 was used to code data into a framework based on Ericsson's framework of acquisition of expertise using pattern matching. All relevant data points from interviews, single observations, group observations, concept maps, narrative prompts, and demographics were coded for each participant of the study.

While Ericsson's theory of acquisition originally detailed thirteen indicators of expertise, coding of the data revealed four major themes that were significant. The following themes were found after the initial data was read: domain-related knowledge, performance, problem solving, and time. For example, the domain knowledge them was comprised of the following expertise indicators: (a) complexity of portfolio knowledge, (b) modification of knowledge structures, (c) situational factors that affect expertise level, and (d) growth in mastery. The performance theme consisted of the following expertise indicators: (a) consistency of task performance, (b) deliberate practice increases expertise, and (c) plan consequences of actions during portfolio support.

The problem solving domain was comprised of the following expertise indicators: (a) identification of characteristics of problem and reproduce solution, (b) level of problem solving ability, (c) perception of the structure of the problem, and (d) production of multiple solutions to a problem. Time in the domain was an amalgamation of (a) time involved with technical support and (b) time involved with technology. The final theme consisted of the interaction between each study participant and the learning environment. Each of the four themes contained several of the original indicators of Ericsson's theory but for the purposes of the study contained data points that possessed commonalities and were aggregated into common themes. Additionally, a fifth theme representing the learning community based on Lave and Wenger's (1991) theory emerged in the data analysis.

Context

The study was located primarily inside a technical lab in a midsize Southwestern university. All of the study participants were members of a technical support team responsible for troubleshooting technical issues for faculty and preservice education students within the School of Education. Specifically, the study participants oversaw duties related directly to the development of preservice teachers' electronic portfolios such as: conducting group training classes and individual training sessions, developing training materials for the electronic portfolio, and reviewing research related to advances in electronic portfolio technology. Each of the study participants with one exception was a graduate student from the School of Education who was assigned to the electronic portfolio support team as a graduate assistant. The remaining study participant was an undergraduate student worker that also supported the electronic portfolio system to a lesser degree and was mainly restricted to conducting group training sessions and individual training sessions. All of the study participants were hired with no previous training and were expected to acquire all of the necessary knowledge and skills via on-the-job training. The researcher also investigated how the beliefs and dispositions of each participant may have affected the acquisition of expertise.

Participants

The study participants were chosen because of their employment in the technical lab. The bounded environment of the technical lab and the job position as electronic portfolio support staff served as the primary criteria used to determine eligibility for the study. Four of the study participants were male and the remaining study participant was female. Three of the study participants were doctoral students; 1 participant was working on a Doctor of Education degree in curriculum and instruction and the other doctoral students were working on Doctor of Philosophy degrees in educational psychology. One of the study participants was working on a Master's degree in curriculum and instruction with an emphasis in educational technology. The remaining study participant was pursuing a bachelor's degree in accounting from the School of Business.

Case Study for Each Participant

Data were collected from six different sources during the Fall 2007 school semester using methods outlined in the qualitative literature (Creswell, 1998; Yin, 2003). One interview with each research participant was conducted using a tape recorder to capture the conversation. Each study participant was also filmed via camcorder as he or she taught a group training session. Each participant was randomly filmed three times as he or she was conducting personal training sessions with preservice teachers. Participants were responsible for completing a set of narrative prompts regarding problem solving skills related to hypothetical electronic portfolio situation. Finally, each study participant completed a concept map and filled out a piece of paper containing demographic information. All data collected in the study were organized into a case study for each participant in an effort to examine common themes. The following section will describe each of the five cases included in the study. The order of the following cases was determined by which participant's data were analyzed first. The order of the following cases was determined by the age of each participant with the oldest participant being discussed first.

Participant 1

Domain-Related Knowledge

At the time of data collection, Participant 1 had been a member of the electronic portfolio support team for approximately five and a half years. Participant 1 was the most senior member of the team and was most often chosen to answer complicated technical questions and to impart technical knowledge to other members of the team (Participant 2, Concept Map).

Participant 1 demonstrated extensive knowledge on the subject of electronic portfolios beyond the general scope of information necessary to support School of Education candidates successfully. He was the only study participant that discussed the origin of the electronic portfolio as a derivate of a paper-based portfolio and the role of technology in making the electronic portfolio possible (Participant 1, Concept Map).

> "Electronic" portfolios are fundamentally an extension of paper-based models. They offer greater flexibility, variety, scope, distribution potential, ease of revision, economy and review opportunities than hard-copy varieties. Eportfolios were made possible by the relatively recent widespread availability of digital technology via personal computers and the Internet. Choice of electronic media is contingent on the resources available and the overall purposes of the portfolio. Web-based models are popular because of the potentials of the Internet for storage, distribution, and asynchronous review.

Participant 1 also noted that the electronic portfolio was utilized in other industries and vocations because of its capability to document knowledge and skill acquisition (Participant 1, Concept Map).

> Our focus in the [technical lab] has naturally been the use of electronic portfolios in teacher education. However, the use of efolios is very broad and growing.

> Because it documents growth and proficiency, it has become popular in medical training. Other disciplines, particularly those that require professional growth on the part of the student, have begun using the efolio. Portfolios have always been a centerpiece for displaying the work of those in the arts. The multimedia capabilities of electronic portfolios extend to even broader use by the art community—musical, video, etc. Various US and international consortia and organizations have been formed to help guide and encourage further research and development of the electronic portfolio in everything from education to professional credentialing. They anticipate that the electronic portfolio will become an integral part of a person's resume.

Participant 1 included a discussion on the value of an electronic portfolio as an evaluation tool. He wrote that the strength of the electronic portfolio was that it was created by an individual and therefore was a more authentic measure of what the student had learned. Participant 1 argued that the creator would seek instruction from both peers and experts in the field leading to growth in the field, which would then be displayed through the electronic portfolio (Participant 1, Concept Map).

> The key feature of efolios touted by proponents is the fact that it is creator-centered rather than other-centered. i.e., it is an expression of the individual and is therefore more "authentic" than simply responding to prompts by others. As an expression of personal growth unique to the individual, it should be a more accurate representation of their progress and ability than other forms of evaluation. Ideally the person creating the efolio will seek and utilize feedback from others, both peers and experts in their field. This formative assessment leads to growth in the skills and information necessary to pursue and continue in a given occupation.

Participant 1 wrote that the reliability and validity of an electronic portfolio, like other types of assessments, could be compromised when any support systems needed for success were not implemented (Participant 1, Concept Map).

> Naturally there are multiple ways that validity and reliability can be compromised. Failure to understand the purpose and process, lack of support, lack of mentoring, failure to utilize the efolio as an instrument of personal and professional growth are just some of the ways the portfolio can be compromised, particularly in a setting where it is seen as a requirement for a grade or for promotion rather than a valuable part of education. Institutions can compromise the reliability of the efolio as a valid form of evaluation through lack of training

and poor envisioning of those who do the evaluating.

Participant 1 further wrote that the validity of the electronic portfolio could be further compromised when an academic institution became too directive of the content of an electronic portfolio (Participant 1, Concept Map).

> Validity is often compromised when institutions are too directive as to content. The efolio becomes "standardized" and less an expression of personal growth than a series of required documents that supposedly meet the criteria for promotion or "passing." Another factor confounding validity is failure to provide adequate training in the skills and concepts necessary for building and developing the efolio. Creators who do not understand purpose and process and lack the technical skills necessary to complete the task are less likely to produce a valid representation of their growth than a person with the requisite knowledge, vision and expertise.

Based on Participant 1's writings, it is evident that the individual spent a large amount of time researching various aspects of the electronic portfolio beyond the context of this study.

The role of domain-related knowledge is essential in all tasks related to supporting an electronic portfolio system. Domain knowledge played an integral part in solving technical related issues according to Participant 1 (Participant 1, Interview).

> Ted: When you encounter a problem you have never seen before, how do you exactly go about solving it?
> Participant 1: That I've never seen before? Those are fun. That's what I live for. Uh, well, of course, first you evaluate what they've done, call on past knowledge, and see if there is anything, anything I've ever run into before that's similar or anything I know about that's part of the technical aspects I've seen, that I know about, that might be causing the issues.

Participant 1 stated that domain knowledge makes troubleshooting issues a simpler process because there are not many problems that the participant has not seen before. However, to build that body of knowledge, Participant 1 spent many hours reading supplementary manuals related to the software package used to create an electronic portfolio and creating multiple electronic portfolio instances (Participant 1, Interview).

> Participant 1: One thing, I've seen so many problems and issues that there's not many of them I see that I haven't seen before. People tend to make the same errors over and over; so it doesn't take me long to figure those out. When I first started this, we had no training in the technology ourselves; so I acquired my expertise through hundreds of hours of poring through manuals and building pages myself. So... Yeah, I've definitely improved. Today I'm a much more proficient problem solver; a much more proficient user of the technology. There might be some problems now that easily would have stumped me when we first started, but we were all novices then.

Participant 1 demonstrated that an extensive array of domain-related knowledge and experience could dictate problem solving strategies. Each participant of the study was provided with a narrative prompt containing hypothetical problem solving situations that they were required to complete. Participant 1 was the only study participant that explicitly stated that one of the narrative prompts was not realistic and would never occur within the context of the technical lab (Participant 1, Narrative Prompt).

> First, we do not handle these sorts of issues simultaneously; so this scenario is not normal. If four students come in at once with issues and we are not already busy with a student, we take them one at a time—first come first served—and do a little triage.

After stating it was not realistic to troubleshoot multiple students at once, Participant 1 chose to use a peer teaching approach to troubleshoot four students simultaneously in the hopes that some of the students might be able to assist one another (Participant 1, Narrative Prompt).

> However, if I were for some reason in the situation of orchestrating a quartet with the issues above, I would have each student sit in front of a computer (with A & C seated next to one another) and proceed with Dreamweaver setup as far as they know how to accomplish the task (with the aid of the web-based tutorial if they need it for reference). Peer teaching is encouraged among the four! I would deal with the quick B & D issues first so that they could continue to work independently. Then I would go through a review of the entire process with A &

> C. With 30-45 minutes of coaching, they should be able to work independently. Of course, I would be available for questions and to help with final uploads and shut downs as needed.

Participant 1's extensive knowledge of the electronic portfolio software tool allowed him to use advanced functions to determine if a specific cause was at the root of the problem. Without using the report function, it would be necessary to manually examine each file within the electronic portfolio which could take a rather significant period of time another (Participant 1, Narrative Prompt).

> I would then use Dreamweaver to generate a report of all orphan files in her site and assign her the task of removing them (either by deleting or saving in a file outside the root folder). That done, her next task is to move the remaining files into the appropriate folder and make sure the links update. (While she is doing this, I would download an archive copy of her Internet site for backup purposes.) Next she would need to check every link in her site to make sure it works before uploading. Finally, with a quick visual check of the remote site to make sure there were no obvious things that needed attention, she would do a synchronization with the "delete files" option checked in order to completely clean up her site and get rid of all extraneous files.

Advanced domain knowledge of the electronic portfolio allowed Participant 1 to more easily problem solve using sophisticated aspects of the electronic portfolio software program.

During his interview, Participant 1 was asked to distinguish between an expert and a novice within the role of an electronic portfolio support staff team member. Participant 1 said that the novice lacks the necessary expertise and domain knowledge to problem solve properly. Experts must be aware in cases where a novice might cause further harm to an electronic portfolio inadvertently (Participant 1, Interview).

> Ted: OK. Now you, you had said that ability was the other distinction. What is the difference in ability between a novice and an expert? Can you elaborate for me please?
> Participant 1: Well, a novice basically knows what we teach in the seminars--workshops--as opposed to building the templates and this that and the other. They

> don't necessarily learn how to cure a problem when it crops up or if the student does something that messes up the system then you have to go in and rectify it--they are not real sure how to do that.

Participant 1 felt that attitude was crucial in becoming an expert in the field of electronic portfolio support. An aspiring expert should be interested in learning how to solve a particular problem when they bring it to the attention of the expert.

> Ted: So you would classify somebody that complained about students as kind of a novice or an intermediate support staff member?
> Participant 1: Yeah, they--support is in there for a reason. If you don't like supporting people who need help, you shouldn't be in there.

Spending time watching how the problem is solved seemed to be an indicator of wanting to develop electronic portfolio skills and knowledge (Participant 1, Interview).

> Participant 1: Of course, you gain expertise as you go if you are interested. You can tell who is interested because when they bring a problem, they will sit there and hang around and watch me solve in. Next time--they are building their skill set.

In summary, Participant 1 thought that the ideal expert would possess extensive domain knowledge acquired through years of experience and believed that an attitude of willingness to learn was necessary for someone who sought to reach the expert level.

Performance

In his seminal work, Ericsson (2003) wrote that a sign of an expert was consistency in performance of domain-related tasks in a variety of circumstances. Participant 1 noted that there are not many problems he has not seen before, which allows him to perform at a fairly consistent level (Participant 1, Interview).

> Participant 1: One thing, I've seen so many problems and issues that there's not many of them I see that I haven't seen before. People tend to make the same errors over and over; so it doesn't take me long to figure those out.

Through observation, Participant 1 was seen using the same function within the electronic portfolio software program to import lesson plans into a student's electronic portfolio (Participant 1, Individual Observation 1).

> Participant 1 asks what type of evidence the student needs to insert on the evidence page and student says there is a lesson plan and two images. Participant 1 has the student find the lesson plan on her flash drive and open it in Microsoft Word. Participant 1 has student remove the name of one of her students. Participant 1 has student once again use the 'File > Import' function to copy the lesson plan text onto the webpage. Participant 1 states that using the Import feature preserves the formatting of the original lesson plan.

Most importantly, Participant 1 attempted to teach the students he worked with to be consistent in their use of the electronic portfolio software (Participant 1, Individual Observation 1).

> Participant 1 teaches student about the importance of the naming convention for evidence pages and the importance of naming files consistently across time. Participant 1 explains on the difficulty of using random file names and the future consequences of possibly not being able to find files at a later time.

The idea that consistency is a major factor in performance can indicate the difference between a novice and an expert.

Participant 1 discussed in his interview that deliberate practice increased his knowledge and understanding of the electronic portfolio itself (Participant1, Ibid). Participant 1 believed that his experience increased through deliberate practice of supporting students while they worked on their electronic portfolios. Participant 1 experienced significant growth in related electronic portfolio knowledge and skills due to working with students through difficult situations while still at the novice level (Participant 1, Interview).

> Ted: Explain your experiences in transitioning from novice to your current expertise level. What factors influenced your change from the novice stage to your current level of expertise?

> Participant 1: I don't know. I guess there's things that . . . I'd say there's two diff . . . two factors. One is just working with the students as much as I could with a difficult process.

The role of deliberate practice was important in the acquisition of knowledge and skills, which allowed Participant 1 to better support preservice teachers.

Participant 1 briefly described his problem solving strategy when he encountered a problem related to the electronic portfolio. Having enough experience in the field, Participant 1 can plan exactly how systematically solve a technical issue, paying particular attention to the consequences of his strategy (Participant 1, Interview).

> Ted: When you encounter a problem you have never seen before, how do you exactly go about solving it?
> Participant 1: . . . first you evaluate what they've done, call on past knowledge, and see if there is anything, anything I've ever run into before that's similar or anything I know about that's part of the technical aspects I've seen, that I know about, that might be causing the issues. Usually it's, It can be something that's staring you in the face, like they're trying to use Photoshop documents on the Internet or it could be some little minutiae like they put an extraneous character in their path to the file and so the route loses it. So, you have just, like troubleshooting anything, you start with, start with A and then you go to B, and you continue that process along the chain of what should work and eventually you'll see what little bug in there is keeping it from working.
> Ted: So, trial and error?
> Participant 1: Not so much trial and error as it is ... I'm not trying things to see if they work, I'm going through the process of what should work to figure out why it doesn't work.

In the following excerpt from a narrative prompt, Participant 1 clearly detailed his plan to troubleshoot the issues each preservice teacher experienced and clearly defined the expect outcome (Participant 1, Narrative Prompt).

> Assuming she has already set up Dreamweaver and we are working on her local files (root folder on flash drive) . . . For this student I would take over the mouse and clear up the technical details first. Some of the issues are beyond what we can expect our students to be competent to handle. After restoring the templates and reapplying them to any errant files, I would hand over the mouse and coach through the process of creating new pages properly and filing them appropriately.

> I would then use Dreamweaver to generate a report of all orphan files in her site and assign her the task of removing them (either by deleting or saving in a file outside the root folder). That done, her next task is to move the remaining files into the appropriate folder and make sure the links update. (While she is doing this, I would download an archive copy of her Internet site for backup purposes.) Next she would need to check every link in her site to make sure it works before uploading. Finally, with a quick visual check of the remote site to make sure there were no obvious things that needed attention, she would do a synchronization with the "delete files" option checked in order to completely clean up her site and get rid of all extraneous files.

Participant 1 explained that his problem solving strategy was quite a bit different at this level of proficiency. His approach to solving problems does not include trial and error but rather going through a process to determine what is not working in the electronic portfolio (Participant 1, Interview).

> Participant 1: Not so much trial and error as it is . . . I'm not trying things to see if they work, I'm going through the process of what should work to figure out why it doesn't work.

An observation of Participant 1 teaching a group training session showed Participant 1 using the knowledge gained through his experience to teach preservice teachers about best practices when using the electronic portfolio. To begin, Participant 1 stated that having all images ready and narratives written before a technical support training session will greatly speed up the process of completing an electronic portfolio benchmark (Participant 1, Group Observation).

> Participant 1 explains the EP website that contains the policies and resources of the EP. Participant 1 explains that there are best practices to complete before coming to the training session such as typing up narratives and formatting images. Participant 1 basically states that the more prepared you are for the appointment, the easier the appointment will be on behalf of the student. Participant 1 points out that the resources website can be used to read teacher feedback and also be used as a portal to view their EP.

Participant 1 spoke with the preservice teachers regarding the most common question that arose in a training session. He suggested several strategies that could help preservice teachers avoid some of the more common electronic portfolio problems (Participant 1, Group Observation).

> Participant 1 states one of the most common questions are how do I setup Dreamweaver. Participant 1 suggests that printing out the setup instructions and carrying the instructions will save students the hassle of having to ask for help in setting up Dreamweaver each time. Participant 1 explains it is also helpful to carry the instructions because each time the student uses Dreamweaver; it is necessary to define the site. The second question is how come I cannot see my work online? Participant 1 further explains that this probably means the students did not upload their EP to the Internet so Participant 1 explains to be sure to upload the EP each time it is worked on.

Participant 1 continued to reveal information to the group of preservice teachers that will help them successfully avoid pitfalls in dealing with the electronic portfolio such as using care to create file names inside the software program used to edit the electronic portfolio (Participant 1, Group Observation).

> Participant 1 states that the dash, the underscore, a number, or a letter are the only characters that should be used when naming files. Using any other characters can cause potential usage issues. Using marks like the pound sign will cause errors or percentage signs and may cause the webpage to not appear on the Internet.

In summary, Participant 1 was able to perform the duties of an electronic portfolio support staff member at the expert level with a high level of consistency. Relying on past experience and an extensive electronic portfolio knowledge base, Participant 1 was able to solve problems effectively and also provide information in the form of best practices to preservice teachers to help them avoid some of the common electronic portfolio pitfalls.

Problem Solving

Ericsson wrote that the problem solving of an expert in a given field would be superior to problem solving skills of the novice. The ability to identify characteristics of a problem and then reproduce the solution for multiple problem scenarios defines the very meaning of the expert. In his interview, Participant 1 revealed that there were very few problems that he had not dealt with in his time as support staff (Participant 1, Interview).

> Participant 1: One thing, I've seen so many problems and issues that there's not many of them I see that I haven't seen before. People tend to make the same errors over and over; so it doesn't take me long to figure those out. When I first started this, we had no training in the technology ourselves; so I acquired my expertise through hundreds of hours of poring through manuals and building pages myself. So . . . Yeah, I've definitely improved. Today I'm a much more proficient problem solver; a much more proficient user of the technology. There might be some problems now that easily would have stumped me when we first started, but we were all novices then.

But when faced with a problem he has seldom seen, Participant 1 spoke about the process he used to solve a problem (Participant 1, Interview).

> . . . Uh, well, of course, first you evaluate what they've done, call on past knowledge, and see if there is anything, anything I've ever run Into before that's similar or anything I know about that's part of the technical aspects I've seen, that I know about, that might be causing the issues. Usually it's, It can be something that's staring you in the face, like they're trying to use Photoshop documents on the internet or it could be some little minutiae like they put an extraneous character in their path to the file and so the route loses it. So, you have just, like troubleshooting anything, you start with, start with A and then you go to B, and you continue that process along the chain of what should work and eventually you'll see what little bug in there is keeping it from working.

When asked what factors he considered during his problem solving routine, Participant 1 answered that he attempted to find the source of the problem and how the problem exactly occurred (Participant 1, Interview).

> Well, I'm always trying to evaluate how it happened to begin with. Because hopefully I can remediate that. But the student . . . Like our, our latest issue of going into the templates folder and dragging and dropping and using that instead of doing what you do in any other application and using file new. If we just go in and fix that, next time the student works on it, they are going to go in and drag out a document and start using it. If you always show them what they did wrong and how to do it right, or maybe how to do it right, they won't do it the other way.

He stated that fixing the problem is sometimes not enough to prevent the problem from occurring again. In the case of a technical issue, Participant 1 stated that determining the cause of the problem and explaining the cause to the preservice teacher who initiated the problem was a suitable method for preventing the problem to happen again the future.

The evidence that Participant 1 possessed extensive experience was evident in writings taken from his narrative prompt. When posed with a hypothetical situation in which each research participant was asked to respond, Participant 1 replied that the problem posed was completely unrealistic and then applied his past experience to generate a realistic approach to solving the proposed problem (Participant 1, Narrative Prompt).

> Participant 1: First, we do not handle these sorts of issues simultaneously; so this scenario is not normal. If four students come in at once with issues and we are not already busy with a student, we take them one at a time—first come first served—and do a little triage.

During his second individual observation, Participant 1 attempted to import text from Microsoft Word to Adobe Dreamweaver for a preservice teacher. However, paragraph tab and space markers native to Microsoft Word appeared between the text and Participant 1 had to deactivate the markers prior to importing the preservice teacher's text (Participant 1, Individual Observation 2).

> The student has a Microsoft Word document that needs to be placed inside Dreamweaver but there is a problem. The paragraph, tab, and space marks are showing up in the Word document, which causes problems trying to import text from Microsoft Word into Dreamweaver. Participant 1 attempts to click an icon inside Microsoft Word that deactivates these symbols.

The two aforementioned examples are but two instances of identifying problems and applying the appropriate solution. The role of the expert is to be able to recognize domain-related problems and then use domain-related knowledge to solve the issue at hand. The level of problem solving ability demonstrated by Participant 1 indicated he had a firm, conceptual grasp of the domain of knowledge related to the electronic portfolio. Participant 1 demonstrated the participant's ability to recognize a hypothetical problem and question the validity of the narrative prompt confirms an expert level of problem solving ability by recognizing the extreme nature of the narrative prompt.

In addition to identifying the characteristics of a problem, the expert will also be able to produce multiple solutions to a problem. A hallmark of a novice in a domain is a limited amount of knowledge when solving domain-related problems. The lack of time interacting with a domain strictly limits the novice in that only simple solutions are available to combat domain-related problems. Conversely, the domain expert has witnessed and experienced a plethora of issues often requiring inventive solutions that can be applied in multiple problematic situations.

During an individual observation, Participant 1 taught a preservice teacher that it was necessary to sync changes made in the local copy of the electronic portfolio with the electronic portfolio dwelling on the remote server. Participant 1 revealed that there were multiple methods of initiating the syncing process between copies of the electronic portfolio (Participant 1, Individual Observation 3).

> Participant 1 tells the student to click on the folder containing her electronic portfolio and to choose the sync option. This option will sync all of the newly created and edited files on the electronic portfolio and place them on the Internet. Participant 1 states that this is a second method for uploading WebPages to the Internet.

In another observation, Participant 1 taught a different preservice teacher another way of syncing an electronic portfolio. He first asked the preservice teacher to begin manually syncing pieces of the local copy of the electronic portfolio but then later offered the preservice teacher another approach to syncing the electronic portfolio (Participant 1, Individual Observation 2).

> Student asks Participant 1 how to transfer her electronic portfolio onto the web. Participant 1 tells the student to click the icon with the two arrows on it and click the "Put" option and click the "Yes" option. Participant 1 instructs the student to replicate this procedure for every webpage that the student has worked on. Participant 1 also offers another solution to the student and tells her to click on the right side of the Dreamweaver screen and select the folder that contains her electronic portfolio. Participant 1 tells the student to click the synchronize option. Participant 1 tells the student to make sure that the computer is going to upload all of the worked on WebPages. Participant 1 tells the student that using the second option will place the entire site online.

Analyzing Participant 1's narrative prompt also revealed another problematic situation in which the participant described two possible methods of saving a preservice teacher's electronic portfolio in its entirety. Typically, a preservice teacher is required to save the local copy of their electronic portfolio on a USB flash drive. However, each research participant was provided with a hypothetical prompt in which the preservice teacher they "assisted" in the narrative prompt did not possess a USB flash drive. Participant 1 wrote that the hypothetical preservice teacher should store the updated electronic portfolio on Bearspace, a network storage drive available for all students at the university where this study was conducted (Participant 1, Narrative Prompt).

> A student in the situation of this intern probably only needs someone to help jump-start the process. Since it is nearly closing, a computer in the LRC is the appropriate place to work. Chiding about lack of flash drive is likely counterproductive at this stressful juncture, so I would show her how to download her site to work on as well as how to preserve it (e.g., on Bearspace) "just in case".

Participant 1 wrote about a rather abstract solution that solved the issue of where exactly the preservice teacher was going to store the changes made to the local copy of the electronic portfolio until a USB flash drive became available. Participant 1's ability to problem solve so effectively through the identification of a problem, understanding the structure of the issue, and then applying the appropriate solution(s) demonstrated that

Participant 1 acquired a large amount of experience and knowledge during his tenure as an electronic portfolio support staff member.

Deliberate Practice in the Domain Over Time

Participant 1 had spent five years and five months involved in the support of the electronic portfolio system at the time of data collection, more time than any of the other research participants (Participant 1, Demographic Sheet). Participant 1 was involved in the inception of the electronic portfolio at the university where this study was conducted; he contributed to the design and development of the initial electronic portfolio. Since its inception, Participant 1 directly participated in the evolution of the electronic portfolio as the structure and content changed over time. It is no wonder that Participant 1 collected such a large body of knowledge and experience directly related to the electronic portfolio, as he has been involved with the project since it began.

Prior to working as a member of the electronic portfolio support staff, Participant 1 acquired technical support expertise through maintenance and support of various computer network and systems since 1996 (Participant 1, Interview).

> Do you have any previous technological work experience? If so, please provide details regarding your job history: Technological by it's broadest definition? That would cover the years I spent working in the building construction trades! If you mean electronic technological specialties, I guess that began as a part of my administrative job description when I returned to the USA in 1996. I took care of the networking and maintenance of computers at the AMI headquarters. Not as a full-time vocation, however.

When surveyed about use of technology in the work and home environment, Participant 1 indicated that technology was utilized on a daily basis. In the same survey, Participant 1 also indicated that a large amount of free time was spent using technology as a personal hobby (Participant 1, Demographic Sheet). It is quite obvious that technology played a predominant role in many areas in his life. Spending such a large amount of time involved with technology clearly revealed why Participant 1 was considered an expert.

Learning Community

In the electronic portfolio learning community, Participant 1 was considered to be the most experienced contributing member. He generated new knowledge, which he shared with his peers, and also taught incoming support staff members how to use the electronic portfolio tools. Participant 1 interacted at a much deeper level with the electronic portfolio than his colleagues because he actually created the hmtl templates that preservice teachers used to build their electronic portfolio while the other study members were considered to be only advanced users. He was responsible for creating the training checklist used by other support staff when they were teaching groups of preservice teachers. Participant 1 was considered to be a bedrock to the learning community due to his knowledge and longevity in the domain.

Summary

Participant 1 worked as electronic portfolio support staff longer than any other support staff member. Participant 1 was originally involved in the establishment of the electronic portfolio system during the initial planning and continued to be involved through the actual implementation of the electronic portfolio system.

Knowledge, skills, beliefs, and dispositions. Participant 1 possessed knowledge about the various components of the electronic portfolio including the software packages used to create and modify the electronic portfolio. He developed a sizeable set of skills related to his role as an electronic portfolio support staff member and possessed extensive problem solving skills, which he used to troubleshoot domain-related problems. Participant 1 also possessed an advanced level of skills with software programs and was able to perform advanced tasks with the tools that other electronic portfolio support staff members were not able to accomplish.

With so much domain-related experience, Participant 1 performed domain-related tasks fairly consistently and stated that there were very few problems that he had not encountered during his tenure. Participant 1 also stated that his problem solving strategy was very consistent when he sought out the cause of an issue. He understood the nature of the electronic portfolio as a system of related components that performed in an expected manner and would investigate issues that displayed irregularities. Participant 1 performed his training and troubleshooting with a high degree of consistency honed from long hours involved in the domain.

He pioneered the first generation of electronic portfolio templates. He was the only study participant to mention the electronic portfolio in a larger context beyond electronic portfolio knowledge and training preservice teachers. Participant 1 discussed the history of the electronic portfolio from its paper-based roots and also discussed the importance of assessment/evaluation of the electronic portfolio. He also discussed the importance of validity and reliability and that support system were necessary to maintain the psychometric integrity of the electronic portfolio system. Participant 1's advanced understanding of the capabilities of each program led him to be able to manipulate the electronic portfolio software on a much higher level than his peers. Participant 1 was a main founder of the policies and procedures used to govern the technical and training aspects of the electronic portfolio system and developed training guides and standardized support procedures.

In relating to preservice teachers, he used preventative problem solving. He stated that when conferring with preservice teachers, he discussed the cause of an issue and explained to them how to avoid making the same mistake again in the future. On many occasions, he displayed the ability to generate multiple solutions to a single issue and tailor a specific strategy that would solve the occurring issue. He also emphasized the idea that consistency was a very important concept when working with the electronic portfolio. For example, Participant 1 stated that using a naming convention on multiple electronic portfolio WebPages was helpful in being able to identify the location of content in the future.

In his interview, Participant 1 attributed his disposition as a problem solver for acquiring expertise. Participant 1 stated that there were few resources when he began the task of being the original electronic portfolio support staff member so he was forced to solve domain problems individually. Participant 1 faced many difficult domain-related problems but drew upon his interest in technology to acquire expertise through reading technical manuals and experimenting with different types of WebPages. Participant 1 could be characterized as having an innate curiosity about how pieces of the electronic portfolio worked, both individually and systemically. When he encountered a difficult or unknown problem, Participant 1 analyzed the problem and would not give up until he found a solution. Participant 1's disposition of curiosity and determination to solve domain problems contributed to him being an expert level electronic portfolio support staff member.

In comparison to the other members of the study, Participant 1 was considered to be the most knowledgeable support staff member. Participant 1 could be considered an expert in the field because of his ability to identify the nature of an issue, provide several possible solutions, and then apply the best possible solution to solve an issue consistently.

Contextual factors. The most obvious contextual factor that affected Participant 1's acquisition of expertise was the fact that he was the original electronic portfolio support staff member. Participant 1 acquired a large amount of domain knowledge and skills because he played a role in the inception and design of the electronic portfolio system. Participant 1 had very little support as he helped establish the electronic portfolio system, which forced him to acquire domain knowledge and skills individually through deliberate practice. Participant 1 familiarized himself with the webpage building software and the picture editing software that was necessary to create an electronic portfolio. He needed extensive knowledge of the capabilities of the software packages that were used to create the electronic portfolio because he was responsible for the development of the electronic portfolio templates that preservice teachers used to develop their individual electronic portfolios.

His sophisticated problem solving strategy was based on his extensive domain experience. He testified that there were very few issues that he had not encountered during his time in the electronic portfolio domain but that sometimes problem solving issues involved another step. The problem solving skills of Participant 1 grew with each new domain problem that he encountered. Participant 1 acquired analytical skills, which he used to determine the cause of domain-related problems, and then drew upon his problem solving skills to generate potential solutions for the domain problem. Participant

1 acquired his expertise through solving novel domain issues and studying external sources of information to master the software packages used to create the electronic portfolio. He developed an extensive domain knowledge base because he faced so many problems that he was forced to solve on his own.

Participant 1 also possessed previous experience as a system administrator and computer technician before he became part of the support staff. Technology played a major role in many different areas of Participant 1's life; granting him expertise in quite a few different technological areas. Participant 1 was considered the ultimate authority on the electronic portfolio system for the scope of this study due to his many years of involvement with the electronic portfolio.

Participant 2

Domain-Related Knowledge

At the time of data collection, Participant 2 was a member of the electronic portfolio staff for approximately two years and considered himself to be close to the expert level in the electronic portfolio domain with one exception (Participant 2, Interview).

> Participant 2: I'd put myself a step below expert, but, but close. And I put myself there because I'm very good at facilitating the tutoring sessions or the workshops and I'm very good at coming up with new ways to try and help the students co-create knowledge together. But I don't know the program in and out. And so I'm lacking in some of the technical, actual how to, how to . . . I don't know yet how to make templates or how to do the bigger stuff.

Participant 2 revealed a knowledge gap in the more technical aspects of developing electronic portfolio page templates. He shared that his domain knowledge was extensive and complex enough to solve problems that he dealt with in the past but again noted that he did not have the knowledge base to handle problems related to .html code used to program the electronic portfolio (Participant 2, Interview).

> Participant 2: Well, the first thing I try to do is analyze it to see if it is similar to something that I have seen previously and if it is, then try, try how I would solve problems I have seen previously. If that doesn't work, I may, depending on the nature of the problem, especially if it's based more in a problem with the coding in the, in the actual, in Dreamweaver, I would look at the drop-down list on the toolbar and see what might help solve it. If that doesn't do it, I'd look at the help on Dreamweaver. And if that doesn't do it then I would ask one of my peers if they've seen it before.

After spending so much time in the domain, Participant 2 shared that his mastery of domain-related knowledge was essential in the problem solving process (Participant 2, Interview).

> Participant 2: Well, it's changed because I've developed more, more mental tools and I'm able to use the tool of Dreamweaver itself at a higher level of proficiency than I originally did. It means I'm able to reason through problems easier and then; using that reason along with what I know about the tool; solve most of the problems that I experience.

Participant 2 began his tenure as an electronic portfolio support staff member with very little training and soon realized that after his first initial training sessions that he needed to expand his knowledge base and experience after several poorly taught tutorial sessions (Participant 2, Interview).

> Participant 2: Well, originally as a novice, I, I really thought that the training I was given was, was pretty weak in that there just wasn't very much of it. And nothing formal, nothing saying, "Here is your manual on how to be an efolio mentor or trainer." And so, you know, when I did my first couple of tutoring sessions and when I first led my first workshops, you know, I fell on my butt because it was not, I wasn't very good at planned--I don't like doing that; so then I had to redouble my efforts and say "What am I going to do now to make it better the next time?" And I started hitting external sources like the tutorials that Adobe and that Macromedia provide on their web sites, reading materials that we have, reading a book on Dreamweaver, and then just reflecting on what I know about how adults learn and trying to make the information personally relevant to those students and how to try and remember that we are trying to co-construct

> knowledge with them. We're trying to help them learn so that they don't even need to come see us because then they have some skills they can take out into the work world, too. And so I guess a lot of it came from, you know, going from a level where I knew next to nothing about it to, to, with the help of other people and through practice, some trial and error, and then some reading and some reflecting, to growing a pretty large knowledge base.

Participant 2 sought to expand his knowledge of the electronic portfolio domain from external sources such as online tutorials and reading texts related to the software tools used to create the electronic portfolio.

Ericsson's (2003) research on expertise discussed the idea that the experts will continually push themselves to achieve new levels of performance and knowledge related to the domain of interest. Participant 2 revealed that he considered himself a lifelong learner and he believed how crucial continual learning was in the effort to increase the complexity of his knowledge in the electronic portfolio domain (Participant 2, Interview).

> Participant 2: But part of being a, a life-long learner and a continual learner, and mainly a really curious person is that I'm not happy staying the level where I am. I'm, I'm always trying to make it better, always trying to improve if I can rather than just saying, "OK, well, I know what I'm doing here now; so it can't be improved anymore." So just staying curious and listening and trying to, to always continually find new analogies to help students understand what they are doing or find new approaches or every once in a while do some reflection on, "OK, it seems the last couple of students haven't been getting it; so what am I doing differently?" Maybe they, they, just--I had--for instance, I had two people on a row who didn't want to learn it because--that is a major problem is that some of our students have no desire to learn this material. They are just gonna, just going to fumble through it so they can hand it in. So sometimes you might get two of those back-to-back, but on other times it could be that I'm on remote and I've quit listening; so I have to say, "OK. Am I still listening? Am I asking the right questions? And am I taking what I know about how people learn and applying that to our tutoring so that they can walk out and go do it on their own without me when they return to their work?"

Participant 2 described the metacognitive process he used to evaluate his performance and determine what instructional element needed to be modified to more effectively educate the preservice teacher on electronic portfolio usage.

Participant 2 displayed the depth of his electronic portfolio knowledge in several of his responses to hypothetical problems provided to each research participant in the narrative prompts. In one situation, Participant 2 utilized an advanced function within Adobe Dreamweaver to apply the correct templates to corrupt electronic portfolio pages. Whereas in past tutorials, he would have manually spotted and removed corrupt files, which was terribly more time consuming (Participant 2, Narrative Prompt).

> I would reassure her that her efolio was not ruined, but that it was pretty messed up. I would ask questions to figure out how she managed to mangle her efolio so as to help her not do it again. In the past I would have helped her learn how to rebuild her site by eliminating the excess folders and by giving the correct suffixes to her files. Now I would help her fix the site by using the more advanced functions within Dreamweaver to apply the correct templates to the corrupted files (i.e. Modify>Templates>Update Pages). I would then help her drag the other folders where they belonged, and help her eliminate redundancies. Once the site was cleaned up, I would go over how to properly log in to DreamWeaver, create evidence pages, insert and optimize evidence, make links, upload, and log off. While it looks really ugly, it is not hard to fix if you can use the "Modify>Templates>Update Pages" solution.

Using the more advanced feature rather than manually spotting corrupt page files proved that Participant 2 held an understanding of more complex capabilities of the electronic portfolio software and applied that knowledge to reach a solution for a problem in a shorter time period.

In another instance, Participant 2 was given a list of symptoms of problems inside a hypothetical preservice teacher's portfolio and asked to determine what exact problems were occurring in the electronic portfolio. Participant 2 identified multiple issues from the narrative prompt and determined several solutions for the problems listed (Participant 2, Narrative Prompt).

> The long upload times would make me wonder if the student had improperly (or even if he had) inserted the images in his site. It sounds like he could have inserted the image and then adjusted the width from the editor within

> Dreamweaver. It also sounds like he might be using a file that is not supported by the program such as a PNG file. The reason that his links were not working could be that he was linking directly to the image files that he had saved either in his benchmarks, or outside of his root folder.

The narrative prompt was designed to be a conglomerate of several possible issues and Participant 2 was able to correctly identify the main issues of the prompt and elaborate on the causes of the issues. The prompt was somewhat abstract in nature and Participant 2 was able to apply his body of electronic portfolio based knowledge and generate several concrete solutions. Overall, Participant 2 was able to determine the primary causes of the main issues and create solutions based on his complex knowledge base.

During his interview, Participant 2 freely revealed that there were some knowledge gaps in his understanding of the electronic portfolio. In his group observation, Participant 2 demonstrated a lack of knowledge in the software program used to edit images that served as evidence inside the electronic portfolio. When trying to view an image at 100% magnification, Participant 2 was unable to find the menu option that initiated this function (Participant 2, Group Observation).

> Participant 2 tells the students the first thing the students want to check is to go to "Image > Image" size. Participant 2 asks the students to check the resolution, which should be 72. Participant 2 also informs the students that the width they wanted to use for the image on the index page is 250 pixels wide. To zoom in on the screen, Participant 2 tells the students use the "View Menu" and choose the "Fit to Page" option. However this strategy does not work. Another Media Center worker has to show Participant 2 another method of seeing the full size of the image, which is by clicking on the percentage on the corner of the screen and typing in 100%.

Another research participant, who was assisting in the training session that Participant 2 was instructing, had to step in and demonstrate to Participant 2 where to find the command he was searching for. In a second instance, Participant 2 attempted to teach the preservice teacher about optimizing images to be shown on the web. He hesitated during this part of the instruction and could not find the information he was looking for (Participant 2, Group Observation).

> Participant 2 states the last step is to optimize the image for the web. Participant 2 stares at his papers for a minute and then asks another one of the Media Center staff for help on displaying multiple save options for the image. The staff member replies to Participant 2 that he must go to "File > Save" for Web and Devices.

Again, Participant 2 accepted assistance from another support staff member to acquire knowledge that he did not possess. The knowledge gaps seen in Participant 2's performance during his group observation confirmed that there were other domain-related activities that he must learn about to further develop his level of expertise.

Participant 2 spoke about his journey of acquiring electronic portfolio knowledge and the sources he used to increase his expertise. He wrote that his knowledge of learning theory, primarily Vygotskyian scaffolding and metacognition, helped him improve his teaching strategies and increase his knowledge base (Participant 2, Concept Map).

> Use of Learning Theory . . . I utilized and improved my knowledge of adult learning theory to better co-create student knowledge. This had a reciprocal effect on my e-portfolio knowledge as I tried to improve it and make it better. I focused on scaffolding students rather than just showing them what and when to click in DW, on drawing on students' previous experience with other, similar software, and by trying to lead the students in creating their meta-knowledge in that they were asked to identify what they were doing with both the program and with their content.

Participant 2 further wrote that he would find himself rehearsing possible strategies to apply in future electronic portfolio support sessions and developing analogies in an attempt to make the electronic portfolio more relatable to preservice teachers (Participant 2, Concept Map).

> Reflection and Mental Rehearsal–I would do this at random times (i.e. at the grocery store, after an e-folio tutoring session). I would get an idea, and then try to integrate it by rehearsing, in my head, how I would employ it. I would reflect on approaches that help me learn content, on analogies that could help students remember content, and by trying to come up with clear instructions that help explain both the how and the why of what the students were required to learn.

During his interview, Participant 2 again noted that rehearsal and reflection played a major role in the development of expertise; attempting new approaches with preservice teachers helped him formulate effective electronic portfolio teaching strategies (Participant 2, Interview).

> Participant 2: In part through, at, at various odd times--because that's kind of the way my head works--doing mental rehearsal, whether I be in the shower or whether it be while I'm trying to fall asleep or there's at times daydreaming. And other ways: going and buying a Dreamweaver book and reading about how to use Dreamweaver, and then in part just by using the tool and by leading the facilitation--tutoring the, the efolio tu . . . tu . . . tutoring. Especially trying to fine-tune . . . If I notice I was trying to help somebody understand how to do a step and they weren't getting it, then I would reflect a lot on, "OK, why aren't they getting it? What might be in . . .what, what might I be doing that's keeping them from getting it or is it something that they're just not getting." But this would . . . Then trying to reflect on it, and then practicing a new approach, I kind of started learning what worked and didn't work with the students I was helping.

The combination of learning theory and mental rehearsal helped Participant 2 develop and modify his knowledge structures to arrange electronic portfolio related information and experience (Participant 2, Interview).

> Participant 2: Well, [my level of knowledge] changed because I've developed more, more mental tools, and I'm able to use the tool of Dreamweaver itself at a higher level of proficiency than I originally did. It means I'm able to reason through problems easier, and then, using that reason along with what I know about the tool, solve most of the problems that I experience.

For Participant 2, the data seemed to indicate that learning theory and metacognition played a very large role in acquiring knowledge and expertise for the electronic portfolio.

Participant 2 noted a few situational factors that affected his level of domain knowledge. He wrote on his demographic sheet that he had spent two and half years as a public school teacher, giving him previous experience in the field of instruction. Participant 2 was asked in his interview if he received any formal training when he first joined the Media Lab responsible for supporting the electronic portfolio. He replied that he received twenty minutes of instruction from a former support staff member and was encouraged to ask questions.

> Ted: OK. Next question is: did you receive any training, any formal training, before you became portfolio support staff? If so, describe the training process. If not, how did you acquire your current level of knowledge?
> Participant 2: Well, there was nothing formal as far as the media center having standard operating procedure for, for mentoring somebody through how to do it. I did sit down with [a former support staff member] for 20 minutes one day and he just kind of walked me through it, and then they had me lead the class. And so, you know, which isn't really formal, that's, that's really more, they said, "Here, lead it and if you have questions, ask us." But it was kind of like throwing you in the deep end, you know, and if you don't know how to swim, at least try to figure out how to bob.

Participant 2 was expected to lead an electronic portfolio training session with virtually zero experience and acquire electronic portfolio knowledge and experience in an ad hoc manner. In summary, Participant 2 possessed fairly extensive domain knowledge though he lacked the ability to create and modify electronic portfolio templates.

Performance

The sign of a true expert is an individual that performs domain-related tasks consistently in a variety of circumstances. Participant 2 felt that as an expert, it was his obligation to consistently strive to improve his level of expertise. He stated that he constantly questioned himself to determine if he was improving his domain knowledge and instructional practices. He felt that it was important to consistently question himself and ask if he was doing everything possible to better his domain-related performance (Participant 2, Interview).

> Participant 2: I guess just . . . I guess in part of it I--and I don't know if it's a question that has been asked? It's not anything that I've touched on and I don't have anything written. But part of being a, a life-long learner and a continual learner, and mainly a really curious person, is that I'm not happy staying the level where I am. I'm, I'm always trying to make it better, always trying to improve if I can rather than just saying, "OK, well, I know what I'm doing here now; so it can't be improved anymore." So just staying curious and listening and trying to, to always continually find new analogies to help students understand what they are doing or find new approaches or every once in a while do some reflection on, "OK, it seems the last couple of students haven't been getting it; so what am I doing differently?"

Participant 2 also mentioned that it was important to always listen to the learner and put the needs of the learner at the center of the tutoring session. He commented that the goal of each training session was to do everything possible to teach the preservice teacher every skill they needed to be able to interact with the electronic portfolio tools independently (Participant 2, Interview).

> Participant 2: So sometimes you might get two of those back-to-back, but on other times it could be that I'm on remote and I've quit listening; so I have to say "OK. Am I still listening? Am I asking the right questions? And am I taking what I know about how people learn and applying that to our tutoring so that they can walk out and go do it on their own without me when they return to their work?"

The role of metacognition played a predominant role in performing consistently for Participant 2. He seemed to reflect on his practices of domain-related behaviors in an attempt to provide the best quality of technical support that he was capable of.

For Participant 2, the role of deliberate practice played a crucial part in the acquisition of expertise necessary to support the electronic portfolio tool. He wrote that attending and leading the electronic portfolio introduction workshops facilitated the development of his knowledge base (Participant 2, Concept Map).

> Workshops – The workshops helped build my knowledge base through my attendance, my preparation to lead workshops, and through my leading workshops.

The opportunity to just actually work with a large number of students in individual training sessions gave Participant 2 the chance to practice the skills he had learned in workshops and apply them directly to instructing preservice teachers (Participant 2, Interview).

> If I notice I was trying to help somebody understand how to do a step and they weren't getting it, then I would reflect a lot on, OK, why aren't they getting it? What might be in . . . what, what might I be doing that's keeping them from getting it or is it something that they're just not getting. But this would . . . Then trying to reflect on it, and then practicing a new approach, I kind of started learning what worked and didn't work with the students I was helping.

The fact that Participant 2 was immediately immersed into the domain created an immediate opportunity for him to begin practicing and developing the skills he learned.

Participant 2 cited that practicing content development in his personal electronic portfolio space refined the skills he learned through experience in the domain (Participant 2, Concept Map). The direct similarity of the personal electronic portfolio training space to the preservice teacher electronic portfolio provided an easy transfer of knowledge from environment to the other.

Finally, Participant 2 wrote that the mental rehearsal and reflection of preservice teacher training sessions gave him the opportunity to practice different instructional approaches and implement the most effective and meaningful of them into actual training sessions (Participant 2, Concept Map).

> Reflection and Mental Rehearsal – I would do this at random times (i.e. at the grocery store, after an e-folio tutoring session). I would get an idea, and then try to integrate it by rehearsing, in my head, how I would employ it. I would reflect on approaches that help me learn content, on analogies that could help students

> remember content, and by trying to come up with clear instructions that help explain both the how and the why of what the students were required to learn.

The deliberate practice of using various approaches allowed Participant 2 to determine what strategies worked and to continually adapt those strategies to fit different student needs. Participant 2 used a very student-centered approach in his training sessions with preservice teachers in an attempt to create meaningful learning experiences for them.

Problem Solving

When faced with a problem, sometimes the most difficult task of actually solving the problem is identifying the root of the issue. Participant 2 stated that when he encountered a problem he had never experienced before, the first step of his problem solving approach was to examine the issue for any similarities to previous issues he had seen before (Participant 2, Interview).

> Ted: All right, the next question is: when you encounter a problem you have never seen before, how exactly do you exactly go about solving it?
> Participant 2: Well, the first thing I try to do is analyze it to see if it is similar to something that I have seen previously and if it is, then try, try how I would solve problems I have seen previously.

If the problem was similar to one he had seen before, Participant 2 attempted to apply a previous solution to solve the issue. For a problem he had not seen before, Participant 2 used a different problem solving approach. He said that when dealing with a foreign problem, especially if the program was related to one of the software tools used to modify the electronic portfolio, he would search for menu options that directly related to existing problem (Participant 2, Interview).

> Ted: All right, the next question is: when you encounter a problem you have never seen before, how exactly do you exactly go about solving it?
> Participant 2: Well, the first thing I try to do is analyze it to see if it is similar to something that I have seen previously and if it is, then try, try how I would solve problems I have seen previously. If that doesn't work, I may, depending on the

> nature of the problem, especially if it's based more in a problem with the coding in the, in the actual, in Dreamweaver, I would look at the drop-down list on the toolbar and see what might help solve it. If that doesn't do it, I'd look at the help on Dreamweaver. And if that doesn't do it then I would ask one of my peers if they've seen it before.

If no menu option could be found, Participant 2 mentioned that he would search out his peers to assist him in solving the technical issue.

Participant 2 spoke about the dynamic he applied to each particular preservice teacher training session and described a student-centered model that he applied to each particular preservice teacher he supported. Participant 2 was interested in discerning the level of technological skill that each preservice teacher considered himself/herself to be and the comfort level the preservice teacher felt around the technology necessary to create and modify the electronic portfolio. He liked to scaffold his instruction to each preservice teacher by comparing the tools used to create the electronic portfolio with popular social media sites such as Facebook.

> Participant 2: Well, I, rather than let them just tell me what they need, or I will let them tell me what they need, but then I'll stop and ask a series of questions. What year is this? Is this your novice year? Is this your TA year? Is this your intern year? Have you had problems with it before? Do you consider yourself tech, technophobic or tech savvy? Are you, you know, comfortable with computers? Have you done this very much before? I like to ask them if the use Facebook and then tell them if they can use Facebook, then they can use Dreamweaver. It's not too far different. And then I listen to what they have to say, and if it's just a simple question about links then we can just deal with links. If it's something a little deeper, like let's say they are having a hard time uploading to their, to the remote site and in doing so I notice that they can't even sign in properly, then I say, "Well, OK, before we get to that, we need to start with this." Sometimes, they'll think they need one thing but by listening and doing diagnosis, you find out in fact that they need to be back five or six steps before because they've been, they don't have the knowledge base to get to the step they are trying to do.

Participant 2 expressed the importance of listening to the preservice teacher describe the electronic portfolio problem and attempting to make the preservice teacher as comfortable as possible with the technology involved. He attempted to create a laid back learning atmosphere that put a preservice teacher at ease in an effort to remove as many barriers to learning about the electronic portfolio as possible.

The importance of a student-centered learning environment to Participant 2 was also conveyed in other data as well. When posed with a hypothetical problem in the Narrative Prompt, Participant 2 took the time to assure the preservice teacher that her electronic portfolio was not ruined, just convoluted (Participant 2, Narrative Prompt).

> I would reassure her that her efolio was not ruined, but that it was pretty messed up. I would ask questions to figure out how she managed to mangle her efolio so as to help her not do it again. In the past I would have helped her learn how to rebuild her site by eliminating the excess folders and by giving the correct suffixes to her files. Now I would help her fix the site by using the more advanced functions within Dreamweaver to apply the correct templates to the corrupted files (i.e. Modify>Templates>Update Pages).

Participant 2 worked with the preservice teacher asking her questions about the issues involved in the electronic portfolio and then used the more advanced functions of Adobe Dreamweaver to fix the issues. He directly involved the student in the process of determining the exact problematic issue and worked with her to fix the problem.

In a problem-based scenario, Participant 2 described his problem solving strategies as centering on scaffolding the preservice teachers' interactions with their electronic portfolios and diagnosing each problem. In the following scenario, Participant 2 was asked to help four preservice teachers simultaneously with their electronic portfolio difficulties. He provided background information on the resources available to assist preservice teachers in interacting with the electronic portfolio (Participant 2, Narrative Prompt).

> If there were four students that were all needing help at the same time, I would introduce myself to them all, and I would explain that I was there to help them

> with their efolio questions. I would then explain to them that they were able to receive one 30-minute appointment per week for each semester. I would have them all sign in to the SOE/ps sign-in page. Then I would direct their attention to the link on the support page that leads to the PDFs that feature the screen capture walkthroughs. I would tell them that they did not need to read them right then, but that they needed to know that they were there to help them use Dreamweaver and Photoshop 24 hours a day, seven days a week. I would also point out the 'links' link to the other online tutorials such as Dr. Barrett's efolio page or the scanner tips. Finally, I would let them know that the purpose of the efolio appointments were to help them learn how to work on their efolios on their own and that they would need to pay attention to what we were doing as they were going to have to be able to then finish their assignments solo.

Participant 2 further stated that tutorials for the electronic portfolio software were available online for the purposes of self-instruction. Finally, Participant 2 stated that each of the preservice teachers should schedule an electronic portfolio training appointment for individual assistance.

Ericsson wrote that the expert learner would provide multiple solutions to domain problems. Participant 2 demonstrated on several occasions that he was capable of producing multiple methods for countering domain-related problems. For example, Participant 2 responded to a narrative prompt with a different reply than his peers. In a hypothetical situation, each of the research participants were asked how they would respond to a preservice teacher coming to the media lab for assistance with her electronic portfolio near the closing time of the lab. However, the hypothetical preservice teacher had a due date for a completed electronic portfolio by the next morning. The typical response from the other study participants was the suggestion that the preservice teacher should come back to the media lab in the morning when there might be an available training appointment. Participant 2 employed a different strategy when he wrote that he would assist her with her problem immediately. He stated that he would assist the preservice teacher by completing one example of the task that she needed assistance with and then letting the preservice teacher finish on her own (Participant 2, Narrative Prompt).

> I will answer this in reverse order. My reaction would be to help her. I would not chastise her. I would let her know that she was cutting it a bit close, as we were about to close. However, I would let her know that I would help her go over and complete one of her benchmarks so that she would be able to do the rest on her own. I would also ask her to remember that her classmates were also working on the same project, and that they could be a valuable resource as she worked on the projects.

Participant 2 also suggested that the preservice teacher search for help among her peers stating that her fellow preservice teachers could serve as a valuable resource to assist her with electronic portfolio related issues.

At the software usage level, Participant 2 demonstrated an ability to access a feature using multiple methods inside a computer program. Adobe Dreamweaver was the html editor used to create and modify electronic portfolio content. During a group training session, Participant 2 informed the preservice teachers he was training that it was possible to access features of Dreamweaver using multiple methods. At the beginning of the training, Participant 2 stated that the first step to modifying the electronic portfolio was to define the electronic portfolio site. He instructed the preservice teachers that they could accomplish this task using one of two methods: using the file menus or clicking a button (Participant 2, Group Observation).

> Participant 2 states that the first thing that the students need to do upon entering Dreamweaver is define a new site. Participant 2 offers two solutions to define the site: “Site > New Site” or click on “Creating Site.”

Participant 2 displayed the ability to apply multiple solutions to a given domain-related problem, demonstrating a certain level of mastery over the electronic portfolio domain.

Deliberate Practice in the Domain Over Time

At the time of data collection, Participant 2 had been a member of the electronic portfolio support team for two years. Before becoming a member of the support team, Participant 2 had no prior work experience in a technology support role position. The extent of Participant 2's technology experience in a work role was interacting with a database that housed information on past sales he had made (Participant 2, Demographic Sheet).

> Do you have any previous technological work experience? If so, please provide details regarding your job history:
> No. The only technology that I used in previous work was in creating a database for maintaining contact with sales leads and of previous customers.

With no previous work experience in a technical support role, Participant 2 learned his entire domain-related knowledge and skill sets directly in the domain environment.

Participant 2 was provided with a brief segment on formal training that consisted of a 20-minute training session with a former support team member and was then encouraged to begin interacting with the domain immediately (Participant 2, Interview).

> Well, there was nothing formal as far as the media center having standard operating procedure for, for mentoring somebody through how to do it. I did sit down with Shannon Trimble for 20 minutes one day and he just kind of walked me through it, and then they had me lead the class. And so, you know, which isn't really formal, that's, that's really more, they said, "Here, lead it and if you have questions, ask us." But it was kind of like throwing you in the deep end, you know, and if you don't know how to swim, at least try to figure out how to bob.

Participant acquired his knowledge through third party instructional materials, facilitating training sessions, and mental rehearsal of potential electronic portfolio training sessions (Participant 2, Interview).

> Ted: OK. How did you acquire that knowledge?
> Participant 2: In part through, at, at various odd times--because that's kind of the way my head works--doing mental rehearsal, whether I be in the shower or

> whether it be while I'm trying to fall asleep or there's at times daydreaming. And other ways: going and buying a Dreamweaver book and reading about how to use Dreamweaver, and then in part just by using the tool and by leading the facilitation--tutoring the, the efolio tu . . .tu . . . tutoring.

Participant 2 further testified that he recognized the fact that his initial training in the electronic portfolio subject area was lacking and mentioned that it was necessary for him to redouble his learning efforts so that he could quickly become a more efficient support staff member (Participant 2, Interview).

> Participant 2: Well, originally as a novice, I, I really thought that the training I was given was, was pretty weak in that there just wasn't very much of it. And nothing formal, nothing saying, "Here is your manual on how to be an efolio mentor or trainer." And so, you know, when I did my first couple of tutoring sessions and when I first led my first workshops, you know, I fell on my butt because it was not, I wasn't very good at planned--I don't like doing that; so then I had to redouble my efforts and say "What am I going to do now to make it better the next time?" And I started hitting external sources like the tutorials that Adobe and that Macromedia provide on their web sites, reading materials that we have, reading a book on Dreamweaver, and then just reflecting on what I know about how adults learn and trying to make the information personally relevant to those students and how to try and remember that we are trying to co-construct knowledge with them.

Participant 2 faced an extremely large knowledge gap with no previous work experience to transfer to the current support position. To successfully adapt to the support position, Participant 2 was forced to utilize external sources and draw upon his learning theory knowledge to cope with his position. In summary, Participant 2 acquired his electronic portfolio knowledge directly through interaction with the domain.

Learning Community

Participant 2 was considered to be a journeyman in the electronic portfolio learning community. He spent two years mastering the electronic portfolio knowledge base in order to begin contributing back to the learning community. Participant 2 began to modify his instructional strategies from the traditional task-based approach to problem solving to more of a student-centered approach. He attempted to scaffold his instruction for each preservice teacher by providing helpful information pertaining to the solution. The purpose of this strategy was an attempt to stimulate the preservice teacher into taking ownership of their electronic portfolio and to become a more independent problem solver. Participant 2 enjoyed interacting with the preservice teachers while trying to instruct them to manage their own electronic portfolios.

Summary

Participant 2 came to the electronic portfolio support team with no previous technological support experience. The limit of Participant 2's technological experience was using a personal computer and inputting data into a customer database in a previous work position. He acquired most of his knowledge as an electronic portfolio support staff member.

Knowledge, skills, beliefs, and dispositions. Participant 2 was considered to be an expert in the electronic portfolio domain by at least one other study participant as well as Participant 2 himself. He stated that he possessed a fairly sophisticated level of knowledge and troubleshooting experience that was similar to Participant 1 except he lacked the ability to create electronic portfolio templates that Participant 1 possessed. Participant 2 did not possess a large amount of domain knowledge when he first became a support staff member but sought out external sources of knowledge to augment his formal training.

Participant 2 also acquired a large amount of domain knowledge as he became an expert level electronic portfolio support staff member. Participant 2 became a portfolio support staff member with absolutely no domain knowledge and acquired a large amount of domain knowledge through deliberate practice. Like Participant 1, Participant 2 possessed an extensive understanding of the components of the electronic portfolio system. Participant 2 understood the capabilities and relationships between each component of the electronic portfolio system. Participant 2 needed extensive knowledge of the domain to be able to function as a support staff member. He drew heavily on this knowledge when providing training preservice teachers and solving domain-related problems.

Participant 2 consistently sought to improve his level of performance in the domain. In his interview, Participant 2 revealed that he often questioned his instructional strategies in an effort to improve the quality of training he proved to preservice teachers. He confessed that he sought to always listen to the needs of each preservice teacher he trained in an effort to provide the highest quality of training session. Participant 2's performance was dependent on the preservice teacher's performance—a student-centered approach. He also stated that an exposure to a large amount of group and individual training session allowed him to perform at a higher level due to the new and unique problems to which he was exposed. Participant 2 always attempted to use every learning experience he encountered to better his level of domain knowledge and skills.

While possessing an almost expert level of expertise, Participant 2 still occasionally encountered novel problems he had not seen before and stated that if he encountered a new type of electronic portfolio problem, the first step in his problem solving strategy was to compare the current issue to previously encountered problems. If he could not generate a solution using that method, Participant 2 would search for solutions in the software menus until he found an option that may be related to solving the problem. Participant 2 did not often seek help from other members of the support staff until he had exhausted all other individual problem solving strategies. When working with preservice teachers that had problems, Participant 2 utilized scaffolding to help preservice teachers understand the root of the issues in their electronic portfolio and provided support to remove the issues. Using the scaffolding approach, Participant 2 could usually offer multiple solutions to the preservice teacher he was assisting. He used a problem solving strategy that was largely based on former experience, investigation, and a student-centered methodology.

Participant 2 acquired several different sets of skills directly related to interacting with the domain. After two years of domain-related experience, Participant 2 acquired the technical skills to manipulate the software packages used to create and make changes to electronic portfolios. Participant 2 possessed the necessary skills to use the webpage building software and the photo editing software to assist preservice teachers with their electronic portfolios. Mastery of technical skills was important because Participant 2 needed those skills to be able to modify electronic portfolio settings and content to assist preservice teachers with technical problems.

One of Participant 2's unique attributes was his belief that connecting with the students was important. Participant 2 sought to structure his instructional approach in such a way that the preservice teacher would be able to relate easily with the material he was teaching. Participant 2 had an empathetic disposition when it came to assisting preservice teachers. It was Participant 2's belief that each preservice teacher he trained should understand the purpose of the electronic portfolio and how easy it was to use. As an educational psychologist, Participant 2 utilized learning theory to derive electronic portfolio training methods that the preservice teacher could relate to. For example, Participant 2 sought to relate the modification of electronic portfolio content to using social media such as Facebook. Participant 2 constantly reassured preservice teachers that if they could use Facebook, they could easily use the electronic portfolio software tools. Participant 2 honed his instructional strategies using metacognition and rehearsal to practice potential problematic situations he might encounter. Participant 2's approach to preservice teacher training was completely student-centered to help each preservice teacher maximize the amount of electronic portfolio information they could learn in a single training session.

Contextual factors. The contextual factors that influenced Participant 2's acquisition of expertise were mainly in the environment of the electronic portfolio. Participant 2 indicated that he acquired a large amount of his domain knowledge and skills through the training sessions that he observed and participated in. The training sessions allowed him to observe other electronic portfolio support staff and how they trained preservice teachers. Observing his peers also gave Participant 2 the opportunity to observe the problem solving skills of other support staff members in action. Also, Participant 2 stated that his exposure to novel domain problems challenged his current domain knowledge and experience greatly. When Participant 2 faced novel problems, it gave him the opportunity to expand his domain knowledge and experience. Context was important for Participant 2 because it gave him the opportunity work with his peers and face novel domain problems.

Participant 2 used his training in educational psychology to enhance his interactions with the domain via rehearsal and metacognition. Participant 2 thought about theoretical problems that he could encounter and then would think about the different methods he could use to solve the issue. The combination of mental rehearsal and external sources of knowledge greatly enhanced the domain knowledge and skills of Participant 2.

Participant 2 possessed several years of teaching experience that he applied directly to his training session with a student-centered instructional dynamic. He was forced to consult external learning sources and on-the-job training to begin acquiring domain knowledge at the beginning of his support staff work position. Participant 2 possessed a significant disadvantage due to his lack of experience when he became a member of the electronic portfolio support staff.

Participant 2 also developed his problem solving skills through his involvement in the domain. As a support staff member, Participant 2 spent a large portion of his time in the domain analyzing problems and applying a solution to said problem. Participant 2 sharpened his analytical skills through observing other support staff members solve domain problems and encountering novel problems of his own. Participant 2 harnessed his domain experiences to create schema for solutions applied in past problematic situations that he could later apply to similar problems or adapt to newly encountered problems using deliberate practice. Participant 2's large amount of domain experience served as an opportunity to hone his technical and problem solving skills to apply to domain related problems.

Participant 3

Domain-Related Knowledge

Participant 3 had been a member of the electronic portfolio support team for three months at the time of data collection. As the newest member of the team, Participant 3 considered himself between a novice and an expert level in the domain of the electronic portfolio.

> Ted: Do you consider yourself a novice portfolio support staff member, an expert, or somewhere in between? And why do you place yourself in this category?
> Participant 3: I would say somewhere in between. And I place myself there because I, I feel like I have a, a good working knowledge of e-portfolio and the processes needed to develop portfolio. I don't consider myself an expert. There are still plenty of things within the program, the programs being used, that I don't have a grasp of.

Participant 3 felt like he had a general grasp of the knowledge necessary to interact with the electronic portfolio. Participant 3 also volunteered that while he did understand the basics of the electronic portfolio; his mastery of the domain knowledge was by no means assured.

Participant 3 stated that he still sought assistance from more knowledgeable individuals when coming across problems he was not familiar with. Participant 3 felt that seeking the help of a more experienced individual when confronted with an unfamiliar problem was a more efficient way to solve a problem due to constraints of time during an electronic portfolio training session (Participant 3, Interview).

> Ted: When you encounter a problem you've never seen before, how do you go about solving it?
> Participant 3: Well, that depends. If I've got some support here than I can check in with, somebody that I know is a little bit more experienced than I, I'll default to them because I recognize when I'm working with the student they have a limited amount of time with me and so they need the fastest response. If I'm here by myself, I don't have someone that's capable of providing better support than what I am; then I am your atypical experiential learner. I'm not afraid to start

> troubleshooting and, and, you know, you know, I was going to say just start pushing buttons but it's not just a random pushing. There is, there is a troubleshooting process that I'm going through.

Typically, each training/support appointment lasted for thirty minutes, leaving a very short window to solve whatever problems the preservice teacher experienced. However, Participant 3 considered himself to be an experiential learner and was not afraid to start "pushing buttons" inside the electronic portfolio program if more experienced assistance was not available.

Another sign that there were gaps in Participant 3's electronic portfolio knowledge base was his inability to define a hypothetical problem as described in the Narrative Prompt. Participant 3 freely admitted that based on the symptoms described, he was unable to discover the source of the problem but wrote he would troubleshoot the problem by checking every possibility (Participant 3, Narrative Prompt).

> I don't know how to define the problem, but I would troubleshoot the problem by checking everything I knew could possibly be wrong (i.e. I would check to make sure it was his site from his flash drive that he was working from; I would check his links to make sure they were all right; see what pictures were not working and see what format they were in and to assure that links were not to images/documents instead of HTML page; and I would synchronize to see that if any of the files indicated a need to resolve problems).

The domain expert would have used an established problem solving process and identified the underlying problem based on the symptoms described in the Narrative Prompt. Participant 3 was atypical compared to the previous two cases in his self-described lack of domain-related knowledge.

Participant 3 revealed several gaps in his knowledge base during a group training session. At the beginning of the training session, Participant 3 instructed the preservice teachers he was training to open Adobe Dreamweaver. Participant 3 provided very specific directions to the preservice teachers how to open the program but then asked another support staff member if the preservice teachers would open Adobe Dreamweaver using the same method (Participant 3, Group Observation).

> Participant 3 has the students open Dreamweaver by clicking on Start > Programs > Web Design > Dreamweaver. Participant 3 asks the other Media Center attendants if the students would find Dreamweaver in the same location that Dreamweaver is located on Participant 3's computer.

In another instance, Participant 3 led the preservice teacher through the process of defining the Dreamweaver site. Defining a site in Dreamweaver provided the computer with the information to link up the local copy of the preservice teacher’s portfolio with the copy of the electronic portfolio that resided online on a remote server. Participant 3 once again asked a support staff member if he chose the right option to begin the site definition (Participant 3, Group Observation).

> Participant 3 begins the process of having the students begin defining their site. Participant 3 asks if the Create New HTML option is the correct one to choose and the other Media Center Attendant states that the correct option is New Dreamweaver site.

The other support staff member informed Participant 3 that he chose the incorrect option and needed to use an alternative option.

Later in the same training session, Participant 3 spoke to the preservice teachers about the appropriate dimension sizes of images to use if inserting photos into their electronic portfolio. Participant 3 instructed the preservice teachers to use the correct image dimensions but did not mention that the image on the top .html page used different dimensions than the standard image used in the electronic portfolio (Participant 3, Group Observation).

> Participant 3 tells the students to go to Image > Image size. Participant 3 states the WebPages in the EP are designed by 900 pixels wide. Participant 3 states that

> the image should not nearly be that size and that the typical size image should be 450 pixels wide. Participant 3 states that the for the index page, the image should be 250 pixels wide with the prompting of another support staff member.

Furthermore, Participant 3 did not instruct the preservice teachers in the necessity of modifying the resolution of each image that they would place inside the electronic portfolio. Participant 3 had to interrupt Participant 3 during instruction and remind him of the importance of modifying the resolution of any image placed inside the electronic portfolio (Participant 3, Group Observation).

> A support staff member stops Participant 3 and states that the first thing Participant 3 needs to have the students do is adjust the resolution of the image to 72 dpi. Participant 3 tells the students to change the resolution to 72 DPI and to change the width to 450 pixels.

It is quite clear based on the data presented that Participant 3 demonstrated several gaps in his knowledge of the domain, verifying his novice status as a support staff member.

Participant 3 spoke about the methods he used to arrange his knowledge as a novice as compared to his "intermediate" status at the time of data collection. He used existing structures of knowledge to arrange information into different mental schema. For example, Participant 3 mentioned that he used the existing Adobe Dreamweaver tutorials as a guide to create mental schema of the process of creating and modifying electronic portfolios. Gradually as his experience level grew, Participant 3 found shorter ways to accomplish tasks and the structures of his mental schema of electronic portfolio knowledge began to reflect the personal experience he acquired (Participant 3, Interview).

> Ted: Okay. And do you, do you arrange your knowledge differently now than you did as a novice?
> Participant 3: Yes. Yeah. Because again, as a novice I relied heavily upon structures that were already in place, you know, whether it's the print formats we have or, you know, the tutorials online, you know, or a way that I was told to do

things, you know, again just with problem solving with students troubleshooting their novel situations. You know, I would find shortcuts along the way. I would find ways of doing things that, that fit my personal organizational way of doing things. For instance, if you need a good example, I think about when we put pictures into evidence pages. You know we have a process for doing that within Dreamweaver where you just, you know, you import your picture in and then you modify it using the toolbar at, at the bottom of the page. Well you know I would have students that were having to flip back and forth between programs with Photoshop and, and the pictures and I just said, you know, maybe a faster way to do this, a little more clean way to do this, is if you have a lot of evidence that you know is going to need to be modified, let's open it all up in Photoshop first, do the modifications, and then when we save it for Web and devices, save it into the folder that you are going to need it in. And so that way they were working in one program at a time, they were repeating processes so that, you know, for instance, if they had eight pictures for evidences that they needed to work on, you know, by about the third one they've gone through the same four process of cropping when they can, blurring when they need to, adjusting image size--72/700--save for Web and devices... that, you know, that repetition, they have that process down. And then when they get into Dreamweaver, you know, and they're working in, in the various folders, then it is just drag and drop. And, and something that they're very familiar with and so they didn't need a lot of support to do that. And then they can work a lot faster through the program, get more work accomplished, and be able to remember the processes.

Participant 3 said that his personal experience and understanding of domain knowledge grew and he began to be more efficient in assisting preservice teachers with their electronic portfolio related problems. He began to understand more efficient methods of using the software programs needed to modify the electronic portfolio and taught the preservice teachers a more simplistic method of using the software as well. The end result was that Participant 3 could teach the preservice teacher to use Dreamweaver to accomplish more work, use the program faster, and help the preservice teachers remember how to use the programs more efficiently.

As time passed, Participant 3 stated that there was a tremendous difference in how he conceptualized his knowledge of the domain. Participant 3 stated that his unfamiliarity with the programs used to modify the electronic portfolio was his biggest hurdle in acquiring domain expertise, but dealing with novel problems forced him to acquire domain-related knowledge when confronted with an issue he had never encountered (Participant 3, Interview).

> Ted: Okay. Is there a difference between the knowledge you possess now than you did when you were a novice? And if so how did that level of knowledge change?
> Participant 3: You know there is a, there is a tremendous difference. Again, whereas at the, you know, at the beginning I could not, well, I was just unfamiliar with all the programs needed to work in, with e-portfolios, you know. I've learned not only how, how to work in e-portfolio but also various shortcuts, you know, dealing with novel problems in troubleshooting and, and, you know, how to remedy problems. I'm trying to think of what else. Well, and also being able to, to provide concepts for students who come in that help them to grasp, you know, the processes that go on in the development of e-portfolios and working in the programs.

Participant 3 stated that some of the novel problems he encountered were very interesting and it is those types of problems that allowed him to begin to expand his knowledge base (Participant 3, Interview).

> Participant 3: Yeah. Yeah, as a novice I didn't know anything about Dreamweaver, Photoshop, or just efolio in general. But with more time working with it and encountering novel problems, because as you're well aware of working with these students, they can come up with some pretty interesting situations. And so with those, I mean that's just more in my knowledge base, so when I do encounter it again or something similar to it, you know, I'm, I’m a lot faster at my troubleshooting capabilities.

Participant 3 believed that his exposure to novel problems granted him the experience and knowledge to be able to troubleshoot faster and more effectively.

Participant 3 mentioned in his interview that several situational factors influenced his domain knowledge of the electronic portfolio. For instance, Participant 3 said that having to lead a training session and deal with preservice teachers and their problems forced him to learn (Participant 3, Interview).

> Participant 3: It was being thrown into a situation of having to lead one of the training sessions. It was dealing with students and working with them. It was experiencing different problems and having to work through them or, like I said, refer to someone with more knowledge than I that could help me troubleshoot.

Participant 3 further stated that the brief training that was given to him at the beginning of membership on the support team was somewhat effective (Participant 3, Interview).

> Ted: Did you receive any training before you became portfolio, portfolio staff? If so, describe the training process. If not, how did you acquire your current level of expertise?
> Participant 3: There was minimal training. And basically what it was: sitting down at the computer, given some instructions, and saying "Here you go." After I played around a little bit, well I had one person help me get through the whole setup. They, they didn't give me instructions, they just walked me through the process of setting up Dreamweaver and downloading the, you know, the efolio folder with the templates in there and then it was, you know, just kind of familiarize yourself. They let me kind of mess around in there and tried to explain how things work and then another individual sat down and gave me a little more detailed instruction.

Participant 3 credited his experiential learning style as the factor that allowed him to quickly establish a basic understanding and working knowledge of the electronic portfolio system. He preferred to learn through direct interaction with the domain (Participant 3, Interview).

> Ted: Do you think it was an effective way of training?
> Participant 3: For me? Yeah. I mean, I'm sure there were probably more effective ways, but, you know, I am, I am an experiential learner and that's how I've always learned. I prefer to get in there and tear it apart and put it back together. I'm not afraid to, to attack things and fail because failure is just a term that really identifies a new way to learn or better understand something. So, you know, I guess what some would call failure is not failure it's an opportunity to learn something new. So...

Participant 3 enjoyed learning about the electronic portfolio system through direct interaction with the electronic portfolio domain.

Performance

Participant 3 showed few signs of consistency of task performance during the time of data collection. Having only been on the support team for three months, it is not a big surprise that Participant 3's domain performances were limited in scope and inconsistent. The few examples of consistent task performance were captured mainly in the Narrative Prompts. One question from the Narrative Prompts asked each research participant how they would respond to a hypothetical situation in which they were forced to support four preservice teachers simultaneously.

Participant 3 wrote that Student A from the aforementioned question needed to download the electronic portfolio templates, create the required benchmarks, and establish an electronic portfolio presence on the Internet. Participant 3 wrote that he would use the same solution for Student C that he used for Student A (Participant 3, Narrative Prompt).

> I would follow the same process from 1A, except that I would encourage the student to lead the process as they remember various aspects of the process. If they appeared to be confident in the process after assisting on the first one, then I would leave them to work on their own.

Even though Participant 3 only possessed the basic level of domain knowledge, he was able to provide a solution to one problem but also recognize the solution could be applied to another student.

There is no question that Participant 3 was just beginning to grasp the enormity of the electronic portfolio domain. Participant 3 was required to learn to use multiple software packages to create and modify electronic portfolios in a very short period of time and was faced with the challenge of not only having to master those software packages but also become fluent enough in the programs that he could successfully teach other individuals. Participant 3 had not been involved in the domain for nearly long enough that he could deliberately practice the skills he had acquired through his brief tenure as a support staff member. He expanded his knowledge base to a certain extent when faced with a training dilemma but did not have enough time in the domain to purposefully test himself or perfect his instructional practices like his more tenured peers. As Participant 3 stated earlier, he increased his understanding of the domain through experiential learning with the different tools in the domain.

Problem Solving

Participant 3 demonstrated a basic ability to identify problems and attempt to solve the detected issue. In one particular instance, Participant 3 attempted to assist a preservice teacher in defining their electronic portfolio site. He asked the student to fill in all of the requisite information and instructed the preservice teacher to click the button that would test the connection between the local copy of the electronic portfolio and the remote copy of the electronic portfolio. The preservice teacher was unable to get the two instances of the electronic portfolio to connect successfully and Participant 3 needed to determine the cause (Participant 3, Individual Observation 2).

> Participant 3 tells student to hit the Test button to test the login information and Participant 3 realizes something is wrong. Participant 3 examines screen and determines that the password is incorrect and has the student re-enter password. Participant 3 tells student that often the other login issue is that students misspell the word "portfolio." However, re-entering the password did not work so Participant 3 has student capitalize first letter in the first and last name for the login. Participant 3 further examines the issue and tries to test the connection again and this time the connection works. Participant 3 has no idea what changed to make the connection work unless there was an extra space somewhere that was not needed.

Participant 3 suggested that the preservice teacher first re-type their password in the event that the preservice teacher inputted an incorrect version of the password. However, the electronic portfolio connection still did not connection successfully and Participant 3 had to re-examine the connection information to determine that every piece of information was typed in correctly.

Participant 3 realized that the student misspelled some of the information that was needed to connect the local electronic portfolio location with the remote location. He incorrectly assumed that the password needed to be changed and did not examine the other connection information for grammatical mistakes or other incorrect information. Participant 3 displayed a trait in his performance that confirmed his novice status in the domain: he automatically applied one solution to a problem without first analyzing all available information to make a determination of the exact nature of the problem.

In another situation, Participant 3 assisted a preservice teacher with photo editing. After they completed the editing process, Participant 3 instructed the student to begin using Dreamweaver again. In the process of photo editing for the electronic portfolio, the final version of the edited photo is automatically inserted into an electronic portfolio in the place of its predecessor and should show up on the screen automatically. For whatever reason, the newly inserted photo did not appear in the place of the original image. Participant 3 suggested minimizing the Dreamweaver program to the taskbar of the computer and then asked the preservice teacher to maximize the program back to normal size on the screen. Participant 3 suggested a potential solution but did not solve the issue. One of the other study participants member suggested to Participant 3 that it was also necessary to click the Refresh button inside Dreamweaver. Similar to the Refresh button in a web browser, the Refresh button in Dreamweaver was designed to display any new content (Participant 3, Group Observation).

> Participant 3 states the image may not look it has changed. Participant 3 suggests minimizing the webpage that the student has been using and then expanding the page again. One of the other study participants suggests that the students should click on the Refresh button to see the new image on the screen.

The second solution successfully displayed the new image for the preservice teacher and provided evidence that Participant 3 could not troubleshoot the issue.

Participant 3 also had several instances occur in which he was able to problem solve successfully. He dealt with one preservice teacher who broke her original flash drive that had her electronic portfolio files stored on it. The potential disaster of this situation was enormous because the flash drive contained the only local copy of the preservice teacher's electronic portfolio. However, Participant 3 stated that he could download a copy of the remote electronic portfolio onto the preservice teacher's new flash drive (Participant 3, Individual Observation 3).

> Participant 3 says that they need to set up Dreamweaver. Student says that all of the files of her electronic portfolio may not be on her current flash drive because she broke her first hard drive. Participant 3 says the solution is to create a folder on the new flash drive that he can then download the remote copy of the EP for the student and then she can modify that copy.

Participant 3 provided a quality solution for the aforementioned problem that gave the preservice teacher a base copy of her electronic portfolio. On another occasion, a preservice teacher was having difficulty with the quality of an image that needed to be inserted into the preservice teacher's electronic portfolio. Participant 3 noticed that the image was not of high quality, and he suggested to the preservice teacher that changing the format of the image would fix the issue (Participant 3, Individual Observation 3).

> When student is saving image, Participant 3 notices that the image is bleeding through on some of the edges. Participant 3 says the way to fix this issue is to change the image format.

While Participant 3 displayed some problem solving skills, his performance indicated that some gaps in domain-related knowledge still existed.

When questioned about his problem solving ability, Participant 3 offered the idea that he considered himself between the novice and expert level. Participant 3 clearly mentioned that he had sufficient knowledge gaps in the programs used to create the electronic portfolio and the most efficient ways to utilize the program to problem solve (Participant 3, Interview).

> Participant 3: I would say somewhere in between. And I place myself there because I, I feel like I have a, a good working knowledge of e-portfolio and the processes needed to develop portfolio. I don't consider myself an expert. There are still plenty of things within the program, the programs being used, that I don't have a grasp of --several of the shortcuts, for instance. There may be quicker ways to, to get things accomplished.

Participant 3 realized there were probably quicker ways to accomplish domain-related tasks but felt that he did not necessarily possess the knowledge or experience to use them. Even in a hypothetical problem-solving situation, Participant 3 had the opportunity to take time to contemplate the nature of a problem and was unable to fully grasp the nature of the problem presented (Participant 3, Narrative Prompt).

> I don’t know how to define the problem, but I would troubleshoot the problem by checking everything I knew could possibly be wrong (i.e. I would check to make sure it was his site from his flash drive that he was working from; I would check his links to make sure they were all right; see what pictures were not working and see what format they were in and to assure that links were not to images/documents instead of HTML page; and I would synchronize to see that is any of the files indicated a need to resolve problems).

However, Participant 3 continued to troubleshoot the hypothetical problem and listed several possibilities that could serve as possible solutions.

The problem solving abilities of Participant 3 were somewhat limited in scope due to a short period of time involved in the electronic portfolio domain. Theoretically, continued exposure to domain-related problems and opportunities to acquire new knowledge should allow Participant 3 to acquire further expertise. Participant 3 displayed basic domain-related knowledge that he could identify basic electronic portfolio problems and offer simple solutions to those problems. Participant 3 did not display a full understanding of the underlying systems of the domain and their contributions to domain-related problems. To further master the domain, Participant 3 will need to continue to encounter novel problems that will challenge his expertise level and force him grow as an expert.

Deliberate Practice in the Domain Over Time

At the time of data collection, Participant 3 spent three months as a support team member. When questioned about the use of technology in his life, Participant 3 stated that technology played a very small role in his life. He only used technology to communicate such as email and in his role as a support staff member (Participant 3, Demographic Sheet).

> Describe how much of a role technology plays in your life: Only use for communication and at work. If this includes media devices, then I use it when I watch TV/movies also.

The limited exposure and usage of technology could have potentially limited the amount of technical skills that Participant 3 could utilize when he became an electronic portfolio support staff member.

Learning Community

At the time of data collection, Participant 3 had been a member of the support staff for three months. Participant 3 considered himself able to solve basic problems but relied on advice from more advanced members of the learning community when he encountered an issue he could not solve. Participant 3 stated that he automatically sought assistance from a more advanced member of the community because of the limited amount of time available for each training appointment (Participant 3, Interview).

> Ted: When you encounter a problem you've never seen before, how do you go about solving it?
> Participant 3: Well, that depends. If I've got some support here that I can check in with, somebody that I know is a little bit more experienced than I, I'll default to them because I recognize when I'm working with the student they have a limited amount of time with me and so they need the fastest response. If I'm here by myself, I don't have someone that's capable of providing better support than what I am; then I am your atypical experiential learner. I'm not afraid to start troubleshooting and, and, you know, you know, I was going to say just start pushing buttons but it's not just a random pushing. There is, there is a troubleshooting process that I'm going through.

Participant 3 observed the methods the expert used to resolve whatever technical issue occurred and then integrated the new knowledge into his own repertoire.

Participant 3 stated that he received minimum training in the software tools used to create the electronic portfolio. Participant 3 said that he was given minimum instructions by a senior member of the learning community, one of the other study participants, and then encouraged to experiment with the capabilities of Dreamweaver (Participant 3, Interview).

> Participant 3: There was minimal training. And basically what it was: sitting down at the computer, given some instructions, and saying "Here you go." After I played around a little bit, well I had [another study participant] person help me get through the whole setup. They, they didn't give me instructions, they just walked me through the process of setting up Dreamweaver and downloading the, you know, the efolio folder with the templates in there and then it was, you know, just kind of familiarize yourself. They let me kind of mess around in there and tried to explain how things work and then another individual sat down and gave me a little more detailed instruction. So...

As Participant 3 experimented with the electronic portfolio software tools, senior members of the learning community, all other study participants, attempted to explain how the electronic portfolio system worked and provided more detailed instruction as needed. Participant 3 stated that the bulk of his learning occurred through interaction with the learning community itself. Participant 3 was forced to begin conducting training sessions as a novice and testified that he learned the most when he was immersed deeply into a training session where he worked directly with preservice teacher. Participant 3 encountered a large variety of different problems that forced him to use his knowledge and generate solutions if possible (Participant 3, Interview).

> Participant 3: It was being thrown into a situation of having to lead one of the training sessions. It was dealing with students and working with them. It was experiencing different problems and having to work through them or, like I said, refer to someone with more knowledge than I that could help me troubleshoot.

If Participant 3 encountered a problem he could not solve, he sought assistance from the experts of the learning community.

Participant 3 was involved in the electronic portfolio support learning community for only a short time when he was interviewed. Participant 3 transferred any issues he could not solve to another support staff member with more experience but did not hesitate to use those situations as learning opportunities to augment his existing knowledge base. Participant 3 was not yet ready to begin contributing to the shared knowledge base of the electronic portfolio learning community but was quickly approaching mastery of basic troubleshooting skills.

Summary

Participant 3 was the newest member of the electronic portfolio support team with exactly three months of electronic portfolio experience. Participant 3 was definitely considered a new incoming member to the electronic portfolio learning community and received very little formal training from other members of the learning community when he first became a support staff member.

Knowledge, skills, beliefs, and dispositions. Participant 3 considered himself to be an intermediate level support staff with a basic grasp of the necessary domain knowledge but still lacking in problem solving experience. Participant 3 revealed several instances of sizable knowledge gaps during his observations in which he could not provide support for a difficult issue. Participant 3 often sought more experienced support staff when he encountered a difficult problem that he could not solve. There were several instances to support his lack of domain experience that revealed more time involved in domain activities was needed to increase Participant 3's level of expertise. Participant 3 attempted to solve each issue that he encountered but was often forced to seek help in order to solve an issue in an expedient manner.

With such a little amount of domain experience, Participant 3 only had a grasp on the basic knowledge of the electronic portfolio domain and the knowledge necessary to assist preservice teachers in creating and modifying their electronic portfolios. Participant 3 did not have as great of an understanding of the dependencies of the electronic portfolio domain because of his limited experience. His knowledge of the electronic portfolio as a system was limited due to his lack of experience and time involved in the domain. While Participant 3 had enough domain knowledge to assist preservice teachers with basic problems, he required help from more experienced peers when he encountered more advanced domain problems.

Participant 3 demonstrated an ability to identify basic level problems that required a simple solution but often required multiple attempts to solve other simple domain-related problems. The data revealed several instances where Participant 3 was unable to discern the exact cause of several issues and attempted to apply several basic potential solutions to a problem in an effort to solve it. Often, his attempts met with limited success, and he was forced to acquire assistance from more experienced support staff members. Participant 3 freely revealed that his problem solving abilities were limited, but he diligently worked to increase his domain knowledge through exposure to novel problems. In the end, Participant 3 was not scared to seek assistance for difficult problems or to explore possible solutions if assistance was not available.

Participant 3 developed some basic technical and problem solving skill sets in the two months that he was an electronic portfolio support staff member. Participant 3 had the basic technical skills necessary to help a preservice teacher use the web page editing and photo editing software needed to modify the electronic portfolio. Participant 3 did not possess the skill sets to perform advanced technical functions with either of the software programs but that did not stop him from assisting preservice teachers or searching out help if he could not figure out how to solve a problem. Participant 3's lack of experience also affected his problem solving skills when he confronted domain issues. Participant 3 had not faced many domain issues in the two months of being a support staff member. The lack of exposure to domain related problems meant that Participant 3 had not developed extensive analytical or problem solving skills. Participant 3 was forced to troubleshoot domain issues with his basic knowledge of domain and the few novel problems he had encountered. Luckily, Participant 3 considered himself an experiential learner and was not afraid to experiment with different approaches to solving domain problems.

Participant 3 possessed a useful disposition that helped him acquire domain expertise despite having little formal training for the electronic portfolio system. He considered himself to be an experiential learner and stated that this perspective was a large advantage when learning all of the domain knowledge and skills needed to become a useful electronic portfolio support staff member. Participant 3 said in his interview that other electronic portfolio support staff demonstrated the basic capabilities of the electronic portfolio but he had to begin experimenting with the software tools used to create the electronic portfolio. Participant 3 held the belief that he was not afraid to begin experimenting and "pressing different buttons" to determine how parts of the electronic portfolio function. This perspective was useful because Participant 3 was not afraid to push the capabilities of the electronic portfolio software packages or determine how they worked. Participant 3's disposition for experiential learning was an advantage in acquiring domain expertise.

Contextual factors. The context of the study environment assisted Participant 3 in the acquisition of domain knowledge and expertise. Participant 3 noted in his interview that he acquired domain knowledge through experimentation with the software tools and other electronic portfolio components. The environment itself was important for the acquisition of expertise because it provided Participant 3 with the opportunity to practice with the electronic portfolio software tools and work with preservice teachers to increase his level of expertise using deliberate practice. Working with preservice teacher forced Participant 3 to be innovative with his troubleshooting strategies and solutions because of his lack of advanced domain knowledge. The direct exposure to new problems gave Participant 3 a chance to apply his experiential learning strategy when attempting to identify problems and solutions outside of his level of domain expertise. Those training experiences gave Participant 3 the opportunity to acquire domain knowledge by encountering novel domain problems.

With so little experience in the domain, Participant 3 did not display many signs of consistent performance. Participant 3's lack of experience in the domain elicited performance that was limited in scope to the few problems he had encountered and inconsistent from one training situation to another. Given his limited exposure to the domain, Participant 3 lacked the opportunities to practice deliberately the skills he learned to increase his level of expertise. However, Participant 3 volunteered during his interview that he considered himself an experiential learner. Participant 3 testified that he thrived in an environment in which he could practice with the electronic portfolio software in a direct attempt to increase his level of expertise. Participant 3 showed an ability to easily learn about the domain with very little formal training.

Participant 3 was never afraid to seek assistance from a more experienced learning community member when he encountered a difficult problem and sought to quickly master the basic level of domain knowledge necessary to support the preservice teachers. But he still needed the opportunities to practice deliberately what he learned to further develop his expertise.

Participant 3 stated that technology played a very small role in other domains of his life outside of the work environment. He periodically used a personal computer for school and email but did not use technology much more broadly than a television. Participant 3's limited exposure to technology before he became a support staff member placed him at somewhat of a disadvantage when he began working with the electronic portfolio support tools. However, his willingness to seek assistance and learn from his experiences helped him acquire domain knowledge and skills.

Participant 4

Domain-Related Knowledge

At the time of data collection, Participant 4 spent one year as member of the electronic portfolio support team. She was a very unique study participant since she used the electronic portfolio as a preservice teacher before becoming a member of the support staff as a graduate student. Participant 4 was the only study participant that actually used the electronic portfolio tool as a member of a different stakeholder group. She was familiar with the idea of the electronic portfolio as a tool and had mastered several of the basic tasks necessary to create an electronic portfolio for her coursework (Participant 4, Interview).

> Participant 4: I was familiar with the idea of the portfolio, working with Dreamweaver, making links, creating a page, but I feel that in a way the, the, the guideline we have was my training and seeing the guys present the efolio at the very beginning when I had barely started working. And so that helped me a lot, just to see how other people work, and how they teach it, and how they went through the whole process of setting, of teaching and setting up an efolio. And so the guideline, it gave me an idea of what everything was like and I think that was my training basically.

It was only as a beginning support staff member that she began to grasp the depth of the electronic portfolio after she watched her fellow support staff members provide trainings to preservice teachers. Participant 4 said that watching her colleagues work with preservice teachers and witness their instructional practices served as her training in the support role of the electronic portfolio.

When asked about her level of expertise, Participant 4 responded that she considered herself somewhere between a novice and an expert level support staff member. Participant 4 felt that she mastered enough domain-related knowledge about the electronic portfolio but felt that she lacked the ability to consistently troubleshoot technical problems (Participant 4, Interview).

> Ted: Okay my first question for you is--do you consider yourself a novice portfolio staff member, an expert, or somewhere in between? And why you place yourself in this category?
> Participant 4: I think I'm somewhere in between. Just because once in a while, I do have questions. I don't know what to do when it comes to some difficult problems--troubleshooting--but as far as the normal procedure of helping a student go through and review the whole process of setting up an efolio and working on it, I think, I think I'm an expert in that, but when it comes to troubleshooting I may need some advice.

Participant 4 admitted that once in a while she sought out her colleagues, which were all participants of this study, when she was not able to troubleshoot an electronic portfolio issue. In the event that a peer was not available for questioning, Participant 2 stated that she considered the nature of the problem and began trying various approaches to solving an issue (Participant 4, Interview).

> Participant 4: Just basically from not knowing what to do to be able to try different things. Okay, we have this problem, so let's try this first. All right let's try that. If it doesn't work, let's move onto another thing, and so I have more knowledge of what to do and how to help students solve their little technical problems.

Participant 4 then built her level of domain knowledge base on the approaches that either succeeded or failed.

One particular instance highlighted the fact that Participant 4 still sought help when she was not able to troubleshoot an issue successfully. During a training session, a preservice teacher wanted to edit video footage and then insert it into her electronic portfolio as evidence for a benchmark. The preservice teacher asked Participant 4 if this was possible and Participant 4 replied that she did not know how exactly to accomplish the requested task (Participant 4, Individual Observation).

> Student asks Participant 4 if it is possible to edit some of the video footage that she would like to post to her EP. Participant 4 does not know the answer. Participant 4 asks the other support staff, [other study participants] if they know how to edit video. The other support staff member debates about the easiest way to accomplish this task with the consensus being that it is necessary to put the video footage onto an Apple Macintosh and edit it using iMovie. The solution to the problem is that one of the support staff takes the video card containing the video footage and attaches it to the Mac and starts editing it.

After editing the video footage, Participant 4 had to insert the footage into the electronic portfolio but also did not know how to accomplish this task. Once again, she was required to seek assistance from a colleague (Participant 4, Individual Observation).

> Participant 4 asks the other support staff how to insert video into Dreamweaver. One support staff member replies with the command Insert > Plugin.

Participant 4 demonstrated that her troubleshooting skills were limited to the basic tasks of the electronic portfolio such as building pages or hyperlinks. When she attempted to solve a more advanced problem, Participant 4 was required to seek the aid of a fellow support staff member to solve her issue.

Participant 4 was asked how her skill and knowledge level changed since she joined the electronic portfolio support staff team. Participant 4 stated that her level of knowledge and problem solving ability were limited to the electronic portfolio experience she had acquired as a preservice teacher. As a novice, Participant 4 used the training outline she was given as her framework for solving domain-related problems (Participant 4, Interview).

> Ted: Do you, thinking back on your past experiences, do you approach problems differently at your current level of expertise than you did as a novice, and how so?

> Participant 4: When I did, when I was a novice, I went by the outline we have. I work with students and I read the outline and helped them with that and later on I started to improve because I started to form my own system of teaching the e-portfolio. I would break it up in, into, okay, let's work on pictures first because I thought that was the hardest part for them, modifying pictures, optimizing them, and so if, if . . . I would make that my main goal and then I would move on into how to make pages and how to make links. I mean I would just break it down in step from most difficult problems to the simplest. So that's the way I would, I would, approach working one-on-one with the student, was try the most difficult task and then go down from there instead of just going by the list: so step one, step two, step three, so . . . .

The training outline consisted of the processes that support staff members used in the initial electronic portfolio given to preservice teachers en masse. Participant 4 systematically broke down the tasks on the outline into individual processes and determined what exact issues the preservice teacher was having. As Participant 4 spent more time problem solving in the domain, she began to see patterns in the problems that preservice teachers experienced and began to draw upon experience and less on the rigid format of the training outline (Participant 4, Interview).

> Participant 4: Just efficiency with time, and just because I started to see patterns on, on what students have the most, like the hardest time with. And so I noticed that optimizing pictures was one of the things that some of the students didn't do and, or they just needed to learn how to do it, so to me that was the hardest, and if they could handle that, they could handle anything else in the portfolio.

The knowledge and skill level of Participant 4 greatly evolved from her time as a preservice teacher as she entered the role of a support staff member but she still required a large amount of additional domain knowledge to be considered an expert.

Performance

The expectation that Participant 4 performed domain-related tasks at a consistent level was almost minimal because of her lack of time as a support staff member. Since she still possessed substantial gaps in her domain knowledge and experience, Participant

4 sought help from her colleagues in matters of troubleshooting. However, even as a novice, Participant 4 stated that she consistently used a particular method for troubleshooting problems, following the handout used in group trainings (Participant 4, Interview).

> Participant 4: When I did, when I was a novice, I went by the outline we have. I work with students and I read the outline and helped them with that and later on I started to improve because I started to form my own system of teaching the e-portfolio. I would break it up in, into, okay, let's work on pictures first because I thought that was the hardest part for them, modifying pictures, optimizing them, and so if, if . . . I would make that my main goal and then I would move on into how to make pages and how to make links. I mean I would just break it down in step from most difficult problems to the simplest.

As she increased her level of expertise, Participant 4 modified her existing troubleshooting framework and developed a typology of solving tasks beginning with solving more difficult problems and continuing to the least difficult tasks. Due to the time limit of thirty minutes for an individual training session, Participant 4 used this method of instruction to assist the preservice teachers in overcoming the most difficult tasks first.

Participant 4 testified that the role of deliberate practice was important to increase her level of performance. She stated that it was necessary to become familiar with the software programs used to create the electronic portfolio and the different types of issues that preservice teachers encounter when using the electronic portfolio (Participant 4, Interview).

> Participant 4: No. I mean just, just practice is always important. You become really familiar with, with the program with the problems that come with it, or, or the, the, the different situations student, students encounter with the program. And so just being there helping, having a positive attitude all the time, help them have a positive attitude about the efolio. Just knowing they can master it, whatever steps they have to learn and just, just have a positive attitude about it. That's one thing . . . I, I don't think the efolio is, is . . . I think it is going to be

> wonderful for them, but at the same time I, I, I don't view the process as something that is boring or difficult or whatever, I just try to show them “Hey, this isn't, this isn’t as complicated as it seems” or I tell them "this is the hardest it will get, everything else will be easy for you." And so I, I try to share that attitude with them. So . . . I think that is important because it will help them relieve their stress and, and they feel more confident about it and more independent and so I try to emphasize that, a good positive attitude towards the whole process of creating the efolio.

Participant 4 felt that understanding the various issues that occurred enabled her to encourage preservice teachers to understand the nature of the electronic portfolio and explain that it was not a difficult tool to use.

Participant 4 stated that practice allowed her to increase her level of domain-related knowledge and experience and felt that she acquired domain knowledge because she was forced to try to find solutions to electronic portfolio problems individually. Participant 4 used the problem solving strategy of trial and error to find solutions to problems she had never encountered before (Participant 4, Interview).

> Ted: Okay. How did you acquire that knowledge?
> Participant 4: Asking my peers, sometimes just trying things on my own, pushing buttons and see if that works. So it's a combination. Trial and error and working with my, with my peers.

The need to be efficient with the thirty minutes of a training session heavily influenced Participant 4 to practice domain-related tasks so that she could more efficiently serve preservice teachers (Participant 4, Interview).

> Ted: So basically practice then allowed you to acquire new knowledge?
> Participant 4: Yeah, yeah, just practice and just trying to be efficient with the time because we’re only allowed 30 minutes--or the student is only allowed 30 minutes--and so we want, we want, I wanted them to know the hardest part, you know. Whatever they were having a problem with.

The role of deliberate practice played an important role in acquisition of domain-related knowledge for Participant 4 because it allowed her to learn from realistic problem solving scenarios.

Participant 4 briefly spoke about the importance of understanding the scope of a problem and determining if she had the skills to troubleshoot successfully an issue. Participant 4 felt that it was important to understand the nature of each problem that she faced because certain problems could affect the entire content of an electronic portfolio (Participant 4, Interview).

> Ted: When you encounter a problem you've never seen before, how do you exactly go about solving it?
> Participant 4: I, if I see that it's going to be something that is not going to, I guess, change the original template that the student has, I'll try to solve it myself. But if I see that it could be something that can affect their entire portfolio--what they already have--and I don't know what I'm doing I would rather ask for some assistance.

Participant 4 suggested that it was important to understand the consequences of her troubleshooting strategies on the content of the electronic portfolio. She clearly realized the extent of her domain knowledge and felt that it was important to seek assistance when facing issues that she might not completely understand and could affect the entire content of a preservice teacher's electronic portfolio.

Problem Solving

Participant 4 stated that she considered her technical support skills to be someplace between novice and expert level. As she was not yet an expert, Participant 4 was able to identify entry-level domain problems and provide a suitable solution. At her current expertise level, Participant 4 felt comfortable enough to troubleshoot problems that were not systemic but preferred to defer to more experienced technical support staff when she encountered more advanced problems (Participant 4, Interview). Since applying an incorrect solution could cause damage to the electronic portfolio, Participant 4 was wise in seeking assistance.

As her experience in the domain grew, Participant 4 began to solve issues she encountered using a different method. Previously, Participant 4 used a pre-existing training guide as the framework for her problem solving strategy. Later, Participant 4 began arranging tasks in a hierarchal fashion beginning with solving the most difficult problems until she reached the most basic problem (Participant 4, Interview).

> Participant 4: When I did, when I was a novice, I went by the outline we have. I work with students and I read the outline and helped them with that and later on I started to improve because I started to form my own system of teaching the e-portfolio. I would break it up in, into, okay, let's work on pictures first because I thought that was the hardest part for them, modifying pictures, optimizing them, and so if, if . . . I would make that my main goal and then I would move on into how to make pages and how to make links. I mean I would just break it down in step from most difficult problems to the simplest. So that's the way I would, I would, approach working one-on-one with the student, was try the most difficult task and then go down from there instead of just going by the list: so step one, step two, step three, so . . .

Participant 4's problem solving strategy evolved as her experience inside the domain grew. This growth supported Ericsson's hypothesis that as the individual becomes more advanced in the domain, his/her problem solving strategies evolve to include past personal experiences in addition to the basic information that the novice learner is taught about the nature of the domain.

Participant 4 experienced an evolution of her problem solving ability as she acquired more domain experience and spoke about the evolution of her problem solving practices in a task-based manner. Participant 4 stated that as a beginner she did not know which approach to try when she encountered a problem. As her expertise level grew, Participant 4 applied a task-based problem solving strategy and would apply different solutions to the problem in question until the issue was solved (Participant 4, Interview).

> Participant 4: Just basically from not knowing what to do to be able to try different things. Okay, we have this problem, so let's try this first. All right let's try that. If it doesn't work, let's move onto another thing, and so I have more knowledge of what to do and how to help students solve their little technical problems.

Participant 4 rated her problem solving abilities at the intermediate level. Participant 4 stated that she mastered the basic knowledge of procedures necessary to create and modify the electronic portfolio (Participant 4, Interview).

> Participant 4: I think I'm somewhere in between. Just because once in a while, I do have questions. I don't know what to do when it comes to some difficult problems--troubleshooting--but as far as the normal procedure of helping a student go through and review the whole process of setting up an efolio and working on it, I think, I think I'm an expert in that, but when it comes to troubleshooting I may need some advice.

However, Participant 4 said that she still occasionally had questions regarding the proper troubleshooting techniques for resolving difficult issues.

One particular instance demonstrated a lack of problem solving skills for Participant 4. A preservice teacher came to a training session asking for assistance in editing some video footage that she wanted to use as evidence for her electronic video. Participant 4 did not know the proper procedure for achieving the requested task and had to ask for assistance from another study participant (Participant 4, Individual Observation).

> Student asks Participant 4 if it is possible to edit some of the video footage that she would like to post to her EP. Participant 4 does not know the answer. Participant 4 asks the other support staff if they know how to edit video. The other support staff member debates about the easiest way to accomplish this task with the consensus being that it is necessary to put the video footage onto an Apple Macintosh and edit is using iMovie. The solution to the problem is that

> one of the support staff takes the video card containing the video footage and attaches it to the Mac and starts editing it.

Another support staff member provided a solution to the preservice teacher's issue with no assistance from Participant 4. Once the other support staff member edited the video, it was necessary to place the video inside the electronic portfolio. Once again, Participant 4 did not possess the necessary knowledge to facilitate this request. Participant 4 was forced to ask the same support staff member how to insert video into an electronic portfolio (Participant 4, Individual Observation).

> Participant 4 asks the other support staff how to insert video into Dreamweaver. One support staff member replies with the command Insert > Plugin.

The data confirmed that Participant 4 may have mastered the knowledge necessary to problem solve basic issues, but she still needed to acquire more domain experience and knowledge to become a more competent problem solver.

Deliberate Practice in the Domain Over Time

Participant 4 came to the team with four years of previous experience as an actual user of the electronic portfolio tool (Participant 4, Interview).

> Ted: Okay. You had mentioned that you had a little bit of past experience when you became a portfolio support staff member. Where was that past experience from?
> Participant 4: Working with the efolio as an undergraduate. Working on my own efolio. We had to make it from scratch and so we didn't have a template, and so a lot of the, the . . . I just had to learn a lot of the basics and I, I used some guideline that they had had back then and I taught myself using that guideline. Way back, what is it 2002? All the way to 2006.

The additional experience as an actual user of the electronic portfolio software provided Participant 4 with a unique perspective in support other preservice teachers because she faced many of the same issues as a former preservice teacher.

Participant 4 became a member of the electronic portfolio support team with no previous work history in a technical support role (Participant 4, Demographic Sheet). Participant stated that she used technology on a daily basis in other areas of her life in addition to work and employed technology in the classroom during her undergraduate career as a preservice teacher. Participant 4 was also pursuing a cognate in Educational Technology from the university in which this study was conducted (Participant 4, Demographic Sheet). The combination of past experience as a preservice teacher who developed an electronic portfolio and used educational technology in the classroom set the foundation for Participant 4 to begin work as an electronic portfolio support staff member.

Learning Community

Participant 4 accumulated quite a bit of electronic portfolio experience as a user during her time as a preservice teacher and became a member of the electronic portfolio support staff with a familiarity of the electronic portfolio from a user perspective. However, Participant 4 possessed a limited understanding of the knowledge and skills necessary to assume a support role and stated that she considered her initial training to become an electronic portfolio support staff member to be rather informal in nature. Participant 4 said that she worked with a senior member of the support team, also a study participant, on an individual basis to learn the basics of her support role and felt that she learned her skills through observing other members of the learning community (Participant 4, Interview).

> Participant 4: Just because I didn't have a person telling me, okay, you know one-on-one just the way we work with the students. It was more like, you're familiar with the program and, I mean yeah, with Dreamweaver, and you've worked on this before, and, I mean I didn't have somebody sitting there with me I guess, and

> just I learned through observation, you know, how to teach other students through observation. I picked up little things from different people and started to use them myself as I taught.

Participant 4 began to compile the various skills and pieces of knowledge she learned and amalgamated all of the information into a knowledge base.

Participant 4 observed how the other members of the electronic portfolio support staff conducted training sessions and the processes they went through involving the electronic portfolio (Participant 4, Interview).

> Participant 4: I was familiar with the idea of the portfolio, working with Dreamweaver, making links, creating a page, but I feel that in a way the, the, the guideline we have was my training and seeing the guys present the efolio at the very beginning when I had barely started working. And so that helped me a lot, just to see how other people work, and how they teach it, and how they went through the whole process of setting, of teaching and setting up an efolio. And so the guideline, it gave me an idea of what everything was like and I think that was my training basically. What was the question?

The processes that Participant 4 observed became the guidelines she used when conducting her own trainings. A combination of working with her peers and a trial and error problem solving strategy comprised Participant 4's learning strategy. Participant 4 seemed to learn the knowledge and skills needed to become a support staff member fairly quickly due to her previous experience as a user of the electronic portfolio system.

Summary

Participant 4 was a unique research participant since she had previous domain experience as a former preservice teacher that used the electronic portfolio system. The transition from the user role to the role of support staff was not entirely difficult as Participant 4 was familiar with many of the domain-related tasks.

Knowledge, skills, beliefs, and dispositions. Participant 4 realized that she faced a knowledge gap in the role of a support staff member and considered herself at the intermediate level in troubleshooting techniques and domain-related knowledge. She sought out the assistance of her peers when she faced a difficult problem. The data revealed that Participant 4 did not successfully solve more advanced technical issues such as inserting video in an electronic portfolio and was forced to seek help to resolve domain issues when her experience was not extensive enough to effectively problem solve. Participant 4 was involved long enough with the electronic portfolio domain to master basic knowledge and skills but not much more.

Participant 4 considered her problem solving skills to be at the intermediate level. While she could solve basic level problems, Participant 4 mentioned that she still needed to acquire more domain experience to be considered an expert. As a novice, Participant 4 used the training checklist as a framework to form her problem solving strategy. Participant 4 later used a more task-based problem solving strategy where she examined the issue and began to systematically examine potential causes of the issue. The problem solving skills of Participant 4 evolved after her year of experience on the support staff team but still needed more exposure to fully mature to the expert level.

Participant 4 possessed enough knowledge to complete basic level domain-related tasks. Participant 4 mentioned in her interview that she possessed enough domain knowledge and experience to support basic level domain problems and introduce the topic of electronic portfolios to students. This reflection assumes that Participant 4 mastered enough domain knowledge to understand the concepts and constituencies of the electronic portfolio system but lacked an advanced understanding of the electronic portfolio components from a system wide perspective.

Participant 4 held a varied level of skills needed for operation in the electronic portfolio domain. She considered herself an expert when she introduced the top of electronic portfolios to preservice teachers because of her previous experience as a preservice teacher. She possessed the skills needed to complete the tasks needed to create an electronic portfolio and also the pedagogical skill to teach those tasks effectively. Participant 4 stated that her problem solving skills were not as fully developed as her instructional skills. She held the necessary troubleshooting skills to confront basic domain problems but did not hesitate to approach more experienced support staff for a solution to a problem she could not solve. Participant 4 possessed the necessary skills to conduct electronic portfolio trainings but needed to focus on improving her level of troubleshooting skills.

Participant 4 held the disposition of a learner, which was helpful in her journey to acquire domain-related knowledge. She mentioned during her interview that she tried to capitalize on every opportunity to learn about different aspects of the electronic portfolio whenever she had the opportunity. She observed the instructional strategies and problem solving approaches used by other electronic portfolio support staff members and compiled all of the observed domain information into her own individualized method of troubleshooting and training. Participant 4 also mentioned that she was not shy to ask questions when a domain problem was beyond her scope of expertise, especially when it came to problems that could affect an entire electronic portfolio. Participant 4's inclination to freely ask for help when required was a strength because she could support preservice teachers more efficiently and learn concurrently from a more advanced support staff member in solving new problems.

Contextual factors. One unique contextual factor that affected Participant 4's acquisition of expertise was her previous experience with the electronic portfolio as a preservice teacher. Participant 4 became a support staff member with four years of previous experience as an end user of the electronic portfolio system. She was familiar with the tasks necessary to establish an instance of an electronic portfolio as well as the tasks needed to modify the content of the electronic portfolio. But, Participant 4 lacked experience in troubleshooting domain problems, which put her on a similar level with the typical novice electronic portfolio support staff member. Participant 4 was forced to utilize opportunities presented in the environment of the study to acquire expertise such as the observation of fellow support staff members when they confronted domain-related problems and encountering novel problems individually. Encountering new problems forced Participant 4 to use deliberate practice to generate new solutions for problems she had not previously encountered. Participant 4's previous experience as an end user granted her a unique perspective about the applications of the electronic portfolio in comparison with her portfolio support staff peers.

Participant 4 was considered to be a novice user in the electronic portfolio learning community. She received very little in the way of formal training to support the electronic portfolio system. As she immersed herself in the learning community, Participant 4 interacted with other members of the learning and community and learned from them through observation. Participant 4 was able to observe both individual and group training session to learn common troubleshooting techniques. In the end, Participant 4 gained her knowledge through her interactions with other members of the domain and exposure to novel problems.

Participant 4 was not expected to perform domain-related tasks consistently with her level of expertise. She stated that she had established a problem solving strategy when basic domain issues occurred but did seek assistance with difficult domain problems when necessary. Participant 4 said that she increased her performance in the domain through the mechanism of deliberate practice. She took opportunities to include new domain information and assimilate it into her existing knowledge base when she encountered a new problem. The exposure to new problems and scenarios allowed Participant 4 to further develop her scope and understanding of the domain and the variety of solutions available for issues that arose. Participant 4 was aware of her shortcomings as a support staff member and realized that it was necessary to increase her level of expertise.

Participant 4 had one year of experience as a support staff member and did not have any previous technical support experience before becoming a member of the support staff. Participant 4 did have some experience as a user of the electronic portfolio system prior to employment as a support staff member, which gave her some familiarity with the system from a user perspective. She planned to become a teacher in the future and to implement technology in her classroom at least once a week. In summary, a contextual factor that influenced Participant 4 was her involvement with the electronic portfolio as a former user.

Participant 5

Domain-Related Knowledge

Participant 5 worked as a member of the support staff team for two years and eleven months at the time of data collection. He stated he did not consider himself a true expert in the electronic portfolio domain but somewhere in between a novice and an expert user. Participant 5 cited his inability to modify the electronic portfolio template WebPages as evidence that he did not hold expert status (Participant 5, Interview).

> Somewhere in between because I have more experience than the people who have just joined one or two semesters ago. Uh, not an expert because I don't know how to fool with the templates, like if we wanted to change a template, for example, I don't know how to do that.

Participant 5 said that the main difference between his level of skill at the time of data collection and when he first joined the support staff was his knowledge of Adobe Dreamweaver. At his current level of expertise, Participant 5 stated that his knowledge of Dreamweaver had grown to the point that he understood its capability (Participant 5, Interview).

> Ted: Is there a difference between the level of knowledge you possess now than when you were a novice?
> Participant 5: Yeah. I mean, I play with it--I play with Dreamweaver a whole lot more so I know what it's capable of now.

As a novice support staff member, Participant 5 viewed Dreamweaver as simply a template tool. He elaborated on the capabilities of the Dreamweaver program that he did not have the knowledge of when he first joined the support staff team (Participant 5, Interview).

> Uh, well I know Dreamweaver is a lot more than just a template tool. You can do a whole lot more with that, and Photoshop, as well. Uh, there are a lot of things that, that School of Ed kids just do not need to get into, but Photoshop has a lot of great stuff in it.

It seemed that Participant 5's viewpoint of expertise was formed as a function of the level of Dreamweaver knowledge that a support staff member possessed.

Participant 5 arranged his knowledge of the electronic portfolio into three major content areas: electronic portfolio theory, electronic portfolio creation/maintenance, and the assessment system (Participant 5, Concept Map).

> Around the EP knowledge circle I have three categories: EP Theory, EP Creation/Maintenance, and the assessment system. You can think of the first two categories as the "why" and the "how."

Participant 3 created the three major domains to serve as a framework to arrange the domain-related knowledge of Participant 5. He stated that the electronic portfolio theory category detailed the purpose and content of the electronic portfolio and how the electronic portfolio would affect preservice teachers during their undergraduate careers (Participant 5, Concept Map).

> The EP [electronic portfolio] theory category is important because students would ultimately like to know how the efolio is going to affect or benefit them. If a student feels the efolio has no purpose or does not fully understand the reasons for its use, they will probably not want to put their best effort into the assignments. They should also know what the different components are so they can be more able to create their own efolio.

Participant 5 felt that preservice teachers would not take their work seriously with the electronic portfolio if they did not understand the purpose of the tool.

Participant 5 wrote that the electronic portfolio creation/maintenance category contained the bulk of his domain knowledge, and he was also the most proficient with tasks related to this category of knowledge. This category contained all of the knowledge necessary to create and modify an electronic portfolio. Participant 5 stated that the largest subcategory of knowledge was related to Adobe Dreamweaver, the software package used for electronic portfolios, because it contained all of the concepts and procedures necessary to create and maintain an electronic portfolio (Participant 5, Concept Map).

> The creation and maintenance section is the area in which I feel I am most proficient. As such, this category is very large. The first subcategory would be the initial setup process where students are introduced to the programs and templates during workshops. The second and largest subsection is about Dreamweaver. Since this is one of our primary tools for the efolio, having a vast knowledge with what the program is capable of is necessary. Three of the largest areas of Dreamweaver, defining a site, evidence pages, and uploading, I am very familiar with because those areas are the most commonly discussed during appointments. Saving, opening, and creating pages are also important fields that I understand very well because these tasks are used every time you use Dreamweaver. The second-largest subsection is Photoshop. As the primary tool for evidence preparation, understanding the in-and-outs is a key asset if you want to teach others how to use the program properly. Highlighting, blurring, cropping, and others are simply, commonly used skills. Saving has a larger subsection because the process is more in-depth and harder to follow. The final subsection, problem solving, is a skill which you need if you are going to tutor and assist students. This section includes the most common problems for which we see students for. Photo errors, page errors, and syncing problems are simply, easy to fix problems which I can often prescribe a solution for immediately, eliminating the need for an appointment. Troubleshooting is also important. To do this, you need to know almost everything about the efolio and know exactly where each file needs to be. This often time-consuming process is used when students do not know how to correctly use the programs or a file-corruption has occurred.

Participant 5 also grouped problem solving and troubleshooting into the second category. He noted that a support staff member needed to know “everything” about the software program used to interact with the electronic portfolio to effectively solve issue that arose.

The last category Participant 5 used to arrange his knowledge was the assessment category. Participant 5 freely admitted that he possessed the least amount of knowledge in this category (Participant 5, Concept Map).

> The smallest section, Assessment, is where I possess the least knowledge. While I can often add students and instructors, since I don’t regularly use the system I must often pass faculty questions off to another media center worker.

Participant 5 admitted to adding students and instructions to the approved list of users for the assessment systems but did not regularly use the system enough to be considered competent and sent anybody with an assessment question to a more experienced support staff member.

Participant 5 recognized a difference in his level of knowledge when questioned about it. As a novice, Participant 5 indicated that his lack of knowledge prevented him from troubleshooting a technical issue if the cause was directly related to electronic portfolio files. He said that his fear of making a permanent change to the electronic portfolio files might have affected his problem solving strategies (Participant 5, Interview).

> Participant 5: Yeah, when I was first starting out, if I didn't know, I was a little bit too scared to go ahead and fool with somebody else's files. Uh, now I know there's a whole bunch of ways you can back yourself up so you can get back to where you were beforehand if you screw something up while you're trying to fix it.

Similarly to Participant 4, Participant 5 used the training outline to solve a problem when he was a novice. The training outline served as a checklist of tasks that Participant 5 could use to help determine the exact cause of a problem.

> Ted: Like, think about the process of like when you were a novice, you had your knowledge a certain way, you know, did you use like a checklist to kinda' go off?
> Participant 5: Oh, yeah, uh, when I was first done, I was doing like all the other kids were with that checklist that they had, going down step-by-step, but, obviously once you do it about 200 times, you get it by heart, so . . .

With so little domain experience, the framework provided a list of topics that Participant 5 could utilize to determine the cause of a problem.

As he grew in domain experience and knowledge, Participant 5 later classified problems into one of two areas: file error or user error (Participant 5, Interview).

Ted: Ok, so how do you problem-solve differently now?
Participant 5: Uh, if it's not something I immediately recognize, it's like I told you before, it's one of those two other things usually.
Ted: All right, you mean like file error . . .
Participant 5 . . . or user error.

Participant 5 defined file error as an issue with the Dreamweaver software that would cause issues such as the program freezing or inadvertently closing. User error was defined as a mistake made by the preservice teacher that would cause issues such as placing electronic portfolio files in an incorrect location or providing incorrect passwords. Participant 5 used this particular typology to arrange his knowledge and problem solving strategies as he acquired more domain-related experience. Participant 5 created this typology after acquiring enough domain knowledge and experience that he could frame the domain knowledge in such a way that made sense with his personal experience.

Participant 5 stated that he acquired his Adobe Dreamweaver training through direct instruction from a prior support staff member. However, Participant 5 built his electronic knowledge base attending electronic portfolio training workshops (Participant 5, Interview).

Ted: Did you receive any training before you became portfolio support staff? If so, describe the process, if not, how did you acquire your current level of knowledge?
Participant 5: I did not--I got training in Dreamweaver, uh, I did not get anything related to the E-Portfolio. Uh, I sat in on workshops and just from being in the Media Center, that's how I learned how to do the E-Portfolio part, and I learned Dreamweaver through [a previous support staff member].

Participant 5 said that he pushed himself to learn to figure out domain-related problems and knowledge because he was "required to" as a support staff member.

Ted: Ok, and how did you, um, how did, how did you, um--were there any specific factors beyond your raise that um, changed your knowledge level?

> Participant 5: Just, just the fact that beforehand I wasn't required to, now I am required to. So, I kind of just pushed myself to figure everything out.

Participant 5 also said that he acquired his experience after being a support staff member for over two and a half years. Participant 5 stated that each semester he gained a bit more knowledge (Participant 5, Interview).

> Participant 5: Um, no not really. It's just the fact that I've been here for 2 1/2 years and so, it's kinda' bit-by-bit come into place and so, each, each semester you gain a little bit more knowledge, and then we have stuff like this semester where we've changed programs completely, and so it's like you're starting all the way over and you gotta' figure out ok, well, what was the equivalent in this program as it was to the other? So . . .

The combination of formal training and informal experience formed the base of Participant 5's knowledge base.

Problem Solving

Participant 5 described his problem solving approach as a step-by-step process in which he attempted to determine the exact cause of the issue. Participant 5 classified the problem into either the file or user category (Participant 5, Interview).

> Participant 5: Uh, pretty much step-by-step. You gotta' determine what you think the probable cause is, whether it's going to be either user error or if it's going to be either software or template or file error. If it's user error, you can probably recover from it, if it's file error or software error, you either need to replace those files, or see if you can find another computer.

Depending on the cause of the problem, Participant 5 either sought out the technical error that was causing the original issue or offer instruction to the user to correct the problem. If Participant 5 could not discern the nature of the problem, he began analyzing the file structure of the preservice teacher's electronic portfolio. Participant 5 stated that he could usually determine the origin of the error if a file looked out of place or had been inadvertently moved (Participant 5, Interview).

> Participant 5: Uh, well if it's something that I can't figure out right off the top of my head, like, I mean something simple like, synching problems or my picture doesn't show up--uh, you obviously gotta' go over there, you can usually tell by looking at how organized their file structure is if they've moved something that they shouldn't have, or maybe they didn't mean to, but they just, you know, dragged it out of there, uh, or you can tell if, like the files are just screwing up all of a sudden, like everything was working, but they're a, obviously if they are a TA, they've been doing this for quite a while, so, and if they know what they're doing, they're just like, all of a sudden it just stopped working, obviously that's going to be more of a--probably not user error.

Participant 5 stated that in the case of not finding anything wrong with the file structure, there was probably some type of file error occurring.

Though he did not consider himself an expert, Participant 5 ranked himself above a novice in terms of level of problem solving ability. As a novice, Participant 5 stated that he used a checklist to help him organize his problem solving approach. Participant 5 used the checklist to create a methodical problem solving approach that was useful in determining the exact nature of a problem (Participant 5, Interview).

> Ted: Like, think about the process of like when you were a novice, you had your knowledge a certain way, you know, did you use like a checklist to kinda' go off?
> Participant 5: Oh, yeah, uh, when I was first done, I was doing like all the other kids were with that checklist that they had, going down step-by-step, but, obviously once you do it about 200 times, you get it by heart, so...

Participant 5 said that he used the checklist so many times that he memorized the problem solving process and was able to recall the process he used without using the outline. He used a different problem solving strategy, as he grew more advanced in the domain. Later, Participant 5 classified problems as either file error in which the issue was caused by the software package and user error that was generated by the preservice teacher (Participant 5, Interview). As he spent more time in the domain and repeated similar behaviors, Participant 5 changed his problem solving strategies.

Performance

The role of deliberate practice contributed greatly to the acquisition of domain-related knowledge for Participant 5. Participant 5 stated that he took every opportunity to practice with the software tools used to create the electronic portfolio. As a novice, Participant 5 was intimidated by the software tools and did not want to experiment greatly with them in the fear that he might cause irreparable damage to a preservice teacher's electronic portfolio. However, as his expertise level grew, Participant 5 began to feel more secure in his domain-related knowledge and experience. Participant 5 grew to understand more fully the capabilities of Adobe Dreamweaver and experimented more with the program (Participant 5, Interview).

> Ted: Is there a difference between the level of knowledge you possess now than when you were a novice?
> Participant 5: Yeah. I mean, I play with it--I play with Dreamweaver a whole lot more so I know what it's capable of now.
> Ted: How did you acquire that knowledge?
> Participant 5: Playing with it, on my own.

Participant 5 credited his experimentation with Dreamweaver as the deliberate practice that increased his level of expertise.

Participant 5 believed that it was important for preservice teachers to understand the purpose of the electronic portfolio and the role it would play in their undergraduate coursework in preparation to become a teacher. He communicated to preservice teachers that they needed to be familiar with the purposes and content of the electronic portfolio. When Participant 5 trained preservice teachers, he spoke with them about the importance of electronic portfolio and the elements that comprised the electronic portfolio (Participant 5, Concept Map).

> The EP theory category is important because students would ultimately like to know how the efolio is going to affect or benefit them. If a student feels the efolio has no purpose or does not fully understand the reasons for its use, they will probably not want to put their best effort into the assignments. They should also know what the different components are so they can be more able to create their own efolio.

Participant 5 used this approach to scaffold instruction to prep each preservice teacher because he felt that the preservice teacher would be engaged in the training session if they understood the importance of the training they were about to receive. Participant 5's choice to use the scaffolding strategy prior to instruction demonstrated a pre-meditated consideration of performance in the domain. He chose to emphasize certain aspects of the electronic portfolio for each preservice teacher in order to draw their attention to the importance of the training session. With this strategy, Participant 5 showed an active effort to plan his performance in such a way that would attempt to convey the importance of the training session and the electronic portfolio as a whole to the preservice teacher.

Deliberate Practice in the Domain Over Time

Participant 5 spent over two and a half years acquiring all of the domain expertise he possessed at the time of data collection to reach his current level of expertise. He stated that his domain expertise gradually grew as each semester passed and he learned more about the electronic portfolio system. In the time Participant 5 had been involved with the domain, he saw changes in software packages and electronic portfolio expectations that forced him to grow as a support staff member. (Participant 5, Interview).

> Participant 5: Um, no not really. It's just the fact that I've been here for 2 1/2 years and so, it's kinda' bit-by-bit come into place and so, each, each semester you gain a little bit more knowledge, and then we have stuff like this semester where we've changed programs completely, and so it's like you're starting all the way over and

> you gotta' figure out ok, well, what was the equivalent in this program as it was to the other? So . . .
> Ted: So, a lotta' practice?
> Participant 5: Yeah, just a whole lotta' practice.

Participant 5 constantly practiced his skills in an attempt to hone his level of expertise to increase his effectiveness as a support staff member.

Participant 5 began his career as a support staff member with no previous technical work experience. He was initially a student worker that was not expected to assist preservice teachers with their electronic portfolios. Gradually, he learned about the electronic portfolio system through observation as he watched other support staff members train preservice teachers. Participant 5 possessed previous knowledge of several software packages similar to the software packages used to build the electronic portfolio (Participant 5, Demographic Sheet).

> Do you have any previous technological work experience? If so, please provide details regarding your job history:
> I had experience with the Mac OS and the Adobe Photoshop and Adobe InDesign.

Participant 5 was able to transfer his experience and knowledge to serve as a base to learn Adobe Dreamweaver. The previous software usage experience proved useful for Participant 5 as he applied those skills to learn a new software tool.

Learning Community

Participant 5 worked as a student worker at the site of this study before becoming a support staff member. His duties included supporting faculty with various technologies that did not include the electronic portfolio. He then received a promotion and became an electronic portfolio support staff member in addition to his other duties. Participant 5 had the luxury of observing the other research study participants as they trained preservice teachers to use the electronic portfolio. As a student worker, Participant 5 became familiar with the electronic portfolio system and assisted preservice teachers with basic questions (Participant 5, Interview).

> Participant 5: One was I got a raise to be on the E-Portfolio staff, and so I had to become a lot more familiar with it, because, before I was just Media Center, I didn't take appointments. But, if I was on my own, I would be able to help somebody. Uh, now, I take appointments, so I have to know everything.

After receiving his promotion, Participant 5 was forced to begin working directly with preservice teachers and actually apply his domain-related skills.

Participant 5 stated that he did not receive much in the way of formal training with the electronic portfolio system. His time as a student worker gave Participant 5 insight into the general purpose of the electronic portfolio but did not equip him with much technical knowledge. Participant 5 worked with a former support staff member to learn about Dreamweaver (Participant 5, Interview).

> Participant 5: I did not--I got training in Dreamweaver, uh, I did not get anything related to the E-Portfolio. Uh, I sat in on workshops and just from being in the Media Center, that's how I learned how to do the E-Portfolio part, and I learned Dreamweaver [from a previous support staff member].

Participant 5 observed training sessions led by other support staff members until he developed a general understanding of the electronic portfolio domain. Like the other participants, Participant 5 was forced almost from the minute of his promotion to support staff to begin training preservice teachers. However, Participant 5 held the advantage of observing other support staff members in their training roles before he became a full support staff member.

Summary

Before he became a support staff member, Participant 5 was a student worker at the site of this study. Participant 5 was given a promotion and became a support staff member alongside his graduate student peers. He classified himself at the intermediate level of expertise for the electronic portfolio system and stated that his level of skill with the electronic portfolio software tools was minimal when he initially started as a support staff member.

Knowledge, skills, beliefs, and dispositions. Like Participant 4, Participant 5 freely stated that his level of domain knowledge was sufficient to combat basic domain related problems. Through observation and deliberate practice, Participant 5 possessed a rather large knowledge base of electronic portfolio concepts and understanding of relationships between those concepts at a systems level. Participant 5 stated that his knowledge base of the electronic portfolio system was advanced enough to solve domain problem and to identify places to begin looking for solutions to problems he had not encountered before. Participant 5 mentioned during his interview that his knowledge of the domain was advanced but he did not possess the necessary knowledge for modifying the electronic portfolio templates. Of all of the electronic portfolio support staff members, only Participant 1 possessed the knowledge to modify the electronic portfolio templates. Participant 5 accumulated a large amount of domain knowledge during his two years as an electronic portfolio support staff member.

Participant 5 considered himself to be above a novice level in his problem solving ability. He used a step-by-step process when he was faced with an issue he had to troubleshoot and created a problem solving strategy that equated each problem he encountered into one of two categories: file error or user error. A file error was a technical error that the electronic portfolio encountered to cause some type of issue and a user error arose due to a mistake made by a preservice teacher. Participant 5 used a problem solving strategy that allowed him to classify an issue into a specific category and then he used that category as a reference to form a solution. He developed a useful framing strategy that he used to classify the nature of each problem and then derive a solution.

Participant 5 understood the basic concepts and capabilities of the electronic portfolio system in his previous role as a student worker and was able to assist preservice teachers with basic questions. Like his peers, Participant 5 did not have any formal basic training and was forced to learn his domain knowledge through direct experience and observing individual and group training sessions. While Participant 5 was considered a novice in the learning community as he began his position, a year later he could adequately support preservice teachers with little assistance from more senior members of the learning community.

Participant 5 acquired both significant technical and problem solving skills during his two years as an electronic portfolio support staff member. During his two years of experience, Participant 5 stated that he pushed himself to learn the advanced functions of the electronic portfolio software packages because he was expected to. He stated that he took preservice teacher support appointments, it was necessary to understand the capabilities of each software package and to have the skills necessary to manipulate the programs. Participant 5 was an advanced user and rarely encountered any domain problems that he had not dealt with previously. Participant 5 also developed his problem solving skills through extensive domain experience during his two-year tenure as a support staff member. Participant 5 witnessed quite a few domain problems during his time as a student worker and further developed his problem solving skills when he actually began to support preservice teachers. Participant 5's analytical skills were also highly developed due to his past domain related experience. Participant 5 could easily manipulate the content of the electronic portfolio using the requisite software programs and discern the causes of domain related problems.

When he initially became an electronic portfolio support staff member, Participant 5 stated that he was very careful with any modification of electronic portfolio files when he worked with a preservice teacher. Participant 5 was responsible when he supported domain-related problems because he did not want to compromise a preservice teacher's electronic portfolio. As his experience level increased, Participant 5 familiarized himself with the capabilities of the electronic portfolio system and became less fearful of compromising a preservice teacher's electronic portfolio. Participant 5's cautionary strategy to problem solving and usage was highly valuable because he sought assistance for problems beyond his level of expertise and maintained the integrity of each preservice teacher's electronic portfolio.

Contextual factors. As an intermediate level expert, Participant 5 stated that he understood the capabilities of the electronic portfolio software tools. Participant 5 grew in his skill and knowledge level as he began to understand the capabilities of the electronic portfolio and observed his peers during training sessions. Participant 5 pushed himself to further develop his domain knowledge and skills directly through interaction with the electronic portfolio domain.

Participant 5 said that deliberate practice was the greatest contributor to the acquisition of expertise for him personally. He shared that as a novice the electronic portfolio system tools were very intimidating because he might cause irreparable damage to the electronic portfolio by misusing them. As his expertise grew, Participant 5 grew more confident in his usage of the tools because he further understood their capacity. The level of performance for Participant 5 grew greatly as his domain knowledge evolved. With a higher level of expertise, Participant 5 attempted to move beyond merely troubleshooting issues to help each preservice teacher understand the root of the issue that occurred and not to replicate the issue in the future. Participant 5 attempted to use his growing level of expertise to assist each preservice teacher to become an independent user of the electronic portfolio.

Participant 5 joined the support staff team with no previous technical support experience. He was already quite familiar with the software package used to edit images for the electronic portfolio so the only learning curve he faced was mastering the basic knowledge of the electronic portfolio structure and software. He was able to observe his coworkers as they interacted with preservice teachers when he was just a student worker. The experience of observing differing training approaches allowed Participant 5 to choose the most effective training approach. Participant 5 began his time as a support staff member with enough experience that he mastered the basic domain knowledge quickly.

Cross-Case Analysis

Domain-Related Knowledge

Each case revealed that the level of domain knowledge held by a member of the learning community was directly related to the time spent involved in the domain. Looking across the various cases, it was apparent that Participant 1 held the greatest level of knowledge due to his heavy involvement across the domain. Participant 1 was a principal figure in the development, implementation, and modification of the system since its inception. Participant 1 developed a sophisticated schema of electronic portfolio domain knowledge. The most pertinent example of Participant 1's extensive knowledge base showed how interconnected his knowledge was. Participant 1 spoke on subjects such as the evolution of the paper portfolio into the electronic format and the validity and reliability metrics needed to create an authentic assessment. Participant 1 also possessed the skills and knowledge to directly modify the template pages used to create the electronic portfolio. Participant 1 was considered the domain expert with the highest level of skills and time in the domain who was also sought out for advice when difficult problems arose.

On the other end of the spectrum, Participant 3 was a member of the support team for the shortest amount of time at three months. Several observations of Participant 3 revealed that he faced several knowledge and skill gaps that prevented him from being a completely effective support staff member. For instance, Participant 3 was unable to teach a group training session in its entirety. Participant 3 stopped several times during the observation because he was not familiar with the procedures needed to create a complete electronic portfolio. Because he could not complete the training session in the allotted time frame, Participant 3 was forced to ask another support staff member to complete the training for him. Participant 3's lack of experience and domain expertise was due to only a short period of time of involvement in the electronic portfolio domain. To be considered an expert, one must have spent a sufficient period of time in the domain acquiring skills and knowledge directly applicable to supporting the domain, in this case, the electronic portfolio system.

Another curious commonality between the cases was the situational environment that served as mechanism for each of the support staff members to acquire domain knowledge. A common theme that each study participant discussed was the lack of formal training. Apparently, each support staff member was given a brief training about the capability of Dreamweaver but then directly exposed to novel problems within the domain that they were expected to solve. More experienced support staff members were usually available for consultation on serious domain problems, but each study participant was expected to begin supporting preservice teachers from almost his or her first moment in the laboratory.

Several of the study participants mentioned that they were also expected to teach group training sessions and individual training sessions almost immediately. Each study participant was forced to confront novel problems that they were required to solve either individually or with some type of limited support. This ad hoc on-the-job training dynamic forced support staff members to improvise solutions to domain problems using their limited domain knowledge and problem solving skills. Each study participant stated that this style of direct immersion into the domain forced a quick growth in common domain knowledge and problem solving skills necessary to solve basic problems. The result was a quickly trained support staff member that could replicate a certain series of procedures used to create an electronic portfolio but not necessarily a cultivated understanding of the intricacies of the electronic portfolio system or of solving related technology problems.

The data also revealed an interesting difference in the methods used to acquire domain-related knowledge. The two most senior members of the support staff mentioned during their interviews that they used external sources to acquire more information about the software used to create the electronic portfolio. Participants 1 and 2 stated that they both sought out information through Dreamweaver technical manuals to broaden their understanding of the capabilities of the program. Participants 1 and 2 studied the Dreamweaver manuals in an attempt to completely understand the differences between the older versions of Dreamweaver with the version being used during data collection.

The other study participants simply relied on experimentation with the electronic portfolio templates during their training sessions to cement their understanding of the program. This particular method of knowledge acquisition was limited because the templates were designed to only use certain basic capabilities of the Dreamweaver program. Because they were interested in the capabilities of the Dreamweaver software program beyond the context of the limited templates used by preservice teachers, Participants 1 and 2 studied the manuals and expanded their domain knowledge. Therefore, Participants 1 and 2 avoided arrested development by pushing themselves beyond the minimum knowledge base necessary to problem solve successfully.

The organization of domain knowledge seemed to evolve across the various cases as well. As a novice, a majority of the research participants seemed to arrange their knowledge according to the training checklist mentioned earlier in the chapter. The checklist was used during group preservice training sessions as an outline of the content that needed to be covered during the training session. It served as a framework or schema that was valuable in assisting each support staff member in organizing their knowledge. As their experience levels increased, study participants began to adapt their acquired knowledge into more personalized, mental schemas.

One commonality gleaned from the data indicated that each participant classified their knowledge differently as their expertise level increased. Participant 1 indicated with his advanced experience that he no longer arranged his domain knowledge using a mental checklist. Participant 1 stated that he classified the nature of problem that he encountered and then generated the appropriate solution based on his large knowledge of domain information. Participant 2 stated that he originally arranged his knowledge of the electronic portfolio domain based on his limited domain experience and the knowledge of his peers. As his experience level grew, Participant 2 stated that he drew upon his larger domain experience, electronic portfolio domain knowledge, and his knowledge of learning theory to problem solve. Participant 3 mentioned during his interview that as a novice he heavily relied on the existing knowledge available such as the written electronic portfolio tutorials. Participant 3 said that as he acquired domain-related experience and faced novel problems, he found shortcuts to problems he consistently encountered and increased his level of experience and domain knowledge. Participant 3 also mentioned that he found teaching preservice teachers about various electronic portfolio concepts reinforced his own understanding of the electronic portfolio domain.

Participant 4 also experienced an evolution in her knowledge arrangement as she grew in experience. Participant 4 stated that as a novice she followed the established guidelines and procedures that existed before she became a support staff member. Participant 4 said that she now used her own method of arranging her knowledge but did not give any specific details beyond mentioning that she no longer used the existing electronic portfolio guidelines in her problem solving efforts. Participant 5 stated that as a novice, he also used the training guidelines as frame of reference for problem solving.

Participant 5 mentioned that he now classified his knowledge using two different schema: user error and file error. His knowledge classification system used user error and file error as frames of reference when searching for a solution to a problem or classifying new domain information. Based on participant testimony, it appeared that support staff members arranged their knowledge according to an internal, individualized schema as they grew in experience and expertise level.

Performance

Ericsson described the idea that an expert will perform domain-related tasks with a high level of consistency. In the electronic portfolio domain, the expert would theoretically solve domain issues and train preservice teachers consistently while encountering varying problems and environments. Conversely, the novice would display erratic problem solving methodologies while attempting to solve issues with a limited domain knowledge base. In this study, Participant 1 was considered to be the domain expert because he displayed consistent problem solving strategies and a consistent training sessions with preservice teachers. Participant 1 stated that there were not many problems or issues he had not encountered during his time in the domain which made performing consistently in the domain a relatively simple task. When one has been exposed to almost every problem-based scenario, there is a high likelihood that consistent performance is not difficult to maintain. In these cases, the level of expertise seemed to be the main factor influencing consistent performance.

The least experienced support staff member displayed erratic problem solving abilities and a distinct lack of domain knowledge when he trained preservice teachers. Participant 3 often stopped during his group training session to ask questions from other support staff members. The other support staff members present in Participant 3's group training session were also forced to interject several times to emphasize important procedures and conceptual ideas that Participant 3 did not include in his instruction. The result was a group training session that spoke of the lack of domain knowledge and skills from Participant 3. At the end, Participant 3 was forced to ask for assistance to complete the training session so that the group training session was finished in the allocated period of time. As the least experienced member of the support team, Participant 3 displayed a marked lack of preparation in his instruction and an inability to structure the content of the training session for it to be effective. When compared to Participant 1 and the other participants, Participant 3 had the least amount of domain knowledge and skills.

An analysis of the cases revealed that as expertise increases, so does the level of consistency in performing domain-related tasks. The data revealed that experience was key in performing consistently. A cross section comparison of the cases displayed an increasing level of comfort with the material after initial exposure to domain-related tasks and opportunities to practice with the knowledge and problem solving strategies introduced to each study participant. It seemed that when each participant was provided with a deliberate opportunity to practice their domain-related skills, problem solving strategies and domain knowledge levels increased for each participant.

The most uniform theme that arose from an analysis of each case was the importance of deliberate practice in the acquisition of domain knowledge and skills. Ericsson described deliberate practice as a premeditated effort to increase domain expertise through direct immersion into domain-related tasks at an ever increasingly difficulty level. Several studies Ericsson conducted revealed that experts continued to hone their domain knowledge and skills through encounters with difficult domain tasks. Increasing domain-related expertise was only possible through mastery of every increasingly difficult task and not through repetitive tasks that the expert previously mastered. The role of deliberate practice was key in the acquisition of domain-related knowledge and skills.

Each study participant mentioned the importance of deliberate practice in their personal acquisition of knowledge and skills. For instance, Participant 1 was basically responsible for the establishment of the technical aspects of the electronic portfolio system. He stated that he learned about the technical capabilities of Dreamweaver by experimenting with various aspects of the program. It was only through deliberate practice of the various aspects of Dreamweaver that Participant 1 learned that how to create the electronic portfolio templates that were used by preservice teachers at the time of data collection. In fact, the evolution of the way in which Dreamweaver was used in various incarnations was a result of the developing understanding of the inherent capabilities of the program that Participant 1 increased over time. For Participant 1, deliberate practice was directly responsible for his vast accumulation of domain knowledge and skills.

Participant 2 used deliberate practice to create his own student-centered approach to training preservice teachers. Participant 2 reached a basic mastery of domain knowledge and skills necessary to solve most domain issues but realized that one component was missing from his training session with preservice teachers. Through his various interactions with the preservice teachers, Participant 2 noticed a trend of training session that preservice teachers were only instructed how to fix issues and taught about the processes necessary to create an electronic portfolio. Participant 2 thought that preservice teachers were not provided with any scaffolding about the purpose of the electronic portfolio or how the system worked. Participant 2 chose to modify his existing task-based problem solving strategy and it evolved into a student-centered approach that involved instructing preservice teachers about the larger context of the system. Participant 2 was only able to develop this pedagogical approach through mental rehearsal and implementation of new problem solving approaches. In essence, Participant 2 used a deliberate practice modality to determine how he could improve his methods of instruction for the benefit of preservice teachers he assisted.

Deliberate practice was perhaps the most important factor in the acquisition of expertise for the participants of this study. Deliberate practice offered each individual the opportunity to combine all of the domain knowledge acquired through interaction with the environment and harness it to further develop expertise. Deliberate practice is a practice that transformed several of the individuals involved in this study from mere domain practitioners into superbly skilled experts that could manipulate the very essence of the domain into a favorable outcome. Only by continuing to challenge themselves to advanced domain activities were Participant 1 and Participant 2 able to reach expert level and avoid arrested development.

Problem Solving

One of the main roles of a support staff member was to solve any issues, most often technical issues, related to the electronic portfolio. Each support staff member possessed some level of problem solving ability that was harnessed to solve domain issues. While problem solving skills were a requisite for the support staff position, the strategies and procedures that each research participant member used to effectively problem solve varied by the individual and the level of expertise. It was fairly clear that the support staff members involved with the domain for a longer period of time possessed more advanced problem solving abilities augmented by a more developed understanding of domain-related knowledge. As the level of expertise increased, problem solving strategies evolved to include new approaches to solving issues that were previously not available to the novice. Problem solving skills were an absolute requirement for any support staff member to be successful in their position.

A majority of the study participants stated that they utilized a training checklist as their first framework for problem solving domain-related issues. The training checklist was developed by Participant 1 originally as a guide to be followed during group training sessions for preservice teachers. The training checklist contained a list of tasks needed to successfully create a new instance of the electronic portfolio for first time uses. The list of tasks contained in the training checklist was all of the basic procedures that each support staff was responsible for teaching in-group training sessions.

The training checklist became useful to novice support staff members because it served as a sort of table of contents for all of the important procedures needed to create an electronic portfolio. Several of the support staff members mentioned that they used the checklist extensively because of the list of tasks written on it. Support staff members used the training checklist as a general reference when a preservice teacher approached them with an issue. Support staff members searched through the list of tasks on the training list and attempted to discern the source of the problem based on the task that the problem affected. This problem solving strategy was a fairly common paradigm used by novice support staff until they developed their own problem solving strategies.

The evolution of problem solving strategies was a fascinating process because it differed based on the individual research participant. As the level of expertise grew, each study participant began to approach solving domain-related problems in a different manner. Each individual problem solving strategy differed on the experience level of the participant and the way in which each participant conceptualized the electronic portfolio. Participant 5 considered himself to be at the intermediate level of problem solving ability after a year of being a support staff member. He was able to solve basic domain-related problems but would seek help when he absolutely needed it. Participant 5 created a problem solving strategy that placed domain-related problems into one of two categories: file error or user error. Participant 5 used the problem solving strategy he created to classify problems he faced and generated a solution based on the classification of the problem. For example, if a preservice teacher was unable to connect the local version of her electronic portfolio with the online version, Participant 5 first searched for a solution based on the user error category. Participant checked all of the necessary information to create a connection between the two versions of the electronic portfolio for mistakes in spelling or incorrect login information. Each of the potential solutions was contained in Participant 5's mental schema based on user error. Participant 5 created his own problem solving strategy after acquiring enough domain knowledge and experience that his problem solving strategies evolved from an external framework to an internal schema.

The novice and intermediate level support staff members seemed to have fairly simple problem solving strategies. The more advanced members of the support staff team developed a more sophisticated problem solving strategy largely based on the large amount of domain knowledge and skills acquired through prolonged exposure of the domain. Every experience that the support staff experts encountered expanded the knowledge level and understanding of the nature of the domain. Participant 1 stated that he had been a support staff member for such a prolonged period of time that there were very few problems he had not encountered. Participant 1 possessed an extremely sophisticated understanding of the domain and the processes that tied each of the components of the domain together. His mastery of the domain was so complete that it was not difficult for Participant 1 to provide multiple solutions to a single problem with little to no effort. Participant 1 was able to draw upon that extensive knowledge base and problem solving strategies to solve even mundane problems.

A consistent theme across each of the five cases in this study was the idea that each participant utilized some type of problem solving strategy. The domain novice used a very simple strategy based on a training checklist created by one of the study participants. Problem solving strategies evolved when each research participant spent enough time immersed in the domain that they had sufficient knowledge and skills to create an internal problem solving strategy. As the level of expertise increased, the support staff member displayed an increasingly complex problem solving strategy based on an extensive level of experience in the domain. In conclusion, the evolution of problem solving continued to evolve with each new encountered domain experience.

Deliberate Practice in the Domain Over Time

Each study participant became a support staff member with differing technological and pedagogical experiences that shaped their domain expertise. Many of the study participants began in their support staff role with no previous technical support experience. Only Participant 1 came into the role of a support staff member with previous technical support experience and a graduate degree in Educational Technology. The lack of experience was quite a hurdle for several of the study participants, as they had to assimilate a whole body of knowledge and develop technical problem solving skills. The direct exposure to domain tasks and problems was a quick remedy to a lack of domain skills. After an initial learning curve, each participant developed basic problem solving skills and domain-related knowledge.

Each study participant used technology at differing levels in other domains of their lives. The most common usage of technology was in the area of email and other fundamental computer uses such as surfing the Internet. The usage of various technologies depended on the needs of the individual, which ranged from extensive to basic needs. One participant basically used the Internet and watched movies with his family as the prime sources of technology in his life. It appeared that past extensive technical experience was helpful for the role of a support staff member but not a necessity to learn the necessary domain knowledge. The primary knowledge base and problem solving skills needed to be a support staff member were learned through direct immersion in the electronic portfolio domain coupled with an interest in technology that supplemented domain learning.

Learning Community

The journey to expert level in the electronic portfolio domain seemed to be fairly uniform for each of the study participants with the exception of Participant 1. Participant 1 was a unique case because he was essential in establishing the electronic portfolio domain and did not have the opportunity to take part in the learning community as a novice. Participant 1 did not have senior learning community members to serve as mentors in the electronic portfolio domain to learn his craft, relying only on faculty assistance and external sources of knowledge. The other four study participants had the opportunity to join an established learning community as novices and receive mentorship from senior members of the community.

The other four study participants began as novices in the electronic portfolio learning community. As novices, the study participants were given very little if any formal training in the various software packages that were used to create the electronic portfolio. The novices were expected to begin troubleshooting domain-related problems immediately and instructed to ask questions if any arose. Senior members of the learning community were an available resource to the novices for consultation on domain-related issues and problem-solving questions. The novices of the learning community were not provided much in the way of formal training but were surrounded by other social resources they could draw upon.

Eventually the novice attained the basic domain knowledge and skills necessary to support preservice teachers in the electronic portfolio domain. Each novice developed a basic level of comfort with the "basics" of the domain and began to grow further in the domain. The novice, now considered a journeyman in the learning community, was able to practice their domain knowledge and problem solving strategies in a more independent manner. The journeymen were able to modify their basic problem solving strategies and develop them to fit internal schema of the electronic portfolio domain. The journeyman support staff members began to offer troubleshooting tips and techniques to novice members of the learning community in an effort to give back to the community. The journeyman's responsibility in the learning community was to continue in their pursuit of expertise and provide support for the novice members of the community.

The expert in the electronic portfolio learning community achieved mastery level in their interactions with the domain. The expert acquired enough domain experience that they developed sophisticated mental schema of domain knowledge and past experiences. Their problem solving abilities and strategies were highly developed because of their extensive domain experience. The expert support staff was responsible for creating or modifying knowledge within the learning community and also responsible for modifying the electronic portfolio templates. Novice members of the learning community approached the expert members of the community with the more advanced problems that were out of their expertise range. The experts were the ultimate source of knowledge based on their extensive experience. The experts were the learners of the community that served as resource for the less experienced support staff members.

Towards a Model of Electronic Portfolio Support Staff Acquisition of Expertise

The qualitative analysis of this study revealed that there were five major areas of expertise that a novice electronic portfolio support staff member must pursue to become an expert (e.g., domain knowledge, performance, problem solving, deliberate practice over time, and preservice teacher relationships). The five major areas of expertise served as the framework for a theoretical model that explains the acquisition of expertise for the context of this study. Moreover, individual characteristics and the learning community influence these areas. The following sections discuss these seven areas that form the basis of the theoretical model of electronic portfolio acquisition of expertise.

Individual Characteristics. The more advanced electronic portfolio support staff members in this study both spoke about how their interest levels were important to furthering expertise levels. Participant 1 spoke about his interest in finding solutions for complex problems and his interest levels in using technology not only in his role of being a support staff member but also in everyday life. Participant 2 spoke of his interest to continuously increase the effectiveness of instruction by finding new ways to relate the electronic portfolio to popular internet tools and applications. The various types of interests pushed both participants to increase their level of expertise in the electronic portfolio domain. Electronic portfolio support staff members that take an interest in either the technology that drives the electronic portfolio or in developing instructional strategies are likely to find opportunities to increase levels of expertise by finding new approaches to accomplish domain tasks.

Learning Community. The role of the learning community is pivotal in the acquisition of expertise. Data from this study indicated that the role of a learning community was a major factor in developing domain-related knowledge. The novice electronic portfolio support staff member started the work position with little knowledge of the domain. Very little formal training was offered to each novice support staff member, which meant that a novice needed to search for other resources in order to learn about the domain. Several of the study participants stated that more advanced support staff members made themselves available as a resource to the novice learners. The expert support staff members were available to answer domain-related questions or provide advice when posed with a specific problem. The expert level support staff members were a direct resource that the novices could use at any point when needed. Moreover, the support staff members were more likely to encounter problems that they did not have the experience to solve easily. When circumstances did occasionally occur when novice or intermediate level electronic portfolio support staff members were forced to assist preservice teachers with difficult problems that were beyond their level of expertise or problem solving skills, they reached beyond their current knowledge and skill set to creatively engineer a solution through experimentation. Working directly in the electronic portfolio environment created these types of opportunities for electronic portfolio support staff members to increase their level of domain knowledge and expertise.

A more indirect resource of the learning community was the novice support staff member's opportunity to observe their expert level peers conduct individual and group training sessions. Observing individual training sessions with one preservice teacher exposed the novice support staff members to the variety of problems that they would eventually face. The novice support staff member observed as the more advanced member of the learning community modeled how to address preservice teacher's issues and investigate potential solutions. The novice support staff members' opportunities to observe advanced problem solving skills and strategies enabled them to incorporate these into their own problem-solving schema. Group observations were used with the novice portfolio support staff members because they would be expected to lead training sessions with multiple preservice teachers. The novice support staff members were able to see how a session was conducted and take notice of any potential problems that might appear in future training sessions. Being involved in a learning community is advantageous for the novice support staff member as it provides a plethora of resources for acquiring domain expertise.

Domain-related knowledge. Domain knowledge lies at the heart of acquiring domain expertise. In the context of the electronic portfolio, the support staff member needs to have an understanding of the uses of the electronic portfolio and its purpose in the preservice teacher's educational career. They need to be able to identify the various components that comprise the electronic portfolio system such as pieces of evidence and the benchmarks that guide the development of electronic portfolio content and understand their functionality. Domain-related knowledge also includes an advanced understanding of the software packages used to create and modify electronic portfolio and edit images. The software packages are crucial in the development and creation of the electronic portfolio; the support staff member that cannot use the software packages will not succeed in the domain. An understanding of the interrelations between electronic portfolio components is also a large part of domain-related knowledge. Often, the source of electronic portfolio issues can arise when components of the domain are not configured correctly. An incorrect configuration can cause system-wide effects that can interfere with usage of the electronic portfolio.

Data captured from the research participants revealed that the majority of domain knowledge was learned through direct interaction and experience within the electronic portfolio domain. Electronic portfolio support staff members increased their domain knowledge with each problematic situation they encountered. Each problematic situation forced the support staff member to either apply previously used solutions to fix a repeated problem or generate new solutions if the domain problem was novel in nature. Research participants also stated that another source of learning domain knowledge came from the opportunity to observe advanced support staff troubleshooting domain problems. In summary, without domain knowledge the electronic portfolio support staff member will be ineffective in training end users or solving domain related problems.

Performance. A hallmark of the expert in any domain is the ability to perform domain-related tasks consistently among varied circumstances. The novice electronic portfolio support staff member possessed a limited body of domain knowledge and problem solving experience. As a consequence, the novice's domain performance was inconsistent given a lack of experience. As time passed, the novice support staff member acquired more extensive domain knowledge and experiences, which resulted in a stabilization of performance across domain-related tasks. The electronic portfolio support staff developed a deeper understanding of the complexities of the electronic portfolio domain and theoretically had a large number of chances to encounter domain related issues. Performance of domain tasks became highly standardized and consistent for the electronic portfolio support staff member after a long period of immersion in electronic portfolio domain.

Problem Solving. The novice electronic portfolio support staff member began with limited problem solving skills and abilities. Limited domain experience and knowledge were the primary reasons that the novice portfolio support staff member did not excel in problem solving. Study data uncovered that the problem solving skills and abilities of a support staff member increased with exposure to domain-related tasks, especially novel problems. With each new experience, the electronic portfolio support staff member had the opportunity to hone problem solving skills when confronted with a domain problem.

Problem solving strategies also evolved after a significant time of domain involvement. Data from the study revealed that a majority of the participants first utilized an external problem solving approach created by Participant 1. As each participant grew in experience and confidence, each participant utilized an individualized problem solving strategy that better fit the participant's personal view of the electronic portfolio domain. The evolution of problem solving strategy required a significant level of involvement and time in the domain to occur. The result of that time and experience in the domain was the development of a highly experienced support staff member with an effective problem solving strategy.

Deliberate Practice in the Domain Over Time. Time in the domain is one of the major factors that influenced the acquisition of expertise. The typical novice electronic portfolio support staff member began their position with very little if any time in the electronic portfolio domain. The result was a lack of domain knowledge and experience that highly affected the performance level of the novice. As the support staff member spent more time involved with domain activities, the support staff member began to acquire expertise. Time is a crucial factor because one cannot simply become an expert in any topic quickly. It is necessary to spend large quantities of time involved with a domain and practice deliberately the necessary skills to be considered an expert. For the electronic portfolio domain, Participant 3 was able to acquire the basic knowledge and skills to create and modify an electronic portfolio in as little as three months. However, it took several years for his more advanced peers to become experts in the use of the electronic portfolio system. Novice electronic portfolio support staff members became experts by spending time involved in ever increasingly difficult tasks. Only in this way did novices become electronic portfolio experts.

Relationships with Preservice Teachers. In this study, preservice teachers are considered to be the main users of the electronic portfolio system. Instructing preservice teachers on the proper methods to use the electronic portfolio system and providing support for any problems they faced were two of the major areas of responsibility for electronic portfolio support staff members. As such, facilitating a positive environment in which instruction could be conducted with the preservice teacher was an important consideration for each portfolio support staff member especially the experts. The transfer of knowledge, whether to solve an issue or teaching about the electronic portfolio itself, was more likely to occur when preservice teachers worked with a support staff member that was positive and encouraging throughout an individual and/or group training session.

Several of the participants of this study spent substantial time considering how to sequence their instruction so that each preservice teacher they trained learned as much as possible. This included using a teaching approach that was student-centered that focused on the needs of the student and providing instruction, using terminology that was appropriate for the level of technological familiarity of each preservice teacher. For instance, Participant 2 conducted a needs assessment of each preservice teacher he worked with to determine the problems each was experiencing, asking him or her about their comfort level with technology. He attempted to tailor his instructional approach to be relevant to each preservice teacher by using nomenclature and analogies to other software tools that the preservice teacher would have used such as Facebook or MySpace.

Taking the time to create a student-centric, constructivist learning environment provided the preservice teacher with the ideal environment to maximize their electronic portfolio learning experience. This knowledge of relating to preservice teachers and scaffolding their instruction was important to becoming an expert in technology support. The following figure is a graphic representation of the electronic portfolio expertise model.

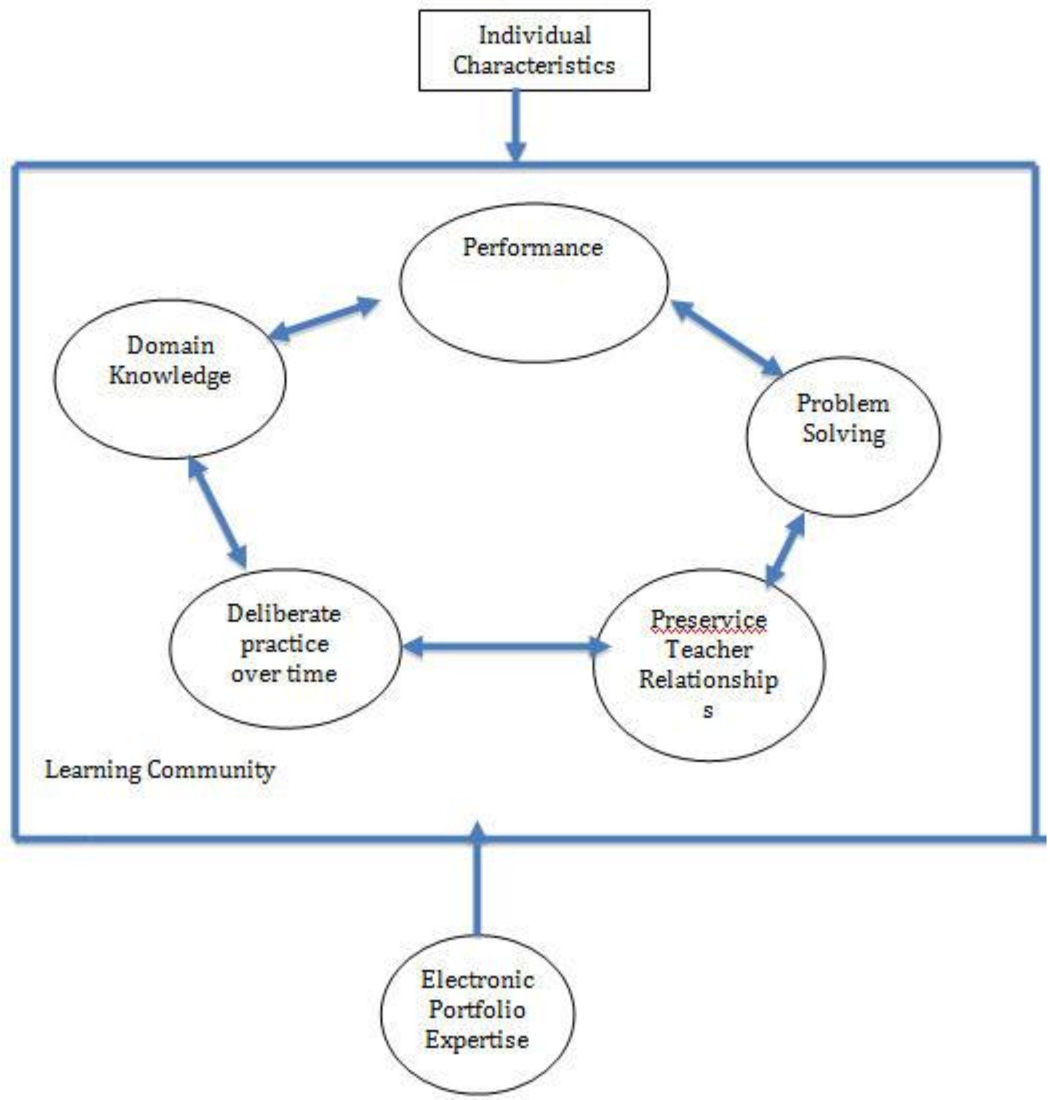

Figure 1: Model of Electronic Portfolio Expertise

Summary

This study investigated the knowledge, skills, beliefs, and dispositions involved in a support member's acquisition of expertise in the field of electronic portfolio technical support and the contextual facts that supported this acquisition. The cross-case analysis revealed several trends present across all of the cases involved in the study that addressed the research questions.

The first trend was the role of deliberate practice in domain-related activities was crucial in the acquisition of expertise for support staff. Deliberate practice would be considered a contextual factor that affected the acquisition of expertise for a support staff member. A support staff member faced domain-related problems specifically within the environment of the electronic portfolio setting. In this situation, the support staff member encountered domain-related problems and opportunities to increase levels of domain knowledge. Opportunities to interface with domain-related tasks were not readily available outside of the Media Lab where the study was conducted as the Media Lab served as the central gathering point for support staff and preservice teachers with electronic portfolio issues. Deliberate practice was only readily available within the electronic portfolio domain.

The second trend is that performance of domain tasks at the expert level is consistent. The expert support staff member will be able to perform domain duties such as training and troubleshooting with a high degree of consistency in a variety of circumstances. The expert support staff member will achieve consistency in performance of domain related tasks after acquiring a large amount of domain experience. A wide range of domain experience teaches a support staff member to respond consistently despite any new challenge that may arise.

The third trend was that problem solving strategies evolved to become more complex and organized as the expertise level increased. Problem solving strategies evolve with domain experience and can be transferred to other situations. For instance, a support staff member working on an electronic portfolio issue outside the Media Lab would be able to analyze and explore the root of the problem. The methods used to search for the cause of the domain problem would be similar to the methods used inside the Media Lab. Problem solving skills are internal structures that the portfolio support staff can apply in a number of locations and situations.

The fourth trend was that deliberate practice over time in the domain was necessary to increase the level of expertise as support staff members faced a variety of domain-related problems. Time was largely a contextual factor in the acquisition of expertise. A portfolio support staff member needed to encounter domain-related problems and situations in order to build experience. The novice support staff member did not become an expert of the electronic portfolio domain because he or she was hired for the position. Acquisition of knowledge required a significant investment of time and effort facing novel situations and deriving solutions for domain problems.

The fifth trend was that novices and experts formed a learning community where domain knowledge was learned from interactions. The learning community was another contextual factor that affected the acquisition of domain expertise. To access this particular domain resource, the support staff member needed to cultivate relationships with the other members of the learning community. To draw upon these resources, the support staff member needed to interact with other members of the learning community in the physical location of the Media Lab. Portfolio support staff members facing domain-related problems outside of their current level of expertise were able to draw upon learning community resources in the Media Lab. Accessing such resources would not be as likely if a member was not in the proximal physical location of the Media Lab. In summary, the support staff member acquired expertise through extended involvement in the domain and through social interactions with other individuals in the learning community.

The final trend involves the relationship that support staff members shared with preservice teachers. Training and supporting preservice teachers are two of the primary roles of the electronic portfolio support staff. They are required to assist the preservice teachers with any matter related to the electronic portfolio system. The electronic portfolio support staff that focused on providing quality instructional methods were able to assist preservice teachers more effectively and encourage them to investigate the nature of their own electronic portfolio problem independently. Developing relationships with preservice teachers created a positive learning environment in which preservice teachers were able to learn about the electronic portfolio successfully.

The researcher constructed a theoretical model based on the data gathered from the study. The theoretical model represents proposed factors that contribute to a novice electronic portfolio support staff member's development of expertise. The following factors represented skill sets, knowledge, relationships, the environment, deliberate practice over time, and individual characteristics necessary to acquire electronic portfolio expertise. Domain knowledge represented an important factor that contributed to a support staff member's understanding of the important concepts and relationships about the electronic portfolio system and its constituent components. The performance factor referred to the ability to complete domain-related tasks consistently in various contexts and situations. Problem solving represented the skills and strategies needed to ascertain the cause of a domain related problem and the ability to generate a solution that can be applied to a domain problem. Deliberate practice over time was an important factor in building an experience base and in providing sufficient opportunities for deliberate practice in developing the support staff member's expertise. The final interacting factor that influenced expertise was the staff member's relationship with the preservice teacher. These interactions between the various aspects of the model enhanced the development of electronic portfolio expertise.

The portfolio support staff member needed to take an active role in the electronic portfolio learning community to access community resources, which aided in the development of expertise. Relationships with preservice teachers are important for electronic portfolio support staff members because the preservice teachers are the main users of the electronic portfolio system. Providing quality training and troubleshooting experiences enabled the preservice teachers to independently create their own electronic portfolio with little assistance. The portfolio support staff member's individual characteristics played a role in the acquisition of expertise when he or she found a topic of interest which when studied could lead to increase in domain expertise. Each of these factors within the model increased the likelihood that the support member acquired the necessary knowledge, skills, and experiences to be considered an expert level support staff member.

CHAPTER FIVE

Conclusions

Within the last decade, the electronic portfolio has become one of the most widely used authentic assessments in preservice teacher education. Preservice teachers use the electronic portfolio to document their skills and knowledge of the teaching profession learned during their undergraduate career (Heath, 2004; Kimball, 2003). Similar to any technological system, the need for technological support and training is a necessity to facilitate the continued usage of the system (Guaglianone, Payne, Kinsey, & Chiero, 2009). Technology support in the context of both hardware and software support in addition to providing training for the system are needed so that users continue to adopt the usage of existing technological systems with a minimum level of difficulty (Ardley, 2009; Chisolm & Wetzel, 2001). The lack of support leads to malfunctioning technology and a decrease in usage of the technology (Lim, Pek, & Chai, 2005).

The existing literature discusses the importance of providing technical support training for users of an electronic portfolio system (Gathercoal et al., 2002; Jun, Anthony, & Achrazoglou, 2007). Beginning in the planning phase of an electronic portfolio system, Wilhelm et al. (2006) wrote that it is important to allocate significant resources to providing initial training for users of the electronic portfolio system but also belied the importance of continuing to offer further training opportunities and resources to users in the future. The responsibility for providing opportunities for training and maintenance of the electronic portfolio system falls within the bailiwick of the electronic portfolio support staff. The electronic portfolio support staff stands between the end user of the electronic portfolio system and any technical errors that may arise.

While the electronic portfolio literature discusses the need for technical support staff, the literature does not discuss the method in which electronic support staff members acquire their technical knowledge of the electronic portfolio system. The literature does not describe the mediating mechanisms involved in the acquisition of expertise, which are necessary in supporting or training users of the electronic portfolio system. This study was motivated by the identification of the lack of electronic portfolio literature offering solutions or research into how an electronic portfolio acquires the necessary knowledge and skill sets to support an electronic portfolio system. The researcher sought to study the interactions of the electronic portfolio support staff with the electronic system and the electronic portfolio end users.

The primary goal of the study was to investigate the acquisition of expertise for each of the study participants, identify contextual factors that influence this acquisition, and construct a model that explained a support staff member's transition from novice to expert. Each of these areas will be discussed in the following sections followed by limitations of the study and recommendations for future research.

Acquisition of Expertise

Ericsson's (2003) framework of expertise was used as a lens to identify and differentiate novice support staff members from their expert counterparts. Ericsson's framework was also used as a guide to search for behavioral signs of expertise from each user in an effort to understand the process of acquisition of domain knowledge and skills. Lave and Wenger's (1991) community of practice theory was also used as a lens to examine the role of the learning community in the acquisition of knowledge in the electronic portfolio domain. Five electronic portfolio support staff members volunteered to become the research participants for this study and were interviewed and observed for signs of developing expertise. A cross-case analysis was conducted that observed similarities and differences between each research participant in an effort to investigate the acquisition of expertise.

Knowledge, Skills, Dispositions, and Beliefs

Data analysis revealed that domain-related knowledge is an essential component for a successful electronic portfolio staff member. Domain-related knowledge encompassed the concepts, the skills, and the experience that each electronic portfolio support staff member needed to possess in order to work with the electronic portfolio system. For example, the successful electronic portfolio support staff member needed to define precisely an electronic portfolio and also develop an understanding of the components that make up the electronic portfolio system. An electronic portfolio support staff member that understood the purpose of the electronic portfolio but did not have an understanding of evidence needed for in the electronic portfolio or the characteristics of a web page would be of little use in this particular support position. Conceptual understanding of the electronic portfolio system as a whole and its individual parts was necessary to be able to support users in the electronic portfolio system.

Domain-related knowledge also included the skill sets needed to interact with the electronic portfolio system (e.g., a working understanding of the software packages used to create and modify an instance of an electronic portfolio). The successful electronic portfolio support staff member needed to understand the capabilities of the software program and also possess the procedural knowledge necessary to accomplish tasks within the software program. Mastery of procedural knowledge and domain-related skill sets were crucial in not only assisting end users with the electronic portfolio but also successfully generating solutions for domain-related problems. Without an understanding of how various processes worked inside the electronic portfolio, an electronic portfolio support staff member was not able to solve domain-related problems.

Domain knowledge mastery played a pivotal role in the troubleshooting process and training of the successful electronic portfolio support staff member. Without that knowledge base to draw upon, the support staff member was not able to delve into the nature of a presented problem and begin to explore the possible causes. The support staff member had no idea of the concepts embodied in the electronic portfolio domain or was not able to analyze the nature of the problem to determine its cause. The support staff member who did not possess an understanding of the procedures necessary to solve the core problem would have no perception of the relationships between software packages or electronic portfolio concepts, which would prove disastrous were someone to attempt to provide a solution for a problem they could not analyze or conceptualize. The support staff member might possess excellent problem solving skills and possess a natural aptitude in technology but without the bedrock of domain knowledge, the support staff member was more than likely exacerbate the problem. Domain knowledge was absolutely necessary to troubleshoot domain-related problems.

Performance

The profile of novice electronic portfolio support staff performance was usually considered to be somewhat erratic. The novice support staff member possessed very little domain knowledge and a very limited level of experience. As such, novice support staff members applied erratic problem solving methods to solve problems never before encountered. The lack of domain knowledge could be witnessed in both their performance of troubleshooting domain related problems and training situations. The lack of consistency in domain performance was related to limited knowledge and skill sets. At this stage of performance, senior members of the electronic portfolio support staff often were required to assist their novice peers in domain related tasks. However, with each domain-related experience, the novice electronic portfolio support staff member acquired just a little bit more knowledge and experience.

The profile of the expert electronic portfolio support staff member is in direct contrast to the profile of a novice portfolio support staff member. The expert support staff member was able to perform his troubleshooting tasks consistently in a variety of settings and problematic situations. The expert’s performance level was fairly consistent due to their extensive experience level and domain knowledge. He had the ability to draw upon a wide range of solutions and experiences that he could apply directly to a problem. The expert support staff member understood the complex relationships between the various components that made up the electronic portfolio domain and also had a working knowledge of the interactions of the components. The more experienced electronic portfolio support staff members testified that there were very few domain-related problems that they had not faced before. The expert support staff member were able to combine their extensive domain knowledge, skill sets, and experiences to perform domain-related tasks with a high level of consistency and success.

For this study, performance was a key component in providing differentiation between novice electronic portfolio support staff and their expert counterparts. The difference in performance behaviors helped classify novice performance behaviors from expert performance behaviors. Understanding the differences between the two typologies of behaviors granted some insight into the process that occurred for a support staff member as they first entered into the electronic portfolio domain and become expert level support staff members. The profiles of each type of learner were different. Viewing the differences between the two types of learners was key in understanding the transformative process that deliberate practice brings.

The novice support staff members that were part of this study served as a baseline for understanding what a novice learner's characteristics were in the electronic portfolio domain. They tended to display a lack of consistency in performance because of a lack of domain experience and knowledge. The novice support staff members used all of the training materials available but still displayed a lack of domain knowledge and problem solving skills. They used deliberate practice as a method for increasing domain knowledge and skills in a fairly short period of time. For instance, Participant 3 was classified as a novice support staff member when the data were collected for this study. With only three months of experience, Participant 3 interacted with preservice teachers in individual training sessions but also participated in group training sessions. Participant 3 displayed a basic working knowledge of electronic portfolio concepts as he led the group training session but left out pertinent details needed to maximize the capabilities of the electronic portfolio.

As Participant 3 led the group's training session, several of the expert support staff members kept interrupting Participant 3 because he left out crucial information in his training. One could see that over a short period of time, Participant 3 collected a base level of electronic portfolio knowledge using deliberate practice but still lacked some domain-related information. Participant 3 was a cogent and interesting case study because he revealed the difficulty of being expected to directly interact in the electronic portfolio domain with a very limited set of domain-related skills and knowledge. Yet, he still managed to persevere over the initial difficulty of leading training and troubleshoot domain-related issues. Participant 3 was a perfect example of the role that deliberate practice played in the acquisition of domain-related knowledge and expertise. The initial exposure of Participant 3 into the electronic portfolio domain forced him to encounter basic problems, master them, and continue forward to solve other difficult domain issues.

Some of the electronic portfolio support staff members served as examples of expert performance. Their performance was consistent across various situations and their performance behaviors were used as models by novice support staff members. Novice support staff members looked to the expert support staff members as guides to teach them about the electronic portfolio domain. Novice support staff members observed the performance of their expert counterparts as they conducted training and solved domain related problems. The observations of the expert's perfected behaviors taught the novice support staff the proper methods to investigate problems and teach training sessions that could be utilized as they built their own domain expertise. The importance of the expert support staff was foundational to growth for the novice support staff members because the experts provided a resource, both through observation and as sources of domain knowledge. In the end, the expert support staff members were models for the novice support staff.

Problem Solving

Problem solving strategies were necessary for the position of an electronic portfolio support staff member. One of the major roles of the position was to provide solutions for domain-related problems. To investigate problems, each support staff member needed to understand the complexity of the problem and used a problem solving strategy to investigate the cause and extent of the domain problem. Problem solving strategies evolved as the support staff member grew in mastery of domain knowledge and experience. In summary, problem solving abilities were a requisite skill for an electronic portfolio support staff member.

Each electronic portfolio support staff member, whether novice or expert, faced different types of domain problems that they were required to solve. More often than not, the problems that the support staff encountered were technical in nature. Each support staff member used some type of problem solving approach to generate solutions for the domain-related problem. Problem solving strategies evolved as the support staff member grew in expertise level until each expert support staff member developed their own highly individualized problem solving strategy. Problem solving strategy formation for the expert support staff member was based highly on individual experiences with the domain. Upon accumulating domain-related experience, each support staff member developed a unique schema about the domain, which influenced the development of a problem solving strategy. Problem solving skills were entirely necessary for the support staff position in the electronic portfolio domain.

A majority of the support staff members from this study stated that they used a training checklist as their framework for problem solving when they first became a support staff member. The training checklist was a resource that was developed by Participant 1 as a guide for leading group training sessions for preservice teachers. The training checklist contained all of the necessary tasks needed to create a new electronic portfolio instance and place the electronic portfolio online.

Several of the study participants used the training checklist as a visual organizer for tasks to examine when a problem occurred. For example, if the content of an electronic portfolio did not appear on the Internet, the novice support staff member verified that the synchronization process worked properly. The training checklist was a framework that the novice support staff member used to organize problem solving activities. It was useful to the novice support staff member because it was a general list of all of the tasks necessary to create the electronic portfolio. The training checklist ensured that the novice portfolio support staff member did not miss a content area when the cause of a problem was investigated.

Deliberate Practice in the Domain Over Time

Each of the study participants became electronic portfolio support staff with differing levels of technical affinity and previous technological work experience. Each of the support staff members seemed to acquire basic domain related knowledge after an initial exposure to the domain after several months. Participant 3 was the newest support staff member at the time of data collection with three months of domain related experience. His observations revealed that he could solve basic domain-related problems with minimal difficulty. However, Participant 3 had some difficulty with leading a group training session of preservice teachers. This indicates that more domain involvement and experience was necessary before he could seamlessly teach training session. Solid mastery of the domain content would allow a support staff member to effortlessly teach a training session.

Conversely, the support staff members that had several years of domain-related experience accumulated a vast amount of domain knowledge. There were very few problems that the expert support staff members had not encountered. When a problem did arise that was unique in nature, the expert support staff members were able to analyze the source of the problem and provide a solution in a timely manner. Novice support staff members consulted the expert portfolio support staff members on difficult or unusual problems. The expert support staff members experience was valuable in planning changes to the electronic portfolio structure and creating training materials for less advanced support staff and electronic portfolio end users. In summary, expert support staff members worked with their novice counterparts to solve domain related problems and train the novice support staff members.

Contextual Factors that Influenced Expertise

Domain Knowledge

Domain related knowledge included an experiential component as well. Study participants accumulated a large amount of their knowledge of the domain through their experiences with the domain. Each time that electronic portfolio support staff members encounter a problematic domain situation, they had the opportunity to apply their knowledge and skills to increase domain knowledge. Interacting with the domain provided key opportunities to apply past knowledge and skills and enabled the electronic portfolio support staff member to increase their understanding of the intricacies of the domain. Each domain interaction gave the willing support staff member an opportunity to increase their knowledge base and skill set.

Domain knowledge was acquired through a variety of mediating mechanisms for each support staff member. Several of the more experienced study participants relied on external sources of knowledge such as technical manuals. External sources of knowledge were valuable because they often provided the procedural knowledge needed to understand how various components of the electronic function such as Dreamweaver. External sources of knowledge were also useful but limited in nature because they were not always context specific. For example, a Dreamweaver technical manual could teach a support staff member to create a webpage but would not provide any expertise to develop the content of the webpage. External sources of knowledge were important for instruction of task completion but were limited in scope.

Social construction of knowledge was also a common theme seen throughout the data as a source of domain knowledge. Many instances in the data demonstrated that when a support staff member could not solve a domain problem or did not understand something, several of the support staff members were very quick to engage their support staff peers in a quest to fill the missing knowledge gap. Knowledge was shared freely between study participants because they all shard the common goal of solving whatever issue or need arose. More often than not, novice level support staff members were quick to approach more senior support staff if a problem arose that required a solution beyond the novice's skill set. Several of the study participants mentioned a lack of formal training in their interviews but mentioned that they learned the basics of the electronic portfolio system through observation of their peers. Social sources of knowledge were freely available to each support staff member if they were ever needed.

Experience, however, was the main cited source by each research participant that explained acquisition of expertise. Each of the study participants began their role as an electronic portfolio support staff member with very little knowledge of the electronic portfolio with the exception of Participant 4 as she was a preservice teacher beforehand. Study participants were forced to acquire basic domain knowledge and begin to apply it to domain-related problems in an effort to increase their knowledge and expertise. Each encountered problem provided new information that could be added to their understanding of the electronic portfolio domain. The study participants learned what solutions worked in specific situations and what approaches did not work. Experience interacting with the domain was the catalyst that caused the evolution of domain knowledge and acquisition of expertise.

Domain knowledge was the amalgamation of concepts, skills, and experience that allowed the electronic portfolio support staff member to interact with the electronic portfolio system. Domain knowledge was acquired through a number of different methods including working with peers, observation of peers, and experiential learning. Each participant began as a novice in the domain with little experience and gradually began to acquire expertise through involvement in the domain. Support staff members faced multiple situations in which they applied the knowledge, skills, and experience they had accumulated. Domain knowledge was essential the support of the electronic portfolio system because without it, a support staff member couldn't interact with the system.

Electronic portfolio staff members built their expertise upon domain knowledge. Acquisition of domain knowledge began the minute that the electronic portfolio support staff member started working in the domain. As the support staff member spent more time involved in the domain, he/she accumulated domain knowledge and experiences about domain related subjects. Each experience, both positive and negative, provided a more complete picture of the domain for the support staff member. Each domain opportunity potentially enriched the support staff member and provided an opportunity to develop new skills and schema.

In the context of electronic portfolio training, the support staff member that lacked domain knowledge was a very ineffective trainer. Imagine attending a mandatory training for a software package and the trainer having absolutely no idea about the capabilities of the software package or lacking the procedural knowledge of how to make the software accomplish a specific task. The support staff member who did not possess an inkling of the knowledge necessary to create and modify an electronic portfolio using the requisite software hindered the students' learning.

In the context of electronic portfolio training, the support staff member needed to possess systemic knowledge on the components of the electronic portfolio and how the components interacted. Additionally, the support staff member needed to possess the procedural knowledge necessary to manipulate the software packages in creating and modifying the content of the electronic portfolio. Finally, the support staff member needed to possess the analytical skills and domain knowledge about causes of potential problems that arose during training sessions such as synchronization issues between local and online copies of preservice teacher electronic portfolio and picture editing issues.

Without possessing the basic knowledge of any of the above categories, the support staff member was not as effective a trainer as they might be. The importance of an integrated body of domain knowledge for the electronic portfolio system was crucial in providing training to electronic portfolio users.

The acquisition of domain-related knowledge was derived from a variety of sources: observation of support staff members involved in domain-related tasks, external sources of knowledge, social sources of knowledge, and personal interactions with the domain. To become an effective support staff member, the successful support staff member acquired a basic level of knowledge in a short period of time. It was important that the support member be provided with plenty of opportunities to acquire the necessary domain knowledge and experience to be a successful support staff member.

The study participants were given ample opportunities to observe their peers during training sessions for preservice teachers. They were also immediately exposed to domain-related problems as they were expected to begin troubleshooting almost from the day they were hired. There was definitely not a lack of opportunities for the study participants to learn the domain knowledge but the acquisition and retention was the responsibility of the individual support staff member. Each support staff member was responsible for the problems brought to their attention and for individual training session so each support staff member needed to become as knowledgeable in the domain as quickly as possible. In the end, the goal for each support staff member was to individually problem solve and train electronic portfolio system users because there were always situations in which other support staff members were unavailable and external sources of information could only provide certain types of information.

Performance

Ericsson (2003) theorized that one of the main signs of a domain expert was being able to perform domain-related activities at a consistent level in the face of varying problems and circumstances. In contrast, the novice was expected to begin learning domain rules and guidelines as interaction with the domain began. Several of the study participants stated that they were given established domain guidelines when they first became support staff members. The guidelines were a simple list of tasks necessary to create an electronic portfolio. The novice support staff members were expected to master the tasks given to them so that they could later assist preservice teachers with the same tasks as they created their own electronic portfolio. The logic behind this approach was that the support staff member would gain a basic level of domain knowledge once the tasks were mastered. As the novice support staff member gradually mastered these tasks, the support staff member would come to gradually understand the electronic portfolio domain.

There is no doubt that the level of performance changed drastically between the novice and expert levels. Direct exposure to domain activities, which built knowledge and experience, facilitated the development of a novice learner in becoming an expert learner given time. Ericsson (2003) theorized that the novice learner transitioned into an expert learner by using the mechanism of deliberate practice. Deliberate practice can be operationally defined as the active effort to triumph over problems with ever increasingly levels of difficulty. Simply stated, the learner becomes an expert through mastery of problems that rise in difficulty. In the context of the electronic portfolio support staff member, the novice support staff member began to encounter simple-domain related problems that needed to be mastered. The novice support staff member faced basic tasks at first such as learning to setup connections between the local copy of a preservice teacher electronic portfolio with the online copy. Upon mastery of that task, the novice support staff member began to discover the problems that prevented successful connections between the two instances of the preservice teacher electronic portfolio. As the novice support staff member gained domain experience, ever increasingly difficult tasks appeared to continue to challenge the novice support staff member.

Problem Solving

The expert learner evolved an individual problem solving approach based on their experience with the domain. The research participants stated that they began to format their own problem solving strategies after being immersed in the electronic portfolio domain for a significant period of time. During that time frame, the support staff members said that they worked to master the basic tasks of the domain but then began changing their problem solving strategies based on the method they used to conceptualize the electronic portfolio. The complexity of problem solving strategies evolved as the support staff member's understanding of the domain grew. Intermediate support staff members mentioned that their problem solving strategies were similar to the training checklist but experience taught the support staff members to also investigate other areas that were not listed on the training checklist. Expert support staff members possessed the most complex problem solving strategies due to their extended period of involvement in the electronic portfolio domain.

Problem solving skills were yet another necessary set of skills that an electronic portfolio support staff member needed to be successful in this job role. Detecting domain issues and then having the necessary skills and experience to analyze the issue and identify a solution were central in the role of a support staff member. Novice support staff members needed to develop a set of problem solving skills and strategies at the beginning of their tenure, which was crucial in the process of domain knowledge acquisition. Novice support staff members needed to be provided with plenty of opportunities to develop problem solving skills from the onset of their time in the domain.

Exposing the novice support staff members to situations in which they might begin to develop their problem solving skills but not feel completely overwhelmed would be an effective method for developing those skill sets. A structured system in which novice support staff members were exposed to controlled types of problems applicable to their current level of expertise would be an ideal system to begin developing problem solving skills. Inside that structured system, the novice support staff members would have different types of resources available to them to draw upon in the pursuit of solving the domain issue. The proposed system would provide scaffolding for novice support staff members to develop problem solving skills without the fear of failing and causing damage to the electronic portfolio. The novice support staff members would be overseen by their expert level colleagues, who would be responsible for preventing potential mistakes that could be made by the novice support staff members. The proposed system would serve as a structured introduction for novice support staff members in developing problem solving strategies and skills without fear of failure.

The expert level electronic portfolio support staff members would also share responsibility in the proposed system. The expert level support staff members would be responsible for assigning appropriate level problem scenarios to individual novice support staff members based on their level of exposure to the domain and current level of skill sets. Furthermore, the expert support staff members would serve as a resource to novice support staff members. Novice support staff members would be able to question expert support staff members about varying approaching to solving domain related problems and possible locations for other domain resources. Also, expert novice support staff members could share relevant past experiences with their novice support staff members that related to the problem novice support staff members were attempting to solve. The purpose of this approach would not be to solve the domain issue for the novice support staff member but provide some general ideas for solutions and let the novice portfolio support staff member attempt to apply the new domain knowledge to the current problem. Working together, both novice and expert level support staff could develop problem solving skills which would create more effective electronic portfolio support staff members.

Deliberate Practice in the Domain Over Time

Each study participant came to domain with different technical skills and pedagogical knowledge. Most of the study participants became support staff members with no previous work experience in a field related to technology. Participant 1 held a previous technology related position and Participant 4 held previous experience using the electronic portfolio system as a preservice teacher. The lack of technical experience was a hurdle for several of the study members as they had no practical technical experience beyond the ability to use a computer. After an initial exposure to the domain, each of the study participants accumulated a basic level of domain-related knowledge and problem solving abilities.

Each of the study participants was involved with technology at some point in their life. Each of the study participants used a personal computer before becoming a support staff member. The level of technological usage varied by research participant depending on their past work and personal experiences. Each of the research participants tended to share an interest or affinity for technology, which seemed to be a common theme for becoming an electronic portfolio support staff member. Several of the participant members stated that their extensive knowledge of technology was useful in the acquisition of electronic portfolio domain knowledge but it was definitely not a necessity. In the end, basic knowledge of how to use a computer was required for the position of electronic portfolio support staff but a more advanced grasp of technology was not a requirement.

Learning Community

A learning community existed among the group of electronic portfolio support staff that served as the participants for this study. Lave and Wenger (1991) define a learning community to be a group of individuals working together to accumulate and modify knowledge around a subject matter. All members of the learning community are involved in tasks related to the creation and continuation of knowledge to further the learning community. The novice learner concentrates on accumulating domain-related knowledge, in other words, mastering the basics of the domain. Upon attaining mastery of basic domain knowledge, the novice learner transitions to the status of journeyman. The journeymen begin working on more advanced domain related problems and begin to contribute knowledge to the learning community based on their experiences. Finally, the expert learners with the community are responsible for the governance of the learning community. They provide educational opportunities for the younger members of the community and serve as gatekeepers for knowledge acquisition within the domain. Each member of the learning community is essential in the continuation of the learning community.

The novice learner came to the electronic portfolio support staff learning community with little if any experience. The novice support staff member was given very little formal training and expected to begin interacting with the electronic portfolio almost immediately. Senior members of the learning community worked with the novice support staff members to acclimate them to the learning community and to serve as a resource for domain knowledge. Novice support staff members were responsible for observing senior members of the community and to begin troubleshooting domain related problems. The novice learners of the community focused on learning domain related knowledge and accumulating domain knowledge. The novice learner status was determined by the degree to which he or she had mastered the basic knowledge of the learning community.

The expert learner in the electronic portfolio learning community was responsible for administrative matters in the community and also serving as a resource for the novice members of the community. The expert support staff members were responsible for making changes to the electronic portfolio templates and investigating the capabilities of the software packages used to design the electronic portfolio. Additionally, the expert support staff members serve as a resource for novice support staff members. While the expert learners were not officially responsible for training novices, they assisted the novice members of the community when the opportunity presented itself. Novice learners often encountered problems that were beyond their current skill set and the expert learners offered assistance when asked. The expert support staff members served as guides in the electronic portfolio community to initiate the novice electronic portfolio into the learning community and assisted them in their efforts to achieve domain mastery.

The concept of a learning community is a very important one for the electronic portfolio support staff. Becoming a member of the electronic portfolio community as a novice learner meant that the novice was exposed to the domain with very little training and previous knowledge. The novice learner was given very little, if any, training on the software packages used to interface with the electronic portfolio system. The learning community is a type of support system in which the members of the community can rely upon one another for assistance with domain matters. Each level of membership has responsibilities to the domain that they must uphold; otherwise the other members of the community would suffer.

The novice learner faced an incredibly difficult task of learning the basic domain tasks of creating and modifying electronic portfolio. Additionally, they were expected to be able to troubleshoot basic domain issues from almost the beginning of their tenure as electronic portfolio support staff members. The novice support staff member had the incumbent responsibility to begin directly interacting with the domain. The novice support staff member utilized every opportunity to learn about the domain whenever possible. As the novice faced difficult troubleshooting situations, the novice carefully observed the strategies that the expert support staff member used and attempted to learn everything possible from domain-related problems. The novice support staff member needed to take every opportunity offered to learn either by troubleshooting independently or through observations of peers. This strategy enabled the novice support staff member to master domain knowledge and become a full-fledged member of the community at a quicker pace. In the end, the responsibility of becoming a knowledgeable, competent support staff member was truly in the hands of each individual electronic portfolio support staff member.

The expert electronic portfolio support staff member also has significant responsibilities in the learning community. The expert support staff members are the leaders of the community and the primary resource for novice support staff members with they experience some type of domain related problem. It is the responsibility of the expert support staff member to be available for questions from novice support staff members and to be models of domain performance. The expert support staff members must be open about their methods of problem solving and their sources of domain expertise. The expert support staff members are to serve as mentors that encourage the novice support staff members to excel in their performance in the domain and to learn as much as possible about the domain. In summary, the expert support staff member is responsible for helping develop and encourage the novice members of the learning community to become productive members of the learning community.

The effectiveness of the learning community is apparent when each of the members is fully committed to the learning community's success. The learning community has the potential to help each of its members but only if each member participants actively in the community. The novice learner that masters the basic troubleshooting skills and domain knowledge at a quick rate is fulfilling a designated role. However, if that same novice becomes an expert later but then does not offer expertise and assistance to novice peers, the system will break down. It is incumbent upon each member of the community to fulfill their roles in order to ensure continued success of the learning.

A Model of Expertise

One of the purposes of this study was to construct a theoretical model for the acquisition of expertise for an electronic portfolio support staff member. The theoretical offered in the previous chapter detailed general knowledge and contextual factors thought to be important in the acquisition of expertise based on the data gathered for this study.

The support staff member acquires expertise within a learning community. The physical learning environment contains all of the resources available for the novice support staff members to increase their level of expertise. In this environment (e.g., the physical environment and learning community), the support staff member faces many domain experiences and situations that can be used to develop various aspects of expertise. Conversely, the expert support staff member serves as a resource within the learning community for less advanced support staff members. The expert support staff members are also responsible for further developing the learning community and teaching and mentoring less advanced support staff members.

Within the environment, the support staff members concentrate their efforts in different areas to reach an expert support staff member level. Domain knowledge represents the skills and concepts required for the electronic portfolio support staff member to function as an effective member of the learning community. This body of knowledge encapsulates all of the necessary information and past experience needed to interact with the electronic portfolio domain. The novice learner begins with a very minimal amount of domain knowledge which will increase as more experience is acquired. Domain knowledge is a very important component in solving domain related problems and providing training to preservice teachers.

Problem solving skills and strategies is another major factor in the electronic portfolio expertise model. The ability to solve domain-related problems is one of the major functions of the electronic portfolio support staff. Electronic portfolio support staff members spend a majority of their time analyzing problems with preservice teacher electronic portfolio and then applying a solution for the problem. The whole problem solving process requires an electronic portfolio support staff member to determine the scope of the problems, discover the cause, and then generate a solution. This ability is somewhat limited when a novice support staff member first enters the learning community but grows with experience and instruction from more advanced members of the community. Problem solving skills and strategies interact with the domain knowledge in increasing a support staff member's level of expertise. .

Performance refers to the ability to complete domain-related tasks consistently. The expert support staff member will have the necessary skills, knowledge, and expertise to perform domain related tasks in a variety of situations and environments. A novice support staff member's performance is highly variable when he or she begins in the position. The novice holds such a small amount of domain knowledge and problem solving strategies that performance tends to vary drastically with each new domain situation encountered. Through the accumulation of deliberate practice over time, domain performance evolves to a consistent level. Once the support staff member has encountered a sufficient number of domain-related problems, he or she will begin to display a fairly consistent display of performance on domain related tasks. Consistent domain performance is another hallmark of the expert electronic portfolio support staff member.

Developing preservice teacher relationships is considered a sign of expertise because they are the primary users of the electronic portfolio system. One of the main roles support staff members are responsible for is the training of users and troubleshooting problems of preservice teachers. Expert support staff members possess the skills to create a positive learning environment for the preservice teacher because they have the necessary domain knowledge and problem solving skills. They are also able to consistently solve problems, which creates a positive experience for the preservice teacher. The expert support staff members should be able to support preservice teachers in such a way so that not only are they able to solve problems but also are able to scaffold instruction. Preservice teacher relationships are an important component in the development of electronic portfolio expertise.

Deliberate practice over time in the domain is the method that support staff members use to acquire expertise. Deliberate practice is defined by Ericsson (2003) as the mastery of domain-related tasks that continue to grow in difficulty level, which influences the support staff in identifying new problems and finding new solutions. As they face a series of new problems, the staff member acquires domain knowledge and expertise that can be applied to future domain tasks. Deliberate practice over time can be used to increase the level of expertise in each area included in this model. It is the method that will allow support staff members to increase their overall level of expertise with the electronic portfolio domain.

The last component of the proposed model is individual characteristics of a support staff member and cannot be underestimated. Having an interest and perseverance is paramount in learning new knowledge. The individual characteristics factor is a combination of the dispositions, beliefs, and previous experience of each support staff member. Individual characteristics of the support staff members affect many areas ranging from how support staff members arrange their domain knowledge to their personal beliefs on the most effective methods for conducting preservice teacher trainings. This factor is highly individualized and will play a role in how each support staff member acquires expertise.

The proposed model represents the factors that contribute to the acquisition of expertise within the electronic portfolio domain. The model is designed to illustrate how interactions among various factors foster the development of expertise. Mastering each component of the model will lead to an increase in the expertise level for the individual support staff member.

Implications for Theory and Practice

The literature review at the beginning of this study highlighted the fact that very little research existed in the electronic portfolio literature that detailed how to train support staff members. The electronic portfolio literature suggested the importance of maintaining some type of technical support staff but did not give details on the process used by support staff members of the electronic portfolio system in acquiring enough knowledge to effectively support the system. One possible reason for this gap in the literature is that almost every electronic portfolio system varies by institution or college. Variation can occur based on the contents of the electronic portfolio, subject matter, and the software used to create and maintain such a system. However, the fact remains that research was needed to identify effective methods to train support staff in whatever system was being used.

Different institutions across the United States are training support staff members to maintain electronic portfolio using methods that are not empirically tested or research driven. The consequence of this limited data is that support staff member training may not have the desired effects. Without research or accepted theory guiding training, electronic portfolio domain knowledge and practices will be taught ineffectively and based on the experience of individual trainers. The lack of electronic portfolio uniformity may be an issue but literature does exist on how people form troubleshooting strategies and acquire knowledge. Applying such existing literature to the training of support staff members could benefit both the electronic portfolio system and the preparation of support staff members.

The practical implication for research on the acquisition of expertise for electronic portfolio support staff is that it may affect both the electronic portfolio system and its end users. The end user could also potentially suffer as a result of lack of empirically based training methods. For example, assume an end user needed assistance from a support staff member with an advanced domain problem. A support staff member trained with a methodology lacking empirical evidence may not have the domain knowledge necessary to solve the domain problem or the analytical skills to discern the cause of the problem.

Furthermore, the support staff member may also not have the problem solving capabilities necessary to generate a solution for the problem.

From a systems perspective, an incomplete training regime could also affect the electronic portfolio system. An electronic portfolio support staff member not sufficiently trained in the more advanced technical bodies of knowledge could cause technical issues with the electronic portfolio system. For instance, if the server containing copies of the electronic portfolio crashed, serious issues could arise if the support staff member did not know the proper procedures of how to properly restart the server. This situation is just one particular type of problematic incident that could occur. A lack of a standardized training methodology without empirically based evidence could lead to issues of quality training that could affect the electronic portfolio and the end user.

There is an existing gap in the electronic portfolio literature in regards to methods of training electronic portfolio support staff members to become fully functional in supporting an electronic portfolio system. The purpose of this study was to explore how electronic portfolio support staff members acquired expertise. The explorative methods of this study revealed several different areas of expertise that a novice electronic portfolio support staff member needed to acquire before being considered an expert in the electronic portfolio domain. The role of this study was to explore the role of expertise in the electronic portfolio domain and suggest guidelines to train future support staff members.

The largest problem that was revealed in this study was the lack of formal training available to new support staff members. Several of the study participants testified that they were forced to begin in their role as a support staff member with limited training on the electronic portfolio software packages or understanding of the electronic portfolio system as a whole. A formal training system needs to be established for future support staff members that teaches them the basic domain knowledge and problem solving skills about the domain. Written documentation should be provided that details the exact tasks that novice support staff members are expected to use during training sessions with preservice teacher. The suggested documentation should also detail the most common domain-related problems and errors that the novice support staff members will more than likely encounter and provide solutions for each problem. The novice support staff members would use the written documentation as a framework for beginning to acquire domain related knowledge.

Formal training addresses the problem of providing the novice portfolio support staff with the basic resources to begin functioning in the electronic portfolio domain. The next phase in the proposed training curriculum would be to provide the novice support staff members with opportunities to begin troubleshooting domain problems with heavy supervision from expert support staff members. Novice portfolio support staff member would begin meeting with preservice teachers that faced basic domain problems. Working with an expert, the novice support staff members would begin acquiring domain expertise by solving basic domain problems. The expert support staff member would be available as a resource for the novice support staff member if he or she needed assistance with analysis of the problem or generating a solution. The novice support staff member would continue with assistance from the expert support staff member for a certain amount of time until the novice could function on a basic problem solving level independently. In summary, new portfolio support staff members would receive a formal training of the electronic portfolio system and then begin troubleshooting basic domain problems under the supervision of an expert support staff member.

Limitations of the Study

The following limitations apply to the study in terms of internal validity, external validity, and reliability.

Internal Validity

Merriam (1998) wrote that validity qualitative research should capture data that is based in reality. The following techniques were used to ensure the internal validity of the data.

Researcher bias. The researcher was a previous support staff member in the environment that the study was conducted and was familiar with the domain knowledge base and instructional processes used to train new electronic portfolio support staff in the domain. To control for researcher bias, triangulation was used to confirm findings in the data. Multiple sources of data were captured using a variety of different instruments that were based on the objectives and research questions for this study. An expert in the field of qualitative methods verified the coding and experimental design procedures throughout the study.

Reliability. Reliability in the qualitative context of this study referred to the idea that findings were consistent. The goal of reliability for this study would be that the themes and data presented in the study would make sense to other researchers were they to review the data collected for this study (Merriam, 1998). The following approaches were used to increase the reliability of the study.

Triangulation. Multiple sources of data were collected including: multiple observations, interviews, concept maps, and narrative prompts. Data were collected using a series of instruments that were piloted on previous electronic portfolio support staff members and were approved by experts in qualitative methods of research. Data from each case studied was coded using a similar method of pattern matching and each data point was placed into predefined categories of expertise and defined by Ericsson (2003).

External Validity

Merriam (1998) stated that using multiple case studies displaying the same phenomenon can be used to bolster findings of a study. A cross-case analysis was used to investigate the acquisition of expertise. The research participants possessed a variety of expertise levels that were used to investigate the same phenomenon. A series of observations were used to capture the interactions of each research participant in exactly the same settings, granting a measure of generalizability to the data. The sample size for this study was five individuals. The study environment was fairly restricted as the data were captured in one environment at one university. The findings would have been strengthened if more than one institution or department's electronic portfolio staff were also studied.

Recommendations for Future Study

The next phase in this line of research is to conduct a similar qualitative study at several universities from across the United States with electronic portfolio systems similar to one located at the university in which this study was conducted. The electronic portfolio system for this study was created entirely at the site of the university and housed on servers located at the same university. Ideally, several universities would be selected that differed in size and also included both private public institutions. The future study would include the same methodologies that were used in this study. The researcher would conduct a meta-analysis of the results to determine if similar themes existed at different universities and if so, compile a list of common characteristics of knowledge and expertise acquisition.

The theoretical model conducted for this study contained different facets that might exist in the context of this study but not in other academic locations that utilize an electronic portfolio. Once other institutions with electronic portfolio support staff are identified, they could be interviewed regarding their experience with training to become support staff members to determine if they shared similar experiences in their journey to acquire domain knowledge. Electronic portfolio support staff members could be interviewed about their experiences with questions that would be written to target experiences with a specific facet of the model. With enough interviews, an instrument could be created that identified characteristics of the expertise facet to determine if it existed in a specific electronic portfolio system. The purpose of the proposed instrument would be to investigate if that particular facet was pertinent in the area of acquisition of expertise. Identifying if a particular aspect of the model exists in the context of the electronic portfolio system could play a role in the development of the training curriculum used in that particular context.

The next objective would be to create a survey containing questions about learning experiences based on the behaviors and themes identified from the meta-analysis. The purpose of the survey would be to ask electronic portfolio staff across the

United States if their experiences of knowledge acquisition for the electronic portfolio domain were similar to the model generated from the meta-analysis. The survey would include fixed information asking about the themes explored in the earlier qualitative studies. However, the survey would also contain information that the respondent could include any pertinent information about their domain learning experience.

The entire objective of this line of research would be to eventually develop a training program that would assist the novice in teaching them the domain related tasks and knowledge needed to become a successful electronic portfolio support staff member. The training curriculum would include tasks needing to be mastered relevant to the domain such as creating the electronic portfolio and common types of errors. The training curriculum would also include opportunities to interact with domain experts to facilitate the development of problem solving skills and observe expert level performance behaviors. The combination of task-based training and opportunities to apprentice with more experienced domain members would ideally create more balanced, experienced support staff members.

Furthermore, a closer examination of the role of individual characteristics in the acquisition of expertise might be necessary. Each research participant in the study possessed some individual characteristic such as previous technical experience that contributed to the development of domain expertise. An additional study focusing on an investigation of individual characteristics affecting the acquisition of expertise could uncover other common elements that were not part of the current study. Any other factors discovered in the additional study could then be empirically studied and possibly added to the model offered in this study.

Conclusion

This study was designed to address a lack of electronic portfolio literature on the topic of training methods for technical staff that support the various electronic portfolio systems across the United States. The qualitative study explored the various factors that facilitated the acquisition of knowledge for electronic portfolio support staff through a series of case studies of electronic portfolio support staff with varied levels of expertise. The current study offered several themes that research participants thought were important in their journey to acquire expertise. The findings of this study will be useful in exploring potential factors that influence the acquisition of knowledge and expertise for technical support staff of electronic portfolio systems.

APPENDIX

APPENDIX A

Portfolio Support Initial Dreamweaver Workshop

Step-by-Step Instruction Notes

1. Introduce efolio Support staff
2. Review portfolio support site <http://www.baylor.edu/soe/ps>
    - 2.1. Sign in
        - 2.1.1. Open web browser–Explorer or Firefox–to Baylor Home Page
        - 2.1.2. Add soe/ps = support home page
        - 2.1.3. Click "Sign in" > enter info > click "submit" button at bottom
    - 2.2. Review site resources
        - 2.2.1. Contact info & hours available
        - 2.2.2. How to make an appointment
        - 2.2.3. Working with the efolio
            - 2.2.3.1. Setting up Dreamweaver
            - 2.2.3.2. Uploading files
        - 2.2.4. Templates > review example
            - 2.2.4.1. Download & unzip file (preferably to flash drive)
            - 2.2.4.2. Click on title of folder and rename: "last_name efolio" (e.g., "Martin efolio"
            - 2.2.4.3. Explain this will be root folder
            - 2.2.4.4. Emphasize importance of defining site properly
3. Open Dreamweaver (choose "Designer" interface)
    - 3.1. Define site
        - 3.1.1. Click "Site>New Site" in the top menu bar
        - 3.1.2. Select "Advanced" tab as moist simple option
        - 3.1.3. Category on left menu select "Local Info"
            - 3.1.3.1. "Site name" = same as root folder
            - 3.1.3.2. "Local Root Folder" = click on folder icon & navigate to [newly created] root folder; keep using "Open..." to select folders in the lower window until root folder is in "Select" field at top of window; click "Select" button; (ALWAYS, ALWAYS, ALWAYS SELECT THIS AS ROOT FOLDER)
    - 3.2. Category on left menu select "Remote info"
        - 3.2.1. From the "Access:" pull-down menu select > "FTP"
        - 3.2.2. "FTP host:" = portfolio.baylor.edu
        - 3.2.3. "Host directory:" = first letter of Baylor user name followed by "/" followed by complete Baylor user name> e.g. "B/Bobby_Baylor" Note: the Baylor user name is the same as the part of their email address before the @ sign and may contain a number if there are multiple students with that name.

3.2.4. “Login:” = “baylor/” plus your Baylor user name >e.g. “baylor/bobby_baylor”

3.2.5. “Password:” = campus login password (same as for Bearmail or Bearspace) NOTE: only the password is case sensitive in the remote setup process

3.2.6. Click > “Test” button

3.2.6.1. If popup indicates successful, click “OK” > “OK” > “Done” on the successive windows

3.2.6.2. If not successful, check spelling and formatting of required info; make sure password is correct; if still not successful, ask portfolio staff for help

4. Review Dreamweaver interface

4.1. Site files—look particularly at directory structure of template

4.2. Insert bar

4.3. Properties window—editing options change depending on what is selected; default is text

4.4. Panels

4.5. To open document, double-click on it in “Local View” in the “Files” panel on the right—folders should be green [*if they are manila colored, switch to local view*]; e.g., Double click on index.html --NOTE: this will *always* be your first page, do not rename it or move it; *always* work within Dreamweaver after site definition

5. Review index page text area, buttons, links, images, etc.

5.1. Warning – do not delete or modify or even open “Templates” folder; same with “do-not-move-or-delete” folder

5.2. Assistance is available for modifying templates if you desire

5.3. Enter text on index page (name, date of graduation, etc.)

6. New Page creation

6.1. “Evidence” Example

6.1.1. File > new; in window that opens select “Page from template > site: “name of root folder” > Template: “evidence” > Click: “create” button

6.1.2. At top of new page fill in: Title = name of page

6.1.3. Save = File >save (name accordingly--*review naming conventions*)

6.1.3.1. Short; preferably no spaces

6.1.3.2. No characters other than “-”, “_”, letters or numbers

6.1.3.3. So that we can all be on the same page (this is open for discussion), I have found the following text to be most useful over the long haul. This method keeps the directory structure automatically organized by section and date added; will aid student knowing what is in each file without having to open

6.1.3.3.1. Begin with section number (e.g.: 1312)

6.1.3.3.2. Add benchmark number (e.g. 1312-1)

6.1.3.3.3. Add letter in sequence for that section’s benchmark (e.g.: 1312-1a; 1312-1b; etc.)

6.1.3.3.4. Optional but good to add truncated description (e.g.: 1312-1a_rules; 1312-1b_RulesPic)

6.1.3.3.5. Make sure file type is appended (DreamWeaver takes care of this when saving the file, but not if you elect to rename—also remember that you should always close a file before renaming.)

6.2. Create link to appropriate page

6.2.1. Highlight text for link (Note: some instructors have requested each link begin with the section number plus a brief description of the evidence—e.g., "1312 Evidence: picture of students working in class rules"

6.2.2. In properties window find "lasso" and connect to file to link on (in this case index)

6.2.3. In properties window, make target "_blank"

6.2.4. Test in browser after saving

7. Editing & Inserting Images (Photoshop skills needed: rotate, crop, size/resize, enhance, blur, optimize)—I consulted with some of you regarding easiest flow for optimizing and inserting images; it is still open for debate

7.1. Open the image file in Photoshop (or scan the image using Photoshop)

7.2. Rotate, crop, enhance, highlight, blur as needed (demo these tools)

7.3. From menu: "image>image size" dialogue box

7.3.1. Make sure constrain images is checked

7.3.2. Set resolution to 72

7.3.3. Enter the appropriate width (NOTE: The eFolio template pages are built at a width of 900 pixels. Use that as a mental benchmark for your desired width – i.e. full page=900 pixels; ½ page width = 450 pixels; etc.)

7.3.4. Click "OK"; increase image magnification to 100% if needed

7.4. Reduce image digital size for the web

7.4.1. From menu select "File>Save for Web & Devices"

7.4.2. Make sure the "Optimized" tab is selected & note the file size at bottom of page—emphasize importance of small size for fast download

7.4.3. Using the "Preset" pull down menu on the right, choose the setting that gives the smallest file size with the least quality that you need for the purpose of the image (Notes: You need to be able to easily read text you have scanned; photos do not have to be as sharp as print quality. Generally to achieve this end, select JPEG options for photos & .GIF for documents. The PNG options are superior for all uses, but they are still not universally supported by the various browsers; so we avoid them at this time.)

7.4.4. Click the "Save" button on the right side; name the image using the same naming restrictions as we did for html files; make sure you save it into the appropriate folder INSIDE your root folder. E.g., if the image supports Benchmark One, save it to the benchmark_1 folder.

7.5. Insert image on page

7.5.1. Open or create the page you want to display the image

7.5.2. Click and drag to insert on the page

7.6. Demo editing options in Dreamweaver properties box for making quick edits if needed

8. Uploading methods

8.1. Click on 2 arrows in image menu at top of individual page and select "put" (may prompt to save or include dependent images, click yes to all)

8.2. OR Making sure all files to be uploaded are saved, on right in local site files box

8.2.1. Highlight file(s) or folder(s) to upload by clicking on them (Control_Click to choose multiple files)

8.2.2. Click blue “upload” arrow to put file

8.3. OR right click on the root folder

8.3.1. Select “Synchronize”

8.3.2. Select “Preview”

8.3.3. Deselect files in Preview window you may not want to upload

8.3.4. Click on “Put” button to upload selected files

8.3.5. Click “close window”

8.4. Open a browser and go to the web site to double-check and make sure your new files are viewable on the web. Note: you may have to click on the browser refresh button if site had been viewed recently during this session.

9. Downloading site (why would need to do this?)

9.1. Define site

9.2. Click plug icon to connect

9.3. Find file to work on

9.4. Highlight file and click > green arrow to get file to local site

9.5. Save to Flash Drive for back up (unless already working from the Flash)

9.6. You can download your entire site this way for backup or if you lose your Flash drive and need to have a fresh copy.

10. To improve security and prevent others from overwriting your work accidentally, remove the site from DreamWeaver before you close the program.

11. Be sure and eject Flash drive properly!

REFERENCES

Anderson, J.R. (1982). Acquisition of cognitive skill. *Psychological Review, 89*, 369-406.

Anderson, J.R. (1987). Skill acquisition: Compilation of weak-method problem situations. *Psychological Review*, *92*, 192-210.

Ardley, J. (2009). Unanticipated findings: Gains by cooperating teachers via video-mediated conferencing. *Journal of Computing in Teacher Education*, *25*, 81-86.

Ashelman, P., Dorsey-Gaines, C., & Glover-Dorsey, G. (1997). *Applications of portfolio assessment in a teaching and nursing program*. Retrieved from ERIC database. (ED425400).

Banister, S., Vannata, R.A., & Ross, C. (2006). Testing electronic portfolio systems in teacher education: Finding the right fit. *Action in Teacher Education*, *27*, 81-90.

Barlett, A., & Sherry, A. C. (2006). Two views of electronic portfolios in teacher education: Non-technology undergraduates and technology graduate students. *International Journal of Instructional Media*, *33*, 245-253.

Barrett, H. C. (2002). *Researching the process and outcomes of electronic portfolio development in a teacher education program*. Paper presented at the 2002 Association for the Advancement of Computing in Education. Paper retrieved November 1, 2007 from http://electronicportfolios.org/portfolios/site2002.pdf.

Barrett, H. C. (2004). *Differentiating electronic portfolios and online assessment management systems*. Paper presented at the 2004 Society of Information Technology in Education. Paper retrieved November 1, 2007 from http://helenbarrett.com/systems/concerns.html.

Barrett, H. C. (2007). *Using electronic portfolios for formative/classroom-based assessment*. Retrieved from http://helenbarrett.com/portfolios/ConnectedNewsletter.pdf.

Barrett, H. C., & Knezek, D. (2003). *E-portfolios: Issues in assessment and preservice teacher preparation.* Paper presented at the Annual Conference of the American Educational Research Association, Chicago, IL. Retrieved November 1, 2007 from http://electronicportfolios.com/portfolios/AERA2003.pdf.

Basken, P. (2008). Electronic portfolio may answer calls for more accountability. *Chronicle of Higher Education, 54,* A30-A35.

Baume, D., & Yorke, M. (2000). Validity and reliability in the evaluation of portfolios for the accreditation of teachers in higher education. A paper presented at the American Association for Higher Education Assessment Forum (No city).

Beck, R. J., Livne, N. L., & Bear, S. L. (2005). Teachers' self-assessment of the effects of formative and summative electronic portfolios on professional development. *European Journal of Teacher Education*. *28*, 221-244.

Berk, L. (2004). *Development through the lifespan, 3rd Edition*. Boston, MA: Pearson Education, Inc.

Bintz, W., & Shake, M. (2005). From university to classrooms: A preservice teachers' writing portfolio program and its impact on instruction in teaching strategies. *Reading Horizons*, *45*, 217-233.

Blumenfeld, P., Fishman, B., Krajcik, J.S., Marx, R.W., *&* Soloway, E. (2000). Creating usable innovations in systemic reform: Scaling up technology embedded project-based science in urban schools. *Educational Psychologist*, *35*, 149–164.

Bresciani, M. (2005). Electronic co-curricular student portfolios: Putting them into practice. *New Directions for Student Services*, *112*, 69-76.

Buzzetto-More, N., & Alade, A. (2008). The pentagonal e-portfolio model for selecting, adopting, building, and implementing an e-portfolio. *Journal of Information Technology Education, 7*, 45-71.

Calderwood, R., Klein, G. A., & Crandall, B. W. (1988). Time pressure, skill and move quality in chess. *American Journal of Psychology, 101*, 481-493.

Campbell, D. M., Cignetti, P. B., Melenyzer, B. J., Nettles, D. H., & Wyman, R. M. (2001). *How to develop a professional portfolio: A manual for teachers*. Boston, MA: Allyn and Bacon.

Chase, W. G., & Simon, H. A. (1973). The mind's eye in chess. In W. G. Chase (Ed.), *Cognitive skills and their acquisition* (pp. 141-189). Hillsdale, NJ: Lawrence Erlbaum Associates.

Christianson, L., Tiene, D., & Luft, P. (2002). Web-based teaching in undergraduate nursing programs. *Nurse Educator*, *27*, 276-282.

Clark, R. C. (2008). *Building expertise: Cognitive methods for training and performance improvement, 3rd edition*. San Francisco, CA: Pfeiffer.

Cohen, R. J. & Swerdlik, M. (2005). *Psychological testing and assessment: An introduction to tests and measurement*. Boston, MA: McGraw-Hill.

Cole, D. J., Messner, P., Swonigan, H., & Tillman, B. (1991). *Portfolio structure and student profiles: An analysis of education student portfolio reflectivity scores*. Paper presented at the annual meeting of American Educational Research Association, Chicago, IL.

Cole, D. J., Ryan, C.W., Kick, F. & Mathies, B.K. (2000). *Portfolios across the curriculum and beyond*. Thousand Oaks, CA: Corwin Press.

Courts, P. L., & McInerney, K. H. (1993). *Assessment in higher education: Politics, pedagogy, and portfolios*. Westport, CT: Praeger Paperback.

Creswell, J. W. (1997). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks, California: Sage.

Creswell, J. W. (2002). Narrative research: A comparison of two restorying data analysis approaches. *Qualitative Inquiry, 8*, 329-347.

Creswell, J. W. (2007). Qualitative inquiry and research design: Choosing among five traditions (2nd Ed.). Thousand Oaks, CA: Sage.

De Groot, A. D. (1978). *Thought and choice and chess*. The Hague: Mouton.

Derham, C., & Disperna, J. (2007). Digital professional portfolios of preservice teaching: An initial study of score reliability and validity. *Journal of Technology and Teacher Education, 15*, 363-381.

Desmet, C., Miller, D. C., Griffin, J., Balthazor, R., & Cummings, R. E. (2008). Reflection, revision, and assessment in first-year composition eportfolios. *The Journal of General Education*, *57*, 15-30.

Diehm, C. (2004). From worn-out to web-based: Better student portfolios. *Phi Delta Kappan*, *85*, 792-794.

Dornan, T., Carroll, C., & Parboosingh, J. (2002). An electronic learning portfolio for reflective continuing professional development. *Medical Education*, *36*, 767-769.

Donnelly, A. M. (2005). Let me show you my portfolio!: Demonstrating competence through peer interviews. *Action in Teacher Education, 27*, 55-63.

Ediger, M. (2000). *Qualitative assessment versus measurement of student achievement*. Retrieved from ERIC database. (ED447154).

Ericsson, K. A. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review, 100*, 363-406.

Ericsson, K. A. (2003). The acquisition of expert performance as problem solving: Construction and modification of mediating mechanisms through deliberate practices. In J. E. Davidson & R.J. Sternberg (Eds.), *The Psychology of Problem Solving* (pp. 31-85). Cambridge, UK: Cambridge University Press.

Ericsson, K. A., & Kintsch, W. (1995). Long-term working memory. *Psychological Review, 91,* 571-588.

Ericsson, K. A., Krampe, R. Th., Heizmann, S. (1993). Can we create gifted people? In CIBA Foundation Symposium 178, *The origin and development of high ability* (pp. 222-249). Chichester, UK: Wiley.

Ericsson, K. A., Krampe, R. Th., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review, 100,* 363-406.

Ericsson, K. A., & Lehmann, A. C. (1996). Expert and exceptional performance: Evidence on maximal adaptations on task constraints. *Annual Review of Psychology, 47,* 273-305.

Ericsson, K. A., Nandagopal, K., & Roring, R. W. (2005). Giftedness viewed from the expert-performance perspective. *Journal for the Education of the Gifted, 28*, 287-311.

Ericsson, K. A. & Smith, J. (1991). Prospects and limits in the empirical study of expertise: An introduction. In K.A. Ericsson & J. Smith (Eds.), *Toward a general theory of expertise: Prospects and limits* (pp.1-38). Cambridge, UK: Cambridge University Press.

Ericsson, K. A., & Staszewski, J. (1989). Skilled memory and expertise: Mechanisms of exceptional performance. In D. Klahr & K. Kotovsky (Eds.), *Complex information processing: The impact of Herbert A. Simon* (pp. 235-267). Hillsdale, NJ: Erlbaum.

Fiedler, R. L., & Pick, D. (2004, October). *Adopting an electronic portfolio system: Key considerations for decision makers*. A paper presented at the 27th Annual Convention of the Association for Educational Communications and Technology, Chicago, IL.

Fitts, P., & Posner, M.I. (1967). *Human performance*. Belmont, CA: Brooks/Cole.

Fleak, S. K., Romine, J., & Gilchrist, N. (2003). Portfolio peer review: A tool for program change. *Journal of Education for Business, 78*, 139-146.

Garis, J. W. (2007). E-portfolios: Concepts, designs, and integration within student affairs. *New Directions for Student Services, 119*, 3-16.

Gathercoal, P., Love, D., Bryde, B., & McKean, G. (2002). On implementing web-based electronic portfolio. *Educause Quarterly, 25*, 29-37.

Gibson, D., & Barrett, H. (2003). Directions in electronic portfolio development [Electronic Version]. *Contemporary Issues in Technology and Teacher Education*, 2(4). Retrieved July 21, 2007 from http://electronicportfolios.com/ITFORUM66.html.

Glaser, B. G, & Strauss, A. L. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Chicago, Illinois: Aldine Publishing Company.

Glaser, R., & Chi, M.T.H. (1988). Overview. In M.T.H. Chi, R. Glaser, & M.J. Far (Eds.), *The nature of expertise* (pp. xv-xxviii). Hillsdale, N.J.: Erlbaum.

Grier, J. M., Denney, M. K., & Clark, M. M. (2006). *A tale of two programs: A comparative study of electronic portfolio assessment in teacher education*. A paper presented at the Annual Meeting of the American Educational Research Association, April 2006, San Francisco, CA.

Goldsmith, D. J. (2007). Enhancing learning and assessment through e-portfolios: A collaborative effort in Connecticut. *New Directions for Student Services, 119*, 31-42.

Gobet, F., & Simon, H. A. (1996). The roles of recognition processes and look-ahead search in time-constrained expert problem solving: Evidence from grand-master-level chess. *Psychological Science, 7*, 52-55.

Guaglianone, C. L., Payne, M., Kinsey, G. W., & Chiero, R. (2009). Teaching performance assessment: A comparative study of implementation and impact amongst California State University campuses. *Issues in Teacher Education, 18*, 129-148.

Hackman, D. G., & Alsbury, T. L. (2005). Standards-based leadership preparation program improvement through the use of portfolio assessments. *Educational Considerations, 32*, 36-45.

Heath, M. (2004). *Electronic portfolios: A guide to professional development and assessment*. The United States of America: Linworth.

Heath, M. (2005). Are you ready to go digital? The pros and cons of electronic portfolio development. *Library Media Connection, 23*, 66-70.

Herman, J. L., Aschbacher, P. R., & Winters, L. (1992). *A practical guide to alternative assessment*. The United States of America: The Regents of the University of California.

Herner, L. M., Karayan, S., McKean, G., & Love, D. (2003). Special education teacher preparation and the electronic portfolio. *Journal of Special Education Technology, 18*, 44-49.

Hernon, P., Dugan, R. E., & Schwartz, C. (2004). *Revisiting outcomes assessment in higher education*. The United States of America: Libraries Unlimited.

Hewett, S. M. (2004). Electronic portfolios: Improving instructional practices. *TechTrends, 48*(5), 26–30.

Hill, J. R., & Reeves, T. C. (2004*). A report of a 4-year evaluation on the laptop initiative at Athens Academy*. Athens, GA: The University of Georgia.

Hope, J. (2005). Student portfolios: Documenting success. *Techniques Making Education and Career Connections****,*** *79****,*** 26–31.

Hutchins, E. (1996). Learning to navigate. In S. Chaiklin and J. Lave (Eds.), *Understanding practice* (pp. 35-63). New York, NY: Cambridge University Press.

Jamtsho, S. & Bullen, M. (2007). Distance education in Bhutan: Improving access and quality through ICT use. *Distance Education*, *28*, 149-161.

Janisch, C., Liu, X., & Akrofi, A. (2007). Implementing alternative assessment: Opportunities and obstacles. *The Educational Forum*, *71*, 221-230.

Josselson, R., & Lieblich, A. (1995). *The narrative study of lives: Vol. 3*. *Interacting experience*. Thousand Oaks, CA: Sage.

Jun, M. K., Anthony, R., Achrazoglou, J., & Coghill-Behrends, W. (2007). Using eportfolios for the assessment and professional development of newly hired teachers. *TechTrends, 51*, 45-50.

Kilbane, C. R., & Milman, N. B. (2004). *The digital teaching portfolio workbook: Understanding the digital teaching portfolio process*. Boston, MA: Allyn & Bacon.

Kimball, M. A. (2003). *The web portfolio guide*. New York: Longman.

Kohn, A. (2000). *The case against standardized testing: Raising the scores, ruining the schools*. Portsmouth, NH: Heinemann.

Koltanowski, G. (1985). *In the dark*. Coraopolis, PA: Chess Enterprises.

Knight, W. E., Hakel, M. D., & Gromko, M. (2006, May). *The relationship between electronic portfolio participation and student success.* A paper presented at the 46th Annual Forum of the Association for Institutional Researcher, Chicago, IL.

Krampe, R. T., & Ericsson, K. A. (1996). Maintaining excellence: Deliberate practice and elite performances in young and old pianists. *Journal of Experimental Psychology: General, 125,* 331-359.

Lambert, C., DePaepe, J., Lambert, L., & Anderson, D. (2007). E-portfolios in action. *Kappa Delta Pi Record, 43*, 76-81.

Lankes, A. M. (1998). Portfolios: A new wave in assessment. *T.H.E. Journal*, *25*, 18.

Lave, J. (1988). *Cognition in practice: Mind, mathematics, and culture in everyday life*. Cambridge, UK: Cambridge University Press.

Lave, J., & Wenger, E. (1991). *Situated Learning: Legitimate peripheral participation*. United States: Cambridge University Press.

Lehman, H. C. (1953). *Age and achievement*. Princeton, N.J.: Princeton University Press.

Lim, C.P., Pek, M.S. & Chai, C.S. (2005). Classroom management issues in ICT-mediated learning environments: Back to the basics. *Journal of Educational Multimedia and Hypermedia, 14*, 391-414.

Lynch, L. L. & Purnawarman, P. (2004). Electronic portfolio assessments in U.S. educational and instructional technology programs: Are they supporting teacher education? *TechTrends, 48*, 50-56.

Macedo, P., Snider, R., Penny, S. & Labonne, E. (2001, November). The development of a model for using e-portfolios in instructional technology programs. A paper presented at the National Convention of the Association for Educational Communications and Technology.

Maden, J., Taylor, M. (2001, March). *Developing and implementing authentic oral assessment instruments*. A paper presented at the Annual Meeting of Teachers of English to Speakers of Other Languages, St. Louis, MO.

Maloney, M.P., & Ward, M.P. (1976). *Psychological Assessment*. New York: Oxford University Press.

Meeus, W., Questier, F., & Derks, T. (2006). Open source eportfolio: Development and implementation of an institution-wide electronic portfolio platform for students. *Educational Media International, 43*, 133-145.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass.

Molina, A., Sussex, W., & Penuel, W. R. (2005). *Training wheels evaluation report*. Menlo Park, CA: SRI International.

Montgomery, K. (2001). *Authentic assessment: A guide for elementary teachers*. New York: Addison Wesley Longman, Inc.

Mosely, C. (2005). The value of professional teaching portfolios to prospective employers: School administrators' views. *The Professional Educator*, *72*, 58-72.

Mueller, J. (2006). *What is authentic assessment?* Retrieved July 29, 2007 from http://jonathan.mueller.faculty.noctrl.edu/toolbox/whatisit.htm#traditional.

Naizer, G. L. (1997). Validity and reliability issues of performance-portfolio assessment. *Action in Teacher Education, 18*, 1-9.

Newmann, F. M., Secada, W. G., & Wehlage, G. G. (1995). *A guide to authentic instruction and assessment: Vision, standards, and scoring*. Wisconsin: Wisconsin Center for Education Research.

Palomba, C. A., & Banta, T. W. (1999) *Assessment essentials: Planning, implementing, and improving assessment in higher education*. San Francisco, CA: Jossey-Bass.

Patton, M. Q. (2001). *Qualitative research and evaluation methods*. Thousand Oaks, CA: Sage.

Pardieck, S. C., & McMullen, D. W. (2005). *Development of a Digital Portfolio System for Preservice Teachers*. A paper presented at the Annual Meeting of ED Media, Montreal, Canada.

Pecheone, R. L., Pigg, M. J., Chung, R. R., & Souviney, R. J. (2005). Performance assessment and electronic portfolios: Their effect on teacher learning and education. *The Clearing House*, *78*, 164-176.

Plant, E. A., Ericsson, K. A., Hill, L., & Asberg, K. (2005). Why study time does not predict grade point average across college students: Implications of deliberate practice for academic performance. *Contemporary Educational Psychology*, *30*, 96-116.

Rogers, D. W. (2003). *Teacher preparation, electronic portfolios, and NCATE*. A paper presented at 2003 Conference of the Society for Information Technology, Albuquerque, New Mexico.

Rossi, P. G., Magnoler, P., & Giannandrea, L. (2008). From an e-portfolio model to e-portfolio practices: Some guidelines. *Campus-Wide Information Systems*. *25*, 219-232.

Rovai, A. P. (2000). Online and traditional assessments: What is the difference*? Internet and Higher Education, 3*, 141-151.

Saariluoma, P. (1991). Aspects of skilled imagery in blindfold chess. *Acta Psychologica, 77,* 65-89.

Scott, C., & Plumb, C. (2003). A case study of the writing experience of an engineering student as part of a portfolio-based writing program evaluation. *Access ERIC: FullText.*

Schulz, R., & Curnow, C. (1988). Peak performance and age among superathletes: Track and field, swimming, baseball, tennis, and golf. *Journal of Gerontology: Psychological Sciences, 43,* 113-120.

Serafini, F. (2001). Three paradigms of assessment: measurement, procedure, and inquiry. *Reading Teacher*, *54,* 384-393.

Shannon, D. & Boll, M. (1996). Assessment of preservice teachers using alternative assessment methods. *Journal of Personnel Evaluation in Education, 10*, 128-130.

Simonton, D. K. (1997). Creative productivity: A predictive and explanatory model of career trajectories and landmarks. *Psychological Review, 104,* 66-89.

Sunal, C. S., McCormick, T., Sunal, D. W., & Shwery, C. (2005). Elementary teacher candidates' construction of criteria for selecting social studies lesson plans for electronic portfolios. *Journal of Social Studies Research*. *29*, 7-17.

Thomas, K. R., Lamson, S. L., King, A. K. (2001, February). *Training teacher candidates to create web-based electronic professional portfolios.* A paper presented at the 81st Annual Meeting of the Association of Teacher Educators, New Orleans, LA.

Trent, S. C., & Dixon, D. J. (2004). My eyes were opened: Tracing the conceptual change in pre-service teachers in a special education/multicultural education course. *Teacher Education and Special Education, 27*, 119-133.

Tuttle, H. G. (2007). Digital-age assessment: E-portfolios are the wave of the future. *Technology & Learning*, *27,* 22.

United States Department of Education (1997). *Assessment of student performance: Studies of education reform*. Paper retrieved from http://www.ed.gov/pubs/SER/ASP/index.html.

Valencia, A. A. (1998). *Coping with the CBEST: Alternative and inclusive approaches*. A 1998 annual report for the School of Education and Human Development, California State University, Fresno, Fresno, CA.

Venezky, R. L., & Oney, B. A. (2004). Creating and using portfolios on the Alphabet Superhighway. Retrieved July 30, 2007 from http://www.ash.udel.edu/ash/teacher/portfolio.html

Vygotsky, L. S. (1978). *Mind in society: Development of higher psychological processes.* United States: Harvard University Press.

Walker, V. L. (2004). *Integrating video in electronic portfolios*. (Unpublished dissertation).

Waters, J. K. (2007). E-portfolios: Making things e-asy. *The Journal, 34*, 26-33.

Wenger, 2009. http://www.ewenger.com/theory. Retrieved June 15, 2009.

Wetzel, K., & Strudler, N. (2005). The diffusion of electronic portfolios in teacher education: Issues of initiation and implementation. *Journal of Research on Technology in Education*, *37,* 411-433.

Wetzel, K., & Strudler, N. (2005). The diffusion of electronic portfolios in teacher education: Next steps and recommendations from accomplished users. *Journal of Research on Technology in Education*, *38*, 231-243.

Whithaus, C. (2002). Green squiggly lines: Evaluating student writings in computer-mediated environments. *Academic Writing, 3.* Retrieved June 30, 2007 from http://wac.colostate.edu/aw/articles/whithaus2002/.

Wiedmer, T. L. (1998). Digital portfolios: Capturing and demonstrating skills and levels of performance. *Phi Delta Kappan, 79*, 586-590.

Wilhelm, L., Puckett, K., Beissner, S., Wishart, W., Merideth, E., & Sivakumaran, T. (2006). Lessons learned from the implementation of electronic portfolios as three universities. *TechTrends, 50*, 62-71.

Willis, L., & Wilkie, L. (2009). Digital career portfolios: Expanding institutional opportunities. *Journal of Employment Counseling, 46*, 73.

Wolf, A. (1998). Portfolio assessment as national policy: The National Council for Vocational Qualifications and its quest for a pedagogical revolution. *Assessment in Education, 5*, 413-445.

Wright, V. H., Stallworth, B. J. & Ray, B. (2002). Challenges of electronic portfolios: Student perceptions and experiences. *Journal of Technology and Teacher Education, 10,* 49-61. Norfolk, VA: AACE.

Yancey, K. (2009). Electronic portfolios a decade into the Twenty-first Century: What we know, what we need to know. *Peer Review*, *11*, 28-32.

Yin, R. K. (1984). *Case study research: Design and methods.* Newbury Park, CA: Sage.

Yin, R. K. (2003). *Case study research: Design and methods* (3rd Ed.). Thousand Oaks, CA: Sage.

Zalatan, K. A. (2001). Electronic portfolios in a management major curriculum. In B. L. Cambridge, S. Kahn, D. P. Tompkins & K. B. Yancy (Eds.), *Electronic portfolios: Emerging practices in student, faculty, and institutional learning* (pp. 44-52).Washington, DC: American Association for Higher Education.

Zambo, R., Beckett, C., Wetzel, K. & Marquez-Chisholm, I. (2002). Preservice and inservice teachers collaborating with technology in K-8 multicultural classrooms: Year 2. In D. Willis et al. (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2002* (pp. 1501-1507). Chesapeake, VA: AACE.