EFFECTS OF ONLINE PROBLEM-BASED LEARNING ON TEACHERS' TECHNOLOGY PERCEPTIONS AND PLANNING

by

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Abstract

The purpose of this qualitative study was to examine the ways in which the experience of learning through an online problem-based learning (PBL) model affect teachers' perceptions of integrating technology. Participant reflections were collected and analyzed to identify the pros, cons, and challenges of learning technology integration through this online instructional method. Participant perceptions were also examined across variables such as gender, age, level of technology expertise, level of pedagogical expertise, and teaching status. The study also examined the ways in which the experience of learning through an online PBL model affect teachers' planning of technology integration. A qualitative content analysis was conducted in order to assess whether the online PBL method helped teachers plan activities that utilized real world scenarios, multiple disciplines, and technology as a partner in the learning process. Through analysis of study data, themes emerged that revealed the positive, negative, and challenges of this approach. Several positive themes were identified: the need for integration, the PBL process, professional growth, peer interaction, and leadership. Group dynamics and communication technologies were mentioned as negative aspects of the online (PBL) model. Additionally, participants indicated that the following issues represent challenges of learning technology integration through online PBL: group dynamics, scheduling and time issues, use of multiple disciplines, and pushing the boundaries of student learning. Upon completion of the qualitative content analysis, all online PBL groups experienced significant growth from one level to another, with all groups making progress in the area of multiple disciplines. Examination of participant attributes reflected positive attitudes towards the use on online PBL for learning technology integration and planning.

Dedication

I dedicate this work to my wife Cheryl, my best friend, whose constant support and devotion allowed me to pursue this accomplishment. Unselfishly and quietly, you accepted all family responsibilities allowing me to focus on this dream. For this, I will be forever grateful. Without you and your love, this would not have been possible.

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CHAPTER 1. INTRODUCTION

Introduction to the Problem

Though varied in scope and sophistication, educational technology has been used in schools throughout the United States for the last two decades (McCombs, 2000). Throughout this time period, various studies have examined the effect that technology plays in enhancing learning (Brode, 2005; Hollenbeck & Hollenbeck, 2004; Umbach, 1998; Schaidle, 1999). Many of these studies claim that technology, if used appropriately, can have a positive impact on the progress of students (Benson, Farnsworth, Bahr, Lewis, Shaha, 2004; Harvey, 2003; NCREL, 2005). However, the National Center for Educational Statistics reports that very few teachers feel competent in their abilities to integrate technology and as a result may not be using it appropriately in order to achieve this progress.

Thus, the situation at hand suggests that in order to realize the benefits of integrating technology, institutions of higher education must improve or revisit the methods used to teach technology integration to today's teachers. It is no longer enough to simply teach software applications to teachers; this approach often leads to teachers that can use applications, but not understand how to plan for their use in the learning process. In working to move in the direction of teachers having a more global understanding of technology, higher education courses would benefit by moving away

from traditional didactic approaches to that of a more student-centered constructivist effort. By using such an approach, technology becomes a partner in the learning process and provides the critical link that not only motivates students, but helps them to make connections between the tasks that they are being asked to perform and what actually happens in the real world.

It is important to examine ways that the constructivist epistemology might support the acquisition of appropriate technology planning skills for the integration of technology into teacher's curricular units and lessons. Obtaining competency with various applications is important, but teachers should be able to consider how these applications can be utilized in the classroom and plan for their effective use. Therefore, strategies that provide technology instruction through the real world setting could prove effective. With this in mind, perhaps problem-based learning (PBL) in the online environment could provide the appropriate setting for teachers to learn how to utilize technology as a partner in the learning process. The flexibility of online learning paired with PBL's focus on working collaboratively in groups to analyze real world scenarios mirrors what teachers are being asked to do in their professional settings. If technology instruction is delivered by utilizing this approach, it may help them to more effectively plan for the integration of technology into their curricular areas.

Background of the Study

Problem-based learning is an instructional method (Major, 1998) or educational approach (Major & Palmer, 2001; Ngeow & Kong, 2001) that is characterized by the use of real world problems (Barrows, 1999; Dombrowski, 2002; Duch, 1995; Major &

Palmer, 2001) as a stimulus for learners to utilize critical thinking and problem solving skills (Barrows, 1999; Duch, 1995). Considered a process as well as a curriculum (Major & Palmer, 2001), PBL is significantly different from traditional pedagogical methods (Martin, 1996) that employ the use of lecture as the primary method of instructional delivery (Jones, 1996). Contrary to this traditional method, PBL places an emphasis on active engagement that involves learners in the metacognitive process of thinking about their learning (Harper-Marinick, 2001). It is by this process that the learner moves from the shallow surface learning of traditional approaches to deep understanding that reflects the level or depth of understanding that is characteristic of problem-based instruction.

With its roots in constructivism, PBL has an extensive history in the traditional university in the field of health sciences. In the early part of the twentieth century, institutes of higher learning and medical schools were growing concerned by the lack of quality in students' abilities to engage actively in learning; "studies were showing that student learning in traditional classrooms was not effective, as students largely forgot the content" (Savin-Baden & Major, 2004, p. 17) that was delivered in the didactic mode. Therefore, in 1966 problem-based learning was born with the purpose of simulating patient problems that would reflect the authentic setting of a practicing physician. These open-ended problems that focus on "real-life" scenarios enabled medical students to immediately apply the knowledge gained. As a result of this practical application, learner motivation increased, as well as problem solving skills and the ability for self-regulated learning (Barrows & Tamblyn, 1976). The use of PBL as an instructional method in the twentieth century mainly occurred in the face-to-face environment, but this appears to be changing as we begin the twenty-first century.

In the last several years, literature has begun to surface indicating that PBL is now being implemented in virtual environments (Donnelly, 2004; Gibson, 2002; Harvey, 2003). Once again, the field of health sciences appears to have taken the lead in pioneering the delivery of online PBL. Evidence of online PBL being used in other disciplines, such as business, engineering, and information technologies is beginning to surface as well. Online PBL focuses on the same fundamental learner-centered objectives as was done in the traditional setting. Of significance for this study is evidence that online PBL is now being explored for teacher education (Donnelly, 2004; Gibson 2002; Harvey 2003).

Recent research in this area concentrates on design concerns and the environment in which online PBL is conducted. In one such study, Harvey (2003) describes the process of re-designing a traditional print-based simulation for use in a hybrid teacher education course; the study addressed considerations faced in the redesign such as creation of materials, technical support, as well as time and resources. Donnelly (2004) writes about a hybrid approach for in-service teacher training; the study focused on facilitating an environment for participants to develop, deliver, support, and evaluate a course within their own discipline. Ortiz (2004) examined research on distance education environments and teacher education that have attempted to utilize the traditional PBL format and put forth suggestions for the modification of particular areas when PBL is implemented.

Gibson (2002) is the only study that addresses integrating technology into instruction at a pre-service level with web-enhanced PBL. “Most teachers graduate from teacher education institutions with limited knowledge of the ways technology can be used

in their professional practice" (Gibson, 2002, p. 236). Even though Gibson (2002) discusses the importance of developing and using computer-based lessons in teachers' instructional practices, the study has a very limited focus describing one example of using a virtual field trip for social studies instruction. Nonetheless, Gibson's study indicates that it is not enough to merely expose students to technology; it is necessary to rethink traditional instruction and bring to an end the view that technology is an add-on to instruction. This revision would help promote technology integration, or utilizing technology, as a partner in the learning process.

For many years, integration of technology into the classroom has been viewed as a necessary and valuable pursuit (Gibson, 2002). However, attempts at achieving technology integration have varied over the years and has often focused on teachers acquiring application knowledge as the final outcome. More recently, attempts at technology integration have focused around the World Wide Web and inquiry based activities. This evidence signals a move towards "a flexible and adaptive use of technology that moves beyond simple functional and procedural applications and toward the incorporation of technology in the very fabric of everyday teaching and learning" (Gillingham & Topper, 1999, p. 305).

Considering this move towards a focus on technology in everyday teaching and learning, online PBL is a logical choice for teachers attempting to learn how to integrate technology into their own instructional practices because the online PBL approach moves away from a singular skills focus and merges the learning of technology skills with that of a "real world" classroom scenario. Combined with the fact that online learning has become increasingly popular by allowing students to learn anywhere, anytime, and at any

place, more and more teachers pursuing graduate education degrees are moving to the online learning environment. With little research having been done in this area, exploring the context for utilizing online problem-based learning for the purpose of learning technology integration is worthwhile.

Statement of the Problem

Problem-based learning (PBL) has a rich history in the traditional face-to-face classroom with its origin in the medical profession. Developed as a multidisciplinary approach that strives to move beyond content knowledge, PBL consists of student groups working collaboratively to analyze "real world" problems, identify gaps in their knowledge, seek critical knowledge or concepts, and resolve the problem by generating a solution.

Although there is a vast amount of research and literature available on problem-based learning (Barrows, 1999; Camp, 1996; Dombrowski, 2002; Duch, 1995; Evensen & Hmelo, 2000; Greening, 1998; Major, 1998; Major & Palmer, 2001; Savery & Duffy, 1996; Savin-Baden & Major, 2004), few studies have explored PBL when utilized in the online format. Examples of online PBL can be found in specific medical programs such as oncology (Minasian-Batmanian, 2002), pediatrics (Kamin, Deterding, Wilson, Armacost, & Breedon, 1999), and in the health sciences (Sword, Valaitis, Jones, & Hodges, 2002). Online PBL has also begun to be explored in teacher education (Donnelly, 2004; Gibson, 2002; Harvey, 2003; Lopez Ortiz, 2004); however, among studies that have investigated online PBL in teacher education, none have focused on its

impact on the perceptions and planning practices of teachers who are learning to integrate technology into their teaching practices.

Research provides numerous studies that address the topic of technology integration in the traditional instructional setting. As recently as 2003, the average public school contained an average 136 instructional computers and 93 percent of the nation's schools were connected to the Internet (NCES, 2006). However, the last report from the National Center for Educational Statistics in 1999 reported that only one-third of all teachers felt comfortable with using technology. Teachers who did feel comfortable using technology indicated that their training consisted of learning software applications, searching the Internet, or basic computer training which lasted an average of 32 or fewer hours. It appears that very little technology training is devoted to understanding how to integrate technology into instructional planning.

The convenience of online learning paired with the strength of problem-based learning poses an ideal environment for training teachers to integrate technology into their instructional practices. Analyzing the perceptions of graduate level K-12 teachers as they participate in an online PBL model will inform the field of the pros and cons of learning technology integration in this manner. It will also determine if online PBL and the integration of technology helps teachers to see that curricular areas should not be taught as islands unto themselves, but delivered as multi-disciplinary activities that reflect the real world around them. Through the process of planning for technology integration, teachers will demonstrate that they not only understand the mechanics of technology applications, but that they can see how technology can be integrated as a partner in the learning process.

Purpose of the Study

The purpose of this study was to examine the use of online PBL as a method for teaching technology integration planning to teachers. All too often, technology applications are taught to teachers without stressing the context in which those applications will be used. Therefore, the necessary link that helps teachers plan for the use of technology as a partner in the learning process is missing.

This study also examined teacher perceptions with respect to learning technology integration through online PBL. In identifying the pros, cons, and challenges of this method, recommendations for implementing this process are made to other professionals in the education field, therefore, increasing the knowledge base for this area.

Rationale

As previously stated, when technology is used effectively, it has a positive impact on the learning process. However, Lam (2000) posits that a large portion of teachers still feel inadequate in their understanding of how to utilize or integrate technology into their instructional practices. When technology is taught as an island unto itself, the necessary connections are missed for comprehending how to make use of it as a partner in the learning process.

Online PBL, through its focus on real world scenarios, may be the method that provides the relationship between the necessary technological skills and the pedagogical strategies that create the desired partnership in the learning process. Through complex,

open-ended, real world PBL scenarios, teachers examined situations and considered how they could plan for the use of technology to promote problem-solving and higher order thinking.

Research Questions

This study will examine the following questions:

1. In what ways does the experience of learning through an online PBL model affect teachers' perceptions of integrating technology? This question addresses the following sub-questions:
    a. What do teachers perceive as the pros and cons of learning technology integration through online PBL?
    b. What do teachers perceive as the greatest challenges faced in learning technology integration through online PBL?
2. In what ways does the experience of learning through an online PBL model affect teachers' planning of technology integration? This question addresses the following sub-questions:
    a. Does the experience of learning integration of technology through online PBL help teachers to plan activities that reflect "real world" environments?

b. Does the experience of learning integration of technology through online PBL help teachers to plan activities that utilize technology as a partner in the learning process?
c. Does the experience of learning integration of technology through online PBL help teachers to plan multi-disciplinary activities?

3. In what ways do teachers' perceptions of learning technology integration through an online PBL model vary among the participants along variables such as gender, age, level of technology expertise, pre-service or in-service status, and teaching experience in years?
4. What unexpected perceptions and planning practices emerge from learning technology integration through an online PBL model?

Significance of the Study

This exploratory study contributes to the limited research base concerning online problem-based learning and technology integration planning of teachers. Even though there is a wealth of research that focuses on problem-based learning used in a classroom-based environment, very little has been done concerning online problem-based learning within the context of technology integration.

While technology integration is a goal that is stated by most school districts, very few teachers feel proficient in the use of technology. Those that do feel proficient have been trained in the knowledge of applications. This narrow focus, however, does not necessarily translate into teachers that can effectively plan activities that integrate

technology as a partner in the learning process. Through the use of online PBL and its focus on authentic environments, this approach leads teachers not only to learn instructional technologies, but assists them in understanding how to effectively integrate them into their planning practices.

Definition of Terms

Constructivism

Constructivism, an epistemology, believes that a real world exists which we experience throughout life and it is by experience that individuals make sense of how to structure meaning.

Student-Centered Learning

Paramount to the concept of PBL is where the focus and responsibility for learning resides. In didactic instruction, the instructor determines the content, delivers the content, leads the discussions, and summarizes key concepts (Weimer, 2002). In light of this, "students often memorize, forget, fail to apply or integrate knowledge, and resist further learning" (Camp, 1996, p. 2). It is the instructor who is actively involved in the process of learning. Furthermore, Weimer (2002) summarizes traditional methods by stating, "When it comes to who is working the hardest most days in class, we win, hands down" (p. 73). It is through statements such as this that we realize the need for a redistribution of power in the classroom. The focus must move to the learners, empowering them with an environment that not only allows, but expects them to take responsibility for their learning. After all, considering core constructivist conceptions, it

is the learners and their experiences that must construct individual perceptions or concept of knowledge gained (Savery & Duffy, 1996).

Technology Integration

Technology tools, as well as instructional methods, are varied in scope and purpose. "Thus, integrating technology refers to the process of determining which electronic tools and which methods for implementing them are appropriate for given classroom situations and problems" (Roblyer & Edwards, 2000).

Online Learning

Learning that occurs by means of electronic transmission over the Internet has become known as either online learning or E-Learning. In this environment, the instructor and students work at a distance using their computers and Internet connections to fulfill the curricular objectives of the instructional program. Since students are not face-to-face in this environment, they communicate by synchronous or asynchronous methods.

Asynchronous Communication

Asynchronous communication refers to comments, or postings, that are submitted to an area of an online courseroom or website. "Participants in this form of computer-mediated learning can read and comment on the topic under discussion at their leisure" (Palloff & Pratt, 1999, p. 4). Therefore, it is not necessary for individuals to be connected to the Internet at the same time, or real time, in order to carry out a discussion.

Synchronous Communication

Synchronous communication is the exact opposite of asynchronous communication. In this form of discussion, learners or participants are all logged on at the same time, or real time, and comments are viewed as soon as participants press the enter key. One of the most commonly used synchronous tools used today is AOL's Instant Messenger. However, most learning management systems (LMS) such as Blackboard or WebCT have synchronous tools built into their interface.

Problem-Based Learning (PBL)

"Problem-based learning is a method of learning in which the learners first encounter a problem, followed by a systematic, student-centered enquiry process" (Schwartz, Mennin, & Web, 2002, p. 1). In PBL, students typically work in groups to analyze a real world problem; the groups work to identify learning issues and devise a plan for dividing the required labor in their quest to formulate a solution to the problem.

In PBL, the teacher does not embrace the didactic approach. On the contrary, the teacher becomes what is called a "tutor", or a facilitator of the learning process.

Online Problem-Based Learning

Up to this point in time, most problem-based learning has occurred in the traditional face-to-face classroom. However, as learning moves online through the Internet, elements of the problem-based learning model are being developed for cyberspace. Therefore, the steps of PBL are achieved through synchronous and asynchronous means of communication that occurs over the Internet.

Tutor

A tutor is an instructor, or teacher, who facilitates the learning process of PBL work groups. The tutor does not provide information to the PBL groups, but poses questions to provoke analysis and critical thinking.

Real world

For the purpose of this study, the term "real world" will refer to instances that replicate actual events or situations that occur in reality, or the practical world as opposed to the academic world.

Assumptions

The environment in which the study was conducted was an introductory course on the integration of technology for use in the classroom. Therefore, participants came into the study with a wide range of technological proficiency. Some participants were well versed in using productivity suites such as Microsoft Office and some had exposure to authoring web activities. On the other hand, some participants entered this study with minimal knowledge of how to use various forms of technology.

Moreover, the pedagogical experience of the participants varied as well. Participants that were currently employed as teaching professionals have had more experiences and opportunities to grow pedagogically; on the other hand, participants who were pre-service teachers, such as those who are changing careers, were typically novices where pedagogy is concerned.

Finally, participants in the study varied in their understanding and experience with the problem-based learning approach. The majority of participants had heard of PBL, but the degree to which they understand the steps and process varied.

Limitations

For decades, educational researchers have conducted qualitative studies (Eisner & Peshkin, 1990). Unlike quantitative research studies, the design of qualitative research lacks a consistency, or uniformity, of a prescribed procedure.

Therefore, this study was limited in the following ways:

1. This study was restricted to graduate level students in northeastern United States.

2. Due to the sample size and absence of randomization, the sample did not allow for statistical generalizations.

Organization of the Remainder of the Study

This study is presented in five main chapters. The remainder of the study, beginning with chapter two, includes a literature review examining prior research on the following topics: constructivist foundation, problem-based learning, online problem-based learning, technology integration, as well as the intersection of online problem-based learning and technology integration. Considering that a huge volume of literature exists on problem-based learning in the traditional setting, studies that focus on the use of problem-based learning for technology integration will comprise the main focus for review.

Chapter three explains the methodological choices and overall design for this qualitative study. Also included in this chapter is a description of whom the study participants are and how they were invited to participate in the study. Instrumentation for data collection as well as the use of NVivo 7 for analysis of study data is explained in further detail. Finally, considerations for the IRB process are discussed at this point.

Chapter four provides an analysis of participant reflections, focus group data, and artifacts from group materials and postings. From study data, a thick description of teacher perceptions of online problem-based learning is constructed. The Constant Comparative Method (Glaser & Strauss, 1967) was utilized for this purpose in an attempt to identify the pros, cons, and challenges that existed through learning technology integration planning through this method.

Furthermore, chapter four also includes the qualitative content analysis for the pre-PBL technology plan and the post-PBL technology plan evaluation. In assessing the technology plans, an effort was made to determine the impact that online problem-based learning had on the development of the post-PBL technology plan. The focus of this analysis was on evidence of multi-disciplinary activities and authentic activities that are present in the final technology plans.

In closing chapter four, a description of participant perceptions based on gender, age, pedagogical experience, and teaching status is presented.

Chapter 5 discusses the study's results. The discussion focuses on the interpretations of the results with respect to the original research questions. The chapter will conclude with recommendations for future research in this area.

CHAPTER 2. LITERATURE REVIEW

Constructivism

With its origins in psychology, philosophy, and anthropology (Perkins, 1992; von Glasersfeld, 1996), constructivism is "an alternate epistemology of how people learn and assimilate new knowledge" (Gold, 2001, p. 37). Emerging decades ago from the investigations of Jean Piaget and Lev Vygotsky (Piaget, 1972; Vygotsky, 1997), constructivism has evolved into various epistemological positions (Kanauka & Anderson, 1999) such as: cognitive or critical constructivism, radical constructivism, situated constructivism, socio/cultural constructivism, or trivial constructivism (Land et al., 2002). As a result, considerable debate continues to take place over what exactly constitutes constructivism.

Creedman and Wellman (2000) define constructivism as "a learning environment that provides more opportunities and motivation for learning through interactive, authentic, and student-centered learning activities" (p. 222). Ferguson (2001) suggests that constructivism is an epistemology where "human learning is constructed, and the learners build new knowledge on the footing of previous learning" (p. 47).

Perkins (1992) states that "central to the vision of constructivism is the notion of the organism as active, not just responding to stimuli, as in the behavioristic rubric, but engaging, grappling, and seeking to make sense of things" (p. 49). Therefore, the learning

environment is critical as it must be conducive to fostering student exploration and inquiry.

However, some educators debate the extent to which that environment should be structured. Bruner (1973) coined the term *BIG* which stands for *beyond the information given*. In this viewpoint, individuals may be presented with conceptual information, but are required to work through their understandings in a multitude of ways. Contrary to *BIG* is *WIG,* which stands for *without information given* (Perkins, 1992). In this approach, information is available and the instructor provides support; however, direct information is withheld. Perkins (1992) explains that advocates of WIG argue that "concepts are not truly and meaningfully learned in ways that empower learners unless those concepts are in good part rediscovered by the learners" (p. 50). Therefore, evidence can be found that demonstrates a variety of epistemological positions with constructivism as the underlying learning theory.

Knowledge Construction from a Student-Centered Perspective

Another critical assumption of constructivist philosophy is that knowledge must be constructed by individuals through their experiences in the world (Tam, 2000). Contrary to the objectivist perspective where individuals strive to gain reliable knowledge of the world from expert teachers (Kanuka & Anderson, 1999; Murphy, 1997), constructivism establishes a learner-centered environment that is information rich and socially meaningful (Gold, 2001). Cunningham (1992) asserts that in the constructivist learning environment, "the goal of instruction is not to assure that

individuals know particular things but rather to show them how to construct plausible interpretations of those things" (p. 7).

Honebein (1996) describes the knowledge construction process beginning with "the student taking primary responsibility for determining the topics or subtopics in a domain they pursue, the methods of how to learn, and the strategies or methods for solving problems" (p. 11). However, Land and Hannafin (2000) state that learning goals, or objectives, may be established "but the learner determines how to proceed based on individual needs and questions that arise while generating and testing beliefs" (p. 12). Brush and Saye (2001) also elicit the need for objectives; however, they illuminate the necessity for requiring students to set their own meaningful goals and assuming responsibility for achieving them.

Land and Hannafin (2000) explain that individuals who participate in learner-centered environments actively construct meanings. Tam (2000) goes as far as adding the active learning process with student-centeredness as a central tenet to constructivism. A critical requirement for this to happen appears in the form of "a teacher who acts as a facilitator whose main function is to help students become active participants in their learning and make meaningful connections between prior-knowledge, new knowledge, and the processes involved in learning" (Tam, 2000, p. 5).

An example of an active student-centered environment can be found in the Computer Supported Intentional Learning Environment (CSILE). Land and Hannafin explain that the purpose of CSILE is to "support learners in intentional and purposeful processing of information" (p. 8). Evidence of this type of activity can be found in the *Dig Project* that was conducted at Hawthorne Elementary in Oakland, California where

the curriculum for the entire year was organized around the interdisciplinary theme of ancient civilizations. Through this project, students create their own ancient civilizations including artifacts, values, and symbols. "Using CSILE as a shared database, students wrote text and created graphics that described and depicted their cultural universals" (U.S. Department of Education, 2000, ¶ 5). Providing support for both collaboration and thinking skills, students connected concepts by linking their entries and sometimes the corresponding graphic image. Towards the end of the activity, students prepared topographical maps and buried their artifacts for later retrieval. As a result, this type of student-centered learning "provided students with important insight and understanding into the nature of culture and diversity" (U.S. Department of Education, 2000, ¶ 18).

Learning in Authentic Contexts

As mentioned previously, objectivists focus on the pursuit of a complete and correct understanding of knowledge. Methods used to achieve this outcome often utilize approaches such as drill and practice, memorization, or didactic instruction delivered to passive students. Duffy and Jonassen (1992) suggest that experiences that students tend to have with concepts in today's schools are quite different from those that they might experience in the real world. Constructivists would argue that this approach, learning that occurs in a decontextualized situation, leads to knowledge that is inert, or not easily applied to new situations (Land & Hannafin, 2000).

Gold (2001) asserts, "to make meaning, students must focus on concrete situations and understand not only the facts but also the context in which these facts are placed" (p. 38). Learning that takes place in an authentic context allows the students to

construct meanings from their new experiences that intertwine the setting with the concepts, providing a stronger learning experience. Murphy (2002) adds that "in order for the activities to be authentic, they must reflect the natural complexity of real world environments that employ the context in which learning is relevant" (p. 3).

Therefore, a common assumption of constructivist learning environments is that learning is inextricably tied to authentic contexts. Evidence of this can be found in Hypermedia-supported Authentic Learning Environments (HALE). Williams (1999) discusses the creation of a HALE that addresses the content area of astronomy and centers on the use of expert stories to provide authentic situations and content. The study compared two groups that received similar content; however, one group received the treatment where stories and content were provided in an authentic setting with real experts providing the information in video segments. The control group received the same content, but it was provided in a traditional textual format without the use of stories. Upon completion of the initial stage, individuals were asked to apply their knowledge to new and unique situations. The results demonstrated that the group receiving the authentic segment with experts explaining the content in a story-like fashion significantly outperformed the group that simply received the content in the traditional print medium. This would appear to support the need for authentic contexts in learning environments.

Multiple Perspectives and Social Aspects of Constructivism

Considering that individuals construct meanings and understandings based upon their experiences with the real world, how do people come to a common understanding of concepts in general? Constructivists assume that, through the process of social

negotiation individuals can explore and interpret the perspectives of others and in the end develop a deeper understanding of concepts. Land and Hannafin (2000) support this by stating that socially mediated aspects of learning are integral.

Moreover, Kanuka and Anderson (1999) argue that it is imperative for instructors to play an integral part in realizing that students will require a "variety of different experiences to advance to different kinds and levels of understanding" (¶ 6). Considering this, the role of the instructor shifts drastically in the constructivist environment to one of a facilitator rather than that of an expert knowledge provider.

The concept of multiple perspectives also becomes evident in another constructivist approach, problem-based learning (PBL). Even though stages of this process rely on self-regulated investigation and reflection, individuals in PBL are also required to present and negotiate the findings of their research. Through this process, group members analyze and debate concepts that are presented often bringing their own unique perspectives to the discussion. As a result, individuals work to come to a common decision or understanding of the concepts being studied.

Furthermore, through social negotiation, multiple perspectives are examined and considered. Through constructivist activities, individuals may interact with each other in different fashions: student-student, student-teacher, or student-expert. As these interactions occur, individuals assimilate or accommodate new knowledge and reconstruct their mental framework, or schema. Hill and Land (as cited in Land and Hannafin, 2000) suggest that these varied perspectives "can be coordinated to form a knowledge base from which learners evaluate and negotiate varied sources of meaning (p. 13).

The Cage Model for Global Learning is one example of utilizing multiple perspectives in the development of global learning relationships with other cultures. Rimmington, Gibson, Gibson, and Alagic (2004) describe global learning as the "combination of global reach and global perspectives to produce a global graduate" (p. 3027). Through the use of communication technologies such as videoconferencing and asynchronous or synchronous tools found in the LMS, students gain access to the global reach that is necessary to communicate with students of other cultures.

Rimmington et al. (2004) describe communication as the unimpeded flow of information between two characters. However, the message that is transmitted between those two individuals often results in a distortion of information, or invisible barrier, which is defined as "the cage". In describing the cage, bars are determined to be represented by issues such as life experiences, cultural background, current context, and professional or personal experiences. Through the use of intrapersonal and interpersonal intelligences (Gardner, 1983) and online socialization, students need to be culturally and professionally sensitive to how life experiences, language, history, geography, religion, politics, and context help to create an understanding of the multiple perspectives that individuals bring to conversations. Rimmington et al. (2004) state that "ultimately, the intention of the global learning program is to be able to send and receive messages that facilitate the emergence of self-regulated or autonomous learning" (p. 3028).

Scaffolding for Deeper Understanding

Finally, a primary constructivist assumption is that in order to achieve deeper understandings, individuals must scaffold their thinking and actions as they construct new

and unique understandings of their world. Although it is difficult to ascertain a common definition for scaffolding, a key aspect of the process refers to structure that is provided or made available for learners as they proceed through their investigations.

Brush and Saye (2001) describe scaffolding as the "tools, strategies, and guides, which support students in attaining a higher level of understanding; one that would be impossible if students worked on their own" (p. 333). Brush and Saye (2001) provide an example of the importance of scaffolding through the hypermedia database *Decision Point! (DP).*

Decision Point! is an interactive multimedia database designed to address issues of the civil rights movement that were experienced by African-Americans. The DP environment provides various scaffolding tools for identifying, collecting, and analyzing the historical content. Primary documents, period news footage, interviews, and music are organized into three strands that reflect critical change strategies: working within the legal system, nonviolent protest, and black power (Brush & Saye, 2001). Conceptual scaffolds are provided within the database itself and assist students with structure in collecting and analyzing their findings. From the metacognitive perspective, students use a notebook section which provides assistance with self-monitoring and self-regulation (Brush & Saye, 2001). As a result of the scaffolding tools, students construct hyperlinked interactive essays that demonstrate a deeper level of understanding of the struggle that many African-Americans experienced during this period of American history.

Problem-Based Learning

Problem-based learning (PBL) is an instructional method (Major, 1998) or educational approach (Major & Palmer, 2001; Ngeow & Kong, 2001) that is characterized by the use of real world problems (Barrows, 1999; Dombrowski, 2002; Duch, 1995; Major & Palmer, 2001) as a stimulus for learners to utilize critical thinking and problem solving skills (Barrows, 1999; Duch, 1995b). Considered a process as well as a curriculum (Major & Palmer, 2001), PBL is significantly different from traditional pedagogical methods (Martin, 1996) that employ the use of lecture as the primary method of instructional delivery (Jones, 1996). Contrary to this traditional method, PBL places an emphasis on active engagement that involves learners in the metacognitive process of thinking about their learning (Harper-Marinick, 2001). It is by this process that the learner moves from the shallow surface learning of traditional approaches to deep understanding that reflects the level or depth of understanding that is characteristic of problem-based instruction.

It is through this paradigm shift (Camp, 1996) that PBL finds its origins. As early as the 1950's at Case Western Reserve University, medical schools were interested in improving the quality of medical instruction for their students by shifting away from traditional lecture-based delivery to that of a curriculum that integrated real world problems. Shortly thereafter, PBL, in some form or variation, began to spread to other medical schools such as the University of Limburg at Maastricht in the Netherlands, the University of Newcastle in Australia, and the University of New Mexico in the United States (Evensen & Hmelo, 2000; Martin, 1996; Nelson, 1999).

Primarily used in the first two years of medical school, instructors have employed this process to address curricular areas such as anatomy, pharmacology, and physiology (Savery & Duffy, 1996). In time, the PBL approach spread to other curricular areas such as schools of business, education, architecture, engineering, social work, and even into K-12 disciplines (Savery & Duffy, 1996).

Throughout the past several decades, various methods have been employed in delivering this type of activity; however, certain components seem to be congruent throughout the majority of approaches: student-centered, ill-structured problems, multi-disciplinary focus, self-regulated learning, as well as collaboration and assessment. This paper will attempt to outline or discuss the major components that comprise PBL.

Finally, PBL at its inception was designed for instructional delivery in a face-to-face environment. However, a growing number of traditional courses are being redesigned for delivery online; what implications will this have on the PBL process? This paper will formulate suggestions for utilizing the PBL approach in an asynchronous online learning environment.

Major Components of Problem-Based Learning

Before analyzing the major components of PBL, it is important to consider the epistemological foundation that is most aligned with this methodology. Camp (1996) posits that "PBL is consistent with current philosophical views of human learning, particularly constructivism" (p. 4). Furthermore, Savery and Duffy (1996) discuss three critical aspects of constructivism that relate to PBL (p. 136). First, a core concept of constructivism is illustrated in the belief that we understand by our own interactions with

the environment. This is philosophically opposite of the view that is proposed by objectivist tradition which implies that meaning exists in the world independently of the individual (Duffy & Jonassen, 1992).

Next, learning is a result of cognitive conflict or puzzlement. When the learners are given the ability to choose the direction of their inquiry, learning takes on a personal focus and the student is usually motivated to go beyond surface level understanding.

Finally, understanding or knowledge must be tested through the process of social negotiation. Greening (1998) states, "Social negotiation and the ongoing testing of the viability of existing concepts in the face of personal experience are the principle forces involved in the evolution of knowledge" (¶ 4).

Even though the basis for PBL is derived from constructivist philosophy, the methods used to deliver the activities of this approach vary with no one real authoritarian theoretical basis (Newman, 2003). This is partially due to the fact that pioneers such as Howard Barrows of McMaster University were searching for ways to make medical instruction more interesting and relevant; therefore little on no thought was given to educational psychology or cognitive science (Newman, 2003). Instead, Arambula-Greenfield (1996) explains that institutions focused on increasing medical student's abilities to demonstrate diagnostic and problem-solving skills (p. 26).

"PBL, at least in the 'pure' implementation form, fits with the tenets of adult learning theory" (Newman, 2003, p. 2). Martin (1996) supports this by stating that students in this environment utilize their prior knowledge as a basis for new learning experiences; therefore contradicting the "blank slate" notions of didactic pedagogical strategies (¶ 4). Through inquiry, students take ownership for their learning and develop

self-regulated learning skills that focus on the process of metacognition. In the end, students are generally better problem-solvers; this allows them to apply lessons learned to their jobs in the workplace or community in general.

However, in reviewing literature on the design and origins of PBL, it was evident that most variants of the PBL approach shared common elements, or threads, in the development and implementation of instructional activities. These common elements have been combined in a number of different steps as in the Maastricht method, or Barrows ten PBL essentials. However, Vernon D.T. & Blake (cited in Newman, 2003, p. 10) posits that "A review of the field found that the practice of PBL was described in a variety of ways that could be summarized as a complex mixture of general teaching philosophy, learning objectives and goals and faculty attitudes and values" (p. 10).

The following sections examine the nature of the congruent components that are integral in the development of a PBL experience.

Student-Centered

Paramount to the concept of PBL is where the focus and responsibility for learning resides. In didactic instruction, the instructor determines the content, delivers the content, leads the discussions, and summarizes key concepts (Weimer, 2002). In light of this, "students often memorize, forget, fail to apply or integrate knowledge, and resist further learning" (Camp, 1996, p. 2). It is the instructor who is actively involved in the process of learning. Furthermore, Weimer (2002) summarizes traditional methods by stating, "When it comes to who is working the hardest most days in class, we win, hands down" (p. 73). It is through statements such as this that we realize the need for a

redistribution of power in the classroom. The focus must move to the learners, empowering them with an environment that not only allows but expects them to take responsibility for their learning. After all, considering core constructivist conceptions, it is the learners and their experiences that must construct individual perceptions or concept of knowledge gained (Savery & Duffy, 1996).

The instructor's transition to new pedagogical methods is often one fraught with feelings of uncertainty, or fright at the risks that will need to be undertaken (Sebeck, 2003). Instructors have been at the center of the stage for so long that the thought of relinquishing control leaves them wondering where their responsibilities lie. Greening (1998) suggests that even though the responsibility for learning lies at the feet of the student, it does not mean that the instructor abandons them to sink or swim (¶ 29). On the contrary, in the PBL environment, the instructor plays a vital role in the success of the activity by playing the role of a facilitator, educational coach or, in PBL jargon, a tutor (Barrows, 1999; Greening, 1998; Rhem, 1998). The tutor's new role is to facilitate the PBL process. Instead of providing information, the tutor acts as a guide asking probing questions or challenging student thinking. In this new tutorial role, instructors do abandon the traditional lecture format for one that "guides students in the process of discovery, inquiry, analysis, and reporting" (Harper-Marinick, 2001, ¶ 2). As students adjust to this approach, the role of the tutor will diminish.

Ill-Structured Contextualized Problems

"The educational goal of problem-based learning environments is to motivate and engage students to explore open-ended, ill-structured problems that they will face in the

real world" (Dombrowski, 2002, ¶ 6). These ill-structured problems (Arambula-Greenfield, 1996; Greening, 1998) can be described with the following characteristics: complex, open-ended, present minimal information, and provide for various ways of reaching a solution (Harper-Marinick, 2001, ¶ 11). These messy, complex problems (Barrows, 1999) provide a stimulus for learning as well as the integration of knowledge that helps in the retention and recall of knowledge for use at later times.

Savoie and Hughes (1994) examine and identify two essential characteristics of problems that connect students to their worlds. First, the problem should be authentic (Barrows, 1999; Greening, 1998; Sebeck, 2003; Seifert & Simmons, 1997), or contextualized (Jones, 1996; Rhem, 1998) so that students can make the necessary connections to their lives. Secondly, its foundation must be based in, but not limited to, the subject matter of the curriculum (Savoie & Hughes, 1994). As a matter of fact, the PBL process is one that utilizes a multi-disciplinary approach to fully explore the scope of a problem as well as its solution (Seifert & Simmons, 1997).

The number of problems that are generated for a specific PBL activity may vary. Ram (1999) alludes to the use of one problem in the teaching of sophomore chemistry (p. 1122), whereas Arambula-Greenfield (1996) suggests the use of up to four problems for a college level science class (p. 28). Regardless of the number, the problems should be challenging in order to realize the goal of deeper and more meaningful learning.

Ram (1999) suggests that PBL problems should be constructed considering the following ideas: "(a) be based on compelling real world situations; (b) generate multiple hypotheses; (c) exercise problem-solving skills and require creative thinking; (d) require knowledge and skills that satisfy curricular objectives, and (e) be integrated and contain

components of more than one discipline." (p. 1123). Harper-Marinick (2001) contributes that "The most effective problems are complex, open-ended, present a minimal amount of information, and do not have one right solution or require only one way of reaching a solution" (¶ 11).

Multi-Disciplinary Focus

As stated previously, the process of solving a PBL problem often requires learners to utilize skills from various disciplines. Once again, this belief can be traced to PBL's constructivist roots. Barrows (1999) supports a multi-discipline approach; by integrating various curricula into the problem (Seifert & Simmons, 1997), the learner is able to examine the threads that tie their core curricula together in a meaningful way.

Self-Regulation and Collaboration

As already identified, there are several aspects of PBL, such as student ownership for learning (Jones, 1996), or the focus on contextualized problems (Evensen & Hmelo, 2000) that require higher-level thought (VanTassel-Baska, 1998) and challenge learners to acquire skills that will serve them throughout their entire life (Greening, 1998). However, another important component of PBL is the development of self-directed, yet collaborative learners (Ngeow & Kong, 2001).

In the initial stages of the PBL activity, learners are commonly placed into small collaborative working groups (Duch, 1995; Ngeow & Kong, 2001) that range anywhere from five students (Rhem, 1998; Savery & Duffy, 1996) to seven (Barrows, 1999) or even as high as ten (Harper-Marinick, 2001) per group. Woods (1996) states that the PBL group concept could even serve large, small, or even intermediate size groups (¶ 9).

However, a majority of the research on this component suggests that a small group is advantageous if not integral (e.g., Barrows, 1999; Evensen & Hmelo, 2000; Greening, 1998).

Pedersen (2003) posits that some educators question the necessity of collaboration in the PBL activity (p. 73). However, if added, this component can help to provide a positive effect through increased motivation (Dombrowski, 2002; Pedersen, 2003). Furthermore, if the problems of the PBL activity are correctly constructed and complex in nature, collaboration may be seen as a necessity by the students in order to successfully resolve the learning issues presented in the activity.

Moreover, the process of collaboration in the group setting assists the learners in identifying the prior knowledge of the collective whole. It is through the use of this prior knowledge that the learner is able to synthesize new information and create new understanding or cognition from their experiences (Seifert & Simmons, 1997). As the group discusses the problem, it generates hypotheses and identifies relevant facts from its collective prior knowledge; it often becomes apparent that they also lack many pieces of the problem that will be necessary to find a solution (Evensen & Hmelo, 2000). As this occurs through group discourse, learning issues (Duch, 1995; Savery & Duffy, 1996) emerge and the stage is set for a division of labor that leads to the component of self-directed learning.

As previously mentioned, the group collaborates to identify the breadth of their collective understanding of the problem by examining prior knowledge from previous experiences. It is also at this time that tentative hypotheses are formulated from this prior

knowledge (Savery & Duffy, 1996). Sebek (2003) writes that at this point, the focus is on "What do we know?" (¶ 4).

Through this process, gaps in the requisite knowledge for solving the problem are identified (Duch, 1995, Evensen & Hmelo, 2000). These gaps, or learning issues Blue, Elam, Fosson, & Bonaminio, 1998; Evensen & Hmelo, 2000; Savery & Duffy, 1996), are then divided into self-directed tasks by the members of the group who will need to explore a wide range of resources (Ngeow & Kong, 2001) in an effort to uncover the clues to the problem's resolution. Harper-Marinick (2001) implies that in this component, "The learning issues define the focus of the self-directed learning process" (¶ 8). Sebek (2003) supports this by labeling this stage with the questions of "What do we need to know, and what should we do?" (¶ 6).

However, depending upon the age of the learners, some instructors will provide initial starter resources; nonetheless, Blue et al. (1998) proposes that it is integral to have students utilize additional resources in their search for a solution. Examples of additional resources are as follows: consulting with experts, library resources, interviews, as well as electronic sources. Finally, Barrows (1999) adds observation and review of records to the list of necessary resources.

Reflection and Evaluation

At the culmination of the self-directed component, the learners reconvene to present and analyze the problem based upon what it has learned (Evensen & Hmelo, 2000), "integrating their new knowledge into the context of the problem" (Duch, 1995, ¶ 1). "At this point, it is important for the students to evaluate their own information and

that of the others in their group" (Evensen & Hmelo, 2000, p. 3). As new information is presented, the group must identify if new learning issues have arisen. If so, the process of identification and division of labor for self-directed learning can occur all over again. Duch (1995) describes this process of analyzing new information as integral for students to see learning as an ongoing process and that "there will always be learning issues to be explored" (¶ 1).

Closing Analysis

When the group feels that the learning issues have been sufficiently explored, it is necessary to complete a closing analysis of what has been learned as well as reflecting on the concepts and principles (Barrows, 1999) involved with the problem's solution. "Reflection involves focused thinking about learning during the learning process" (Ngeow & Kong, 2001, p. 3). Furthermore, Ngeow & Kong (2001) emphasize that the learner addresses two things through the process of reflection; the learner examines the newly acquired content and thinks about how this information can help to solve the problem at hand. Secondly, the learners ponder how they are doing as a self-directed learner, collaborator, or problem solver (p. 3). Through this metacognitive process, the learners assess strengths and weaknesses and examine how they are approaching the learning process (Parker, 2000) and how does this newly formed understanding help to prepare them for future problems. The use of concept maps at this stage assists in making connections between previous conceptions and the new understandings that have been formed (Barrows, 1999).

Assessment

Since PBL does not follow the traditional methodology for delivering and establishing a knowledge base (Evensen & Hmelo, 2000), the methods for conducting the assessment of learning must be appropriate and reflect the objectives of this instructional approach (Greening, 1998). Based upon constructivist principles and student construction of knowledge, Major & Palmer (2001) support this in stating that the pedagogical focus, "is primarily on learning to learn and less on mastery of a particular body of knowledge, traditional methods of course assessment such as examinations may not be very effective" (¶ 10).

However, Arambula-Greenfield (1996) states that assessment in non-traditional formats, such as PBL, may prove to be a challenging task (p. 28). Major & Palmer (2001) address this difficulty by suggesting that assessment should be authentic and "developed from realistic activities in the professional world" (p. 3).

The first type of recommended assessment relies on the learner themselves to conduct an honest self-assessment (Woods, 1996). Once again, tied to metacognition and reflection, the student must examine the successes and failures of their efforts in this environment in order to make progress in future endeavors. Barrows (1999) supports learner self-assessment in stating, "Self-assessment is a skill essential to effective independent learning" (¶ 4) which is a critical component of PBL as well as a goal of life-long learning (Duch, 1995).

Beyond self-evaluation, there are several other methods that can be used for the purpose of assessment. Similar to self-assessment would be the use of peer-evaluation (Barrows, 1999; Harper-Marinick, 2001). As part of the group process, individuals

understand that it is necessary for them to be a productive part of the generation of the problem solution. Peer evaluation allows group members to acknowledge the efforts and contributions made to the process by other members of the group.

Furthermore, Major & Palmer (2001) suggest other authentic assessment techniques (p.4). Since one of PBL's objectives is to connect learning to real world situations, the use of outside experts as evaluators of culminating exercises seems to be appropriate; culminating activities could be comprised of the following: presentations, written projects, portfolios, or capstone projects. Other assessments could be derived from focus groups, journals or activity logs, or content analysis of projects (Major & Palmer, 2001).

Pedagogical Consideration

As is often common with new educational approaches, instructors often take pieces of the methodology and adapt them by combining them with other methodologies (Herreid, 2003). Herreid (2003) explains that some faculty are not willing to totally give up their didactic ways of lecturing, so they initiate activities based on problems; others modify the strategy due to the size of their classes, or the fact that this approach needs to take place over a considerable period of time (p. 365).

Finally, Barrows (1999) emphasizes that "problem-based learning should not be episodic, added on to or mixed in with more traditional, didactic, teacher-directed, passive, memorization based and lecture based methods" (¶ 10). His statement is based on the necessity of the core components that have been previously discussed. PBL is based on actively involved students who are responsible for their own learning. The use

of any type of teacher-directed approach diminishes the approach and confuses both learner and instructor (Barrows, 1999). Therefore, PBL should be thought of as a curricular commitment and should be supported in its pure sense so that its integrity is kept in tact.

The Role of Complex Open Ended Problems

The creation of the PBL problem is the most important step in this instructional activity. If crafted correctly, it will "engage students' interest, and motivate them to probe for deeper understanding of the concepts being introduced" (Duch, 1995, ¶ 3). However, some instructors may be deterred from PBL due to the fact that creating problems can be time intensive and challenging (Arambula-Greenfield, 1996). However, White (1995) writes that the challenge can prove to be stimulating for the instructor as they will need to craft questions that "pique students' curiosity, require analysis, and generally encourage learning" (p. 1).

In planning for writing the PBL problem, the process must begin with the understanding that the finished product should be ill-structured (Barrows, 1999; Sebek, 2003) with a context that relates to real world situations (Ngeow & Kong, 2001). Building upon constructivist ideology, the question should be inquiry based and open-ended so that students are encouraged to find multiple solutions through the discussion process (Harper-Marinick, 2001). Nonetheless, the problem will need to be authentic and rooted in the curriculum (Savoie & Hughes, 1994) while drawing on prior knowledge.

Since the students will participate in collaborative discussion and self-regulated explorations, the problem should consider the need for collaboration, especially in the

asynchronous environment where it is necessary for meaningful discourse among students (Palloff & Pratt, 2003).

The Role of the Tutor

Schwartz, Stewart, and Webb (2002) define classical problem-based learning as having a student-centered focus with a goal of establishing self-directed learning skills. "Although the purpose of using problems in PBL is to stimulate learning of information and concepts brought out by the problems, PBL teaches both a method of approaching and an attitude towards problem solving" (p. 2). It is through the use of problems in the PBL method that leads to a need for the instructor to reassess their role in the learning process.

In the traditional didactic classroom, the instructor is viewed as the expert that disseminates knowledge to the passive learner. However, in PBL, the role of the instructor changes to that of a guide or facilitator (Delisle, 1997, p. 17). It is through the assistance provided by the tutor that the group stays focused. Kamin et al. (1999) support this in identifying assuring a meaningful discussion and cohesiveness as one of the vital roles of the tutor. "The tutor must ask about student reasoning, synthesize discussion points, and encourage students to discuss the case with each other rather than to simply report on it" (p. 5). In addition, the tutor poses high level questions to the group for the purpose of stimulating critical thinking that is necessary to solve the problem being studied. The skill of tutoring is one that often requires training and a level of content knowledge necessary for problem resolution (Andersen, 1996, p. 12).

Barrows (1994) posits that the problem-based learning method relies on the skills and ability of the tutor. However, when looking at current literature on tutor knowledge, Savin-Baden and Major (2004) suggest that a facilitators role is somewhat ambiguous with the question of what constitutes a clear role giving way to an understanding of the boundaries that exist between teaching and facilitation (p. 27). “Facilitation is not about procedures or rules, but about creating different possibilities for learning” (Savin-Baden & Major, 2004, p. 27).

Heron (1989) attempts to address the ambiguity of a facilitator’s role by proposing three modes for helping novice facilitators to consider how they operate (p. 96):

1. The hierarchical mode: Facilitators direct the learning process and exercise their power over it. Facilitators manage objectives, challenge resistances, team feelings, and structure for learning.
2. The cooperative mode: Facilitators share their power over learning with the team enabling them to become more self-directed. Facilitators prompt team members to assess how they will learn and manage confrontation. They share their own views, but the team determines the direction.
3. The autonomous mode: Facilitators respect the total autonomy of the team. The team has total freedom to do things their own way without assistance or reminders. Facilitators create the conditions for this self-directed approach.

In considering the aforementioned modes of facilitation, they still remain broad in nature and scope with considerable latitude in how the facilitator operates. Heron (1989) also suggests that facilitators understand the necessity of using prior experience, also

being a learner in the process, listening to the teams concerns, being responsive, and sharing an appreciation for associated risks (p. 97).

Online Problem-Based Learning

As established in the previous section, problem-based learning has been in existence for several decades and focuses on the constructivist principles that learning is constructed by participants as they explore complex, open-ended, real world problems. Traditionally taught in the face-to-face environment, PBL is now being delivered through the Internet due to an increased interest in creating new and flexible learning opportunities that reach a diverse group of learners. However, PBL delivered online is in its infancy; therefore, the amount of literature available for this approach is limited (Cheaney & Ingerbritsen, 2005).

Online PBL and Medical Sciences

One of the earliest attempts at using the problem-based learning approach in an online format occurred in the medical sciences. Kamin et al. (1999) designed a hybrid web/CD-ROM course that addressed issues of pediatric curriculum. This innovative use of technology for teaching provided students with cases that were delivered through digital video and presented scenarios in a realistic fashion. Given the acronym L.I.V.E., or Learning through Interactive Video Education, the PBL activities provided students the ability to study the real world behaviors of physicians, learning professional behaviors through examining the modeled actions.

Students were also engaged in discussing cases through the use of asynchronous forums. Through interactive discussion boards, students are provided an opportunity for

discussion, reflection, and collaboration while critically evaluating the learning issues (Oliver & Omari, 1999). Kamin et al. (1999) concluded that using online PBL cases assisted students in "collaborating, solving clinical problems, and pursuing self-directed learning over the Internet" (p. 3).

Minasian-Batmanian (2002) further explains the benefits of interactive discussion through asynchronous means. In an undergraduate Oncology class at the University of Sydney, students participated in PBL scenarios and not only engaged in discussions with their peers, but were provided specific content knowledge, as well as clinical management, through discussions with experts in the field. Once again, an exit survey of the students involved in this experience found the interactive collaboration to be very beneficial in the learning process.

In an attempt to examine the online experience, Valaitis, Sword, Jones, and Hodges (2005) developed a qualitative study to explore the overall picture of health sciences students' perceptions of their experiences while participating in PBL in the virtual environment. The study focused on students' views about learning and also the group processes that were necessary for participating in PBL online.

Valaitis et al. (2005) explain that the participants of this study were very experienced in the PBL process, but were novices where online learning was concerned. The study's PBL format followed the six step process, designed by Howard Barrow's at McMasters University. Students were comfortable with this process; therefore, issues with PBL itself were minimized. In order to deal with the issue of online learning, all participants, students and tutors, received introductory training on the LMS; tutors received additional training in the area of online teaching and learning.

Several groups participated in the online PBL study and researchers collected qualitative data through individual reflections by students, as well as focus group interviews. Analysis was conducted through the use of NVivo, a qualitative data analysis software program. Results of the data analysis suggest that PBL can be successfully implemented in an online format (Valaitis et al., 2005, p. 250). Analysis and synthesis of information was reported as being enhanced due to the use of rich media for presenting the PBL cases which also allowed for the possibility for interdisciplinary learning.

Students also reported positively to the flexibility that the online sessions provided. Use of asynchronous and synchronous forums allowed student activities to be planned around the busy schedules of their medical program.

Online PBL and Education

PBL originated in traditional medical science programs in an effort to achieve greater competence in the practical skills of the students that were studying to enter various medical professions. In time, other professions, such as education, biology, and business, followed the lead of designs that were generated by the medical field. Even though evidence of online PBL is limited in scope and volume, this trend appears to have occurred once again as PBL moves to the online format in the field of education.

As teachers begin to make the transition from traditional instructional methods towards using online PBL, they must consider what changes will occur for both the students and instructors as well. Talpin (2000) examines the experiences of educators who are considered novices in this transitional process. One aspect that must be monitored from the beginning is the self-regulated aspect of student learning that is

required in PBL. Instructors must be sensitive to students' abilities to identify and appraise resources on their own. Educators must also keep an eye on the group aspect of the PBL process. Online PBL provides flexibility for students, but it also requires them to schedule times to meet synchronously, or communicate asynchronously, in order to identify learning issues and develop a final problem solution. Other factors that educators should be aware of are cooperative communication, interpersonal relationships, student motivation, timeliness, and technical problems.

Even when instructors and students are technologically proficient and have an understanding of the PBL process, they must learn to successfully negotiate the process of collaborative group work in the online format. Paz Dennen (2000) discusses the use of asynchronous conferencing to mediate the group process in the PBL scenario. In this study, pre-service teachers worked collaboratively to solve three different problems that revolved around educational computing and task structure; the problems also focused on the use of web-based collaborative tools to help the pre-service teachers feel as if they are part of the community of teachers.

The amount of task structuring provided varied from the first problem to the third problem with the task structure increasing as the problems were released to the students. Results received from the students demonstrated that they felt the increased task structuring helped with extrinsic motivation and task clarity. Task structuring was also deemed as important in helping students to understand the process of problem-solving.

Furthermore, another study conducted by Park and Cramer (2004), and funded through the U. S. Department of Education, elicits the need to consider educator perceptions of pedagogical beliefs where technology-enhanced PBL is concerned.

Barriers and support issues were also examined with a primary focus on how technology supports the implementation of PBL.

Results of the qualitative data suggested that teachers gained an understanding of how their role changed in this new environment and made connections with how PBL could be utilized in the instructional setting. Participants also reported that they felt more comfortable using the necessary technology for teaching with this instructional method. Barriers were identified as time allocation and solving technical issues. Both of these issues led some participants to feel overwhelmed. Professional development was suggested as a way to address and remove such barriers.

Technology-Enhanced Learning

Technology in this section will refer mainly to computing and Internet communications. In his book *Technology and Learning*, Pea (2000) breaks these two areas into applications as diverse as programming, word processing, games, simulations, multimedia composition, performance assessment, and distance education (p. xv). However, educational technology from the 1920's on included radio, television, filmstrips and devices such as the overhead projector (Roblyer & Edwards, 2000, p. 5).

Technology in Education

The Report to the President on the Use of Technology to Strengthen K-12 Education in the United States was presented in March of 1997. A summary of the findings found the following:

> While information technologies have had an enormous impact within America's offices, factories and stores over the past several decades, our country's K-12

> educational system has thus far been only minimally affected by the information revolution. Although it is not possible to fully characterize the optimal ways in which computing and networking technologies might be used, the Panel believes that such technologies have the potential to transform our schools in important ways, and finds ample justification for the immediate and widespread incorporation of such technologies within all of our nation's elementary and secondary schools. (p. 3)

To better understand the current situation with respect to integrating technology into today's classrooms, it is important to revisit the path that technology has taken since its arrival on the educational scene in the late 1970's. From its inception, the role that technology has played in the classroom has varied and evolved and will most likely continue to do so into the future.

Learning with the first microcomputers occurred in the 1970's (Oberlander, 2002) with the advent of computer assisted instruction (CAI). Mainly in the form of drill-and-practice, the programs took on the form of electronic ditto sheets (Jonassen, 2000). Designed based on behaviorist principles students entered answers to questions and received immediate feedback; rewards often included sounds or smiley faces. The rationale for this type of activity was to acquire lower levels of knowledge through automaticity (Merrill et al., 1986) in order to reach the complex, higher order, problem-solving skills. However, Jonassen (2000) reports that this use of technology simply replicated rote learning; ironically, most administrators viewed this activity in and of itself to be advanced and innovative (p. 5).

The use and development of CAI grew through the 1970's and into the 1980's. Development and marketing efforts were conducted by companies such as the Computer Curriculum Corporation (CCC), IBM, and Control Data Corporation (CDC) who dominated the educational computing arena (Roblyer & Edwards, 2000). Through use of mainframes and minicomputers, higher level languages and systems were created such as Coursewriter and PLATO, or Programmed Logic for Automatic Teaching Operations. PLATO provided a tutorial environment that was believed to have the potential to revolutionize the classroom; however, these instructional systems never fulfilled their expectations for delivering higher level learning achievements.

Promoting learning from a student-centered perspective, Papert (1980) focused on programming as an opportunity for students to learn at a higher level through discovery environments called Microworlds. Using the programming language LOGO, students learned geometric concepts by writing commands that enabled a "turtle" to draw the desired figures. Roblyer and Edwards (2000) cite that an important outcome of the LOGO movement was that it challenged traditional instructional methods such as drill-and-practice and tutorials (p. 10). Papert's philosophy revolved around the idea that child-directed exploration was better than teacher-directed instruction. This idea appears to have been ahead of its time as Oberlander (2002) reports that delivery of curriculum was not the major focus of this time period where educational computing was concerned (p. 15).

The studies in the 1990's (Education Commission of the States, 1999; Shohet, 1996; Vanesco, 1990) focused more on the concept of computer literacy as programming waned in popularity. However, computer literacy proved to be the main focus at the

higher grade levels whereas the elementary grades still utilized drill-and-practices and instructional software (Becker, 1994). Later in the decade, instructional computing was delivered in the form of CD-ROMs and the advent of the Internet. Becker (2000) explains that the Information Age would lead schools to rethink how technology would be used in the classroom (p. 14). Even so, Internet access in student homes was at a limited level at this time and would be a factor in the speed at which new technological approaches would be implemented; this would not occur until the beginning of the new millennium with home access to the Internet exploding to record numbers.

As schools begin to move forward in the new millennium, a significant investment has been made in hardware and infrastructure; the crucial challenge now is to use these technological resources to realize their full potential. Some forms of CAI still exist and have proven to be beneficial in low achieving populations (Quinn & Quinn, 2002), but the current focus in educational technology is to find ways to achieve educational objectives while providing an atmosphere for students to solve "real world" problems that require critical thinking and integration of multiple curricular areas (Pea, 2000).

Paramount to achieving this goal, Pea (2000) cites that pedagogical strategies should move away from the unidirectional transfer of content from teacher to student; the new approach should consider "a new constructivist approach in which teachers concentrate instead on helping their students to actively construct their own knowledge bases and skill sets" (p. 5). However, few schools have achieved this objective due to the fact that technology must be viewed as a partner in the learning process, a vital thread in all curricula that is used as a tool to construct key understandings (Jonassen, 2000; Pea,

2000). This change in paradigm would require teachers to rethink their roles within technology-rich constructivist environments.

Constructivist Professional Development for Technology Education

According to the Report to the President on the Use of Technology (1997), K-12 teachers receive very little administrative support, pedagogical training, or technical assistance in planning for and utilizing technology effectively (p. 27). A major factor in this problem is that most school technology budgets only allocate 15 percent to the area of professional development where 30 percent would be more appropriate (Pea, 2000). In order to realize the potential of a school's financial investment, appropriate funds should be allocated to address professional development (Dick, 2005; Grant, 2000). Another barrier is that most of the allocated funds focus on training teachers how to use hardware instead of how to use the tools as partners in the learning process.

As society moves into the information age, teacher education programs will need to provide instruction that focuses on the integration of technology into the curriculum (Marra, 2004). Therefore, it will be necessary to build and deliver effective professional development opportunities for today's pre-service and in-service teachers.

Many models of professional development have existed in the past. For example, models by Grandy, Strickland, Sammons, and Strickland (2001) and Lambert (2001), focus on subject-specific technology integration; these models improved teacher's attitudes toward technology use, but lacked a multi-disciplinary focus and use of real world contexts. Other models, by Franklin, Duran, and Kariuki (2001) and Garthwait (2001), utilize the concept of graduate school mentors to support the technology

integration efforts of K-6 elementary teachers; most teachers are able to understand the value in using technology, but lack the vision to effectively integrate it into their daily classroom activities. Results of mentoring strategies suggest that this approach effectively helps teachers to improve their understanding of technology integration.

Nevertheless, Dick (2005) cites that in order to design successful professional development opportunities, it is advisable to focus on a constructivist model (p. 31). However, previous professional development approaches that have focused on constructivism have not been common (Jonassen, Howland, Moore, & Marra, 2002). Unlike models that focus on computer literacy, constructivist approaches attempt to go beyond basic technology competency and provide for integration to occur in settings that account for real world implementations (Clark & Lowther, 2001).

Furthermore, examples of constructivist models can be found in Torp and Sage's (1998) problem-based learning in K-12 education and Krajcik, Czserniak, and Berger's project-based learning for science instruction. Both of these instructional strategies are student-centered and focus on engaging students in real world, authentic tasks. In essence, these models empower students to construct their own knowledge and skills while using technology as a partner in the learning process.

As far as conducting professional development opportunities for pre-service and in-service teachers, Lehman, Ertmer, Keck, and Steele (2001) suggest that problem-based methods should be considered when the goal is to develop effective technology integration (p. 153). Evidence of this approach can be seen in the Tech-Know-Build grant project between Indianapolis Public Schools, Indiana Community Schools, and Purdue University. In this project, teachers were given the incentive to participate by being

rewarded with a laptop computer. In return the teachers would have to participate in a professional development course that was delivered by Purdue University. The first experience focused on technology competency and basic computer applications. However, this experience was followed by instruction that focused on technology integration through problem-based learning. A modeling activity was developed and the goal of the activity was for teachers to see how technology could be utilized in this instructional approach as a supporting tool. The result of this face-to-face model suggests that the model was received in a positive manner; the majority of teachers reported that the model helped them not only to integrate technology, but to utilize it effectively in a problem-based context.

Another example of a constructivist model for professional development can be found in Williams, Burns, and Oostenink's (2001) Engaging Learners with Technology. Based on using technologies in meaningful and authentic ways, this model is unique in that it focuses not only on teachers, but includes administrator's and curriculum specialists in the professional development process. The 5-step process requires the participants to assume the role of students as they explore engaging learning environments that involve problem-solving and collaboration with technology. The model consists of the following steps: curriculum planning, project focus, project planning, project implementation, and completion. Of the models explored, this model places a significant value on the planning process including evaluating the curricular framework, standards, and benchmarks.

Based upon the social constructivist paradigm, Clark and Lowther (2001) present a model that utilizes cognitive apprenticeship in an effort to prepare pre-service teachers

to plan for the use of technology in instruction (p. 50). In order to succeed in a technology-rich environment, teachers must be able to plan for the meaningful use of technology and how these skills might be applied in the real world setting. In order to achieve this, modeling, coaching, scaffolding, articulation, reflection, and exploration were incorporated into the model. The model was also aligned with the National Educational Technology Standards (NETS) that was designed by the International Society for Technology in Education (ISTE). This pairing provided a basis for constructing a realistic environment that encourages the use of technology as a partner in the learning process.

The study consisted of a treatment and control group that examined beliefs/concerns, perceived ability, and effective design of lessons; results of the study suggest that there was no significant difference where perceived ability was concerned, but the treatment group was determined to have better lesson designs that included the use of meaningful and interesting problems. This model is similar to Williams, Burns, and Oostenink's model in that it requires the participants to take on the role of students, as well as a focus on modeling of appropriate technology usage.

Moreover, Rogers (2000) cites that a focus on technology integration is important to consider when training pre-service and in-service teachers at both the undergraduate and graduate levels (p. 19). Gibson (2001) supports this premise in the study Ensuring Technology Leaders in Classrooms and Beyond. Considering that many teachers gained their pedagogical instruction as undergraduates prior to technology's emergence as an important instructional component, professional development opportunities are imperative to ensure a cohesive integration effort.

The model, based on constructivist epistemology, focuses on acquiring technological competency, as well as requiring students to demonstrate effective integration and use of those skills. Initially focusing on gaining basic application knowledge, the approach moves to action research and reflection of practice that centers on projects for improving instruction at the classroom level all the way through to the district level. The constructivist projects also integrate the ISTE standards as a way of focusing the integration effort; this aspect is very similar to Clark and Lowther's (2001) cognitive apprenticeship model. Conclusions drawn from this approach suggest that integration has been embraced by the participating teachers and helped to encourage integration at the school and district levels.

Conclusion

In order for today's teachers to fully leverage the financial expenditures that district's have placed on technology, they must be trained to effectively utilize available technologies as partners in the learning process; this responsibility will fall largely on institutions of higher education as they provide opportunities for professional development (Pea, 2000).

The professional development opportunities that are created for technology integration should focus on skills and pedagogical understandings that enable teachers to perform effectively in technology-rich learning environments. Development should go beyond what traditional models have focused on, the acquisition of application skills and computer literacy; new models would benefit from a constructivist approach that utilizes real world scenarios and requires students to take ownership for their own learning.

Problem-based learning appears to be an approach that would meet the needs of moving professional development in the desired direction. Through the use of complex, open-ended problems, teachers would be required to identify appropriate technology tools, ensure that they possess the necessary basic competencies, and then plan for the development of multidisciplinary activities that place the learning in the context of an authentic setting.

Problem-based learning has been in existence for many years. However, most evidence of this instructional method has occurred in the traditional face-to-face classroom. As approaches for professional development are created, problem-based learning should be considered and opportunities designed for online delivery. The daily responsibilities of today's teachers are varied and require a great deal of time and dedication. Providing online problem-based learning opportunities not only requires the use of technology in the delivery of instruction, but more importantly provides for teachers to acquire technological skills while considering real world scenarios that they face each and everyday.

Finally, it should be noted that technology continues to change at dynamic rates. Therefore, professional development for pre-service and in-service teachers should be provided on a continuing basis.

CHAPTER 3. METHODOLOGY

The methodology for this research utilizes qualitative principles and case study design. The data was gathered from January 2007 through April 2007. This time period was selected because it provided the opportunity to gather data in the higher education setting for an entire semester. This study was designed to capture students' attempts to effectively achieve technological competency while planning for successful integration in the real world setting. Dietrich (2003) describes integration as "making pedagogical and curricular changes to include technology" (p. 66). For the purpose of this study, implementation was based on teachers' aspirations to effectively integrate technology into their planning practices.

This study will examine the following research questions:

1. In what ways does the experience of learning through an online PBL model affect teachers' perceptions of integrating technology? This question addresses the following sub-questions:
    a. What do teachers perceive as the pros and cons of learning technology integration through online PBL?
    b. What do teachers perceive as the greatest challenges faced in learning technology integration through online PBL?

2. In what ways does the experience of learning through an online PBL model affect teachers' planning of technology integration? This question addresses the following sub-questions:
    c. Does the experience of learning integration of technology through online PBL help teachers to plan activities that reflect "real world" environments?
    d. Does the experience of learning integration of technology through online PBL help teachers to plan activities that utilize technology as a partner in the learning process?
    e. Does the experience of learning integration of technology through online PBL help teachers to plan multi-disciplinary activities?
3. In what ways do teachers' perceptions of learning technology integration through an online PBL model vary among the participants along variables such as gender, age, level of technology expertise, pre-service or in-service status, and teaching experience in years?
4. What unexpected perceptions and planning practices emerge from learning technology integration through an online PBL model?

Research Design

This exploratory qualitative research study was conducted in the online course, Introduction to Computers and Technology in Education (ED568) which is a required course in the Computers and Technology in Education master's degree program at a

private, coeducational, comprehensive liberal arts university located in the Eastern United States.

ED568 is an introductory Education Department course that focuses on assisting teachers in the process of learning technology applications and how to utilize them in their classrooms. In order to provide clarity, Figure 1 illustrates a broad conceptualization of the procedure that was followed in this study.

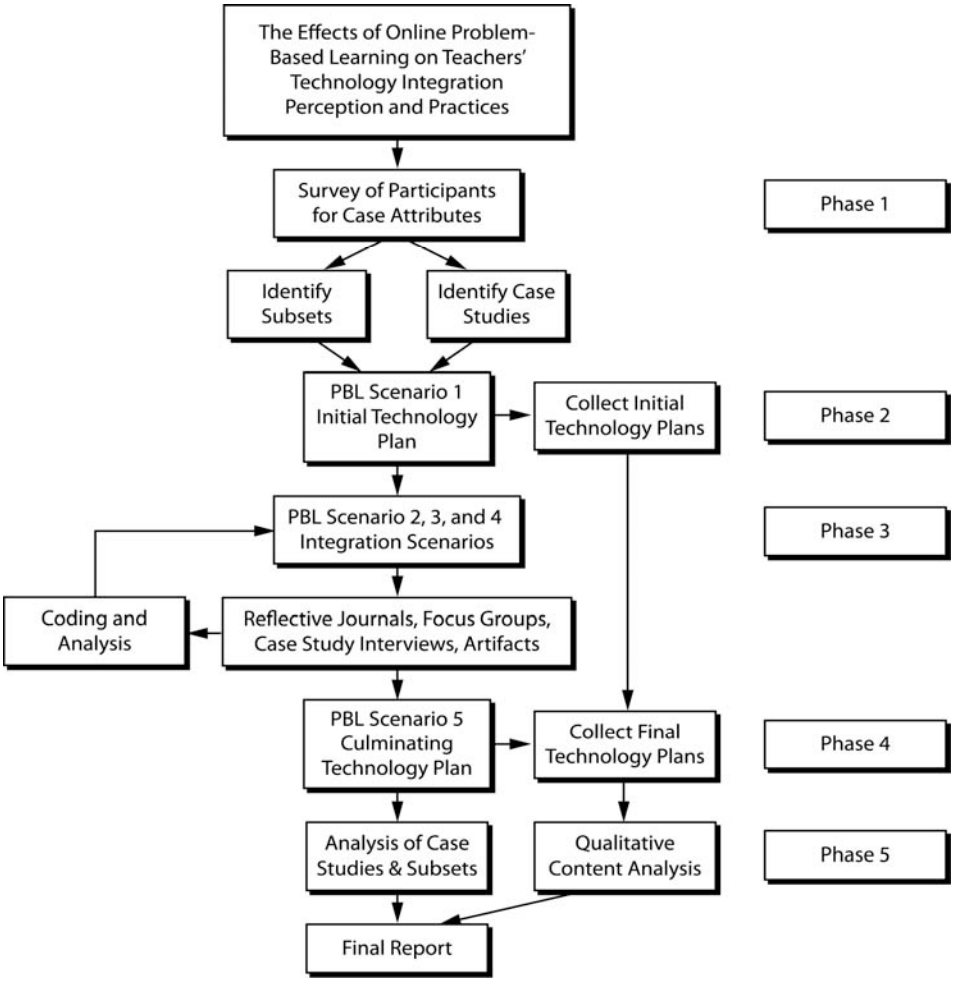

Figure 1. Broad conceptualization of the research design and procedures followed including all phases of the study: phase 1, phase 2, phase 3, phase 4, and phase 5.

At the beginning of this course, students completed a survey that was used to establish PBL groups as well as help to identify subsets of participants. Table 1 illustrates the matrix for developing the study's PBL groups which were determined by teaching level: elementary, middle school, or high school.

Table 1.

PBL Group Formation

	Teaching Status	
PBL Group Levels	Pre-Service	In-Service
Elementary	Elementary Pre-Service	Elementary In-Service
Middle School	Middle School Pre-Service	Middle School In-Service
High School	High School Pre-Service	High School In-Service

An attempt to balance group participants was determined by use of pre-service and in-service distinction. Considering that the study's sample was determined by the enrollments of course participants, an identical balance could not be guaranteed. After PBL groups were established, they remained the same throughout the study for each scenario.

Figure 2 illustrates how this survey was also used to establish subsets, or cases for this study. Each participant in the study was considered a case. Using descriptive coding, cases were determined by responses that describe specific attributes, such as instructional level, teaching status, gender, technological experience, and pedagogical level. Instructional level refers to the participants preferred teaching level: elementary, middle

school, or high school. Teaching status is described as pre-service, not currently practicing, or in-service for a practicing

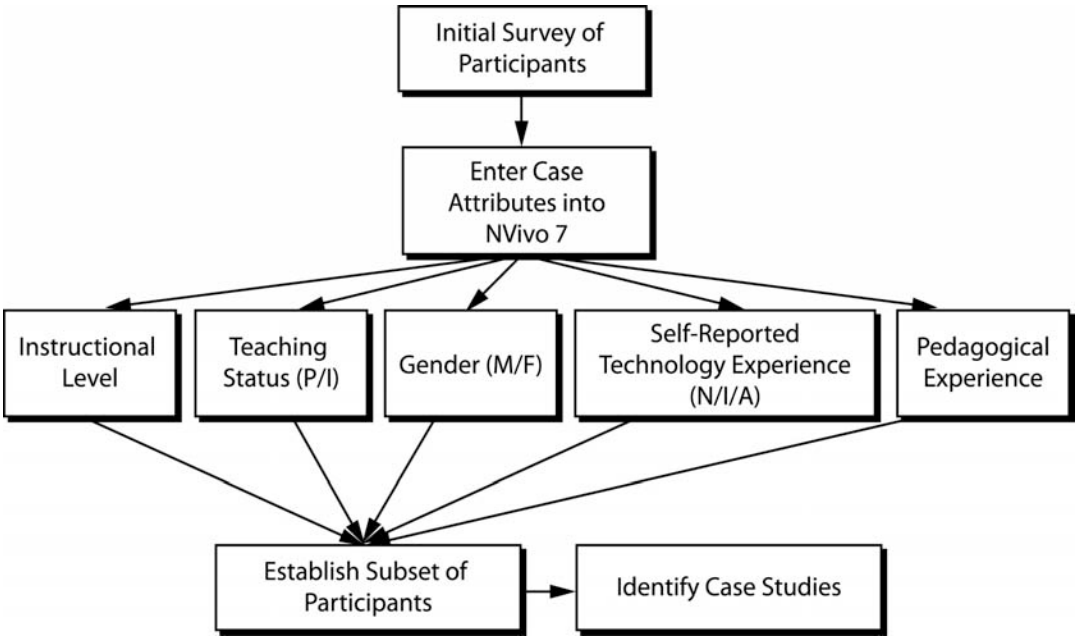

Figure 2. Initial paths taken in phase 1 where the case attributes are collected and used to establish subsets of participants and case studies.

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participant. Gender refers to male and female participants. Technological experience describes the level of technological expertise as reported by the participant. This was determined by a self-reporting tool that asked participants to examine their current skill level. The self-reporting tool can be found in the Appendix B. Pedagogical level was determined by examining the number of years that the participant has practiced in the classroom. In this case, the first category was determined as pre-service through five years. The second and third categories were established using teachers that have classroom experience of five to 15 years and finally 16 years and above. NVivo 7 provided the ability to electronically sort cases by case attributes, which allows subsets to

be analyzed in conjunction with nodes that have been coded. Once again, considering that the sample was determined by enrollments, cases could not be determined before the study.

Data from the initial survey was also used to select four to six participants as individual case studies. The participants were selected based upon varying characteristics such as a participant that has strong pedagogical experience, but weak technology skills, or a participant that has minimal pedagogical experience, but strong technology skills. The participants were followed throughout the study and data was collected from the following sources: reflective journals, focus groups, case study interviews, artifacts, and evidence from the qualitative content analysis of the required technology plans.

The first course assignment required students to develop a technology plan that focused on integrating technology into curricular areas. They collaborated in small groups and submitted their technology plan, as well as instructional samples. This initial technology plan was constructed before any PBL instruction began. Upon completion, the plans were imported into NVivo as artifacts and later used for qualitative content analysis.

Following the construction of the initial technology plan, students participated in a sequence of scenarios that utilize an online model for PBL that is adapted from Howard Barrow's original steps for conducting PBL. The iterative process that was used for scenarios two through four is illustrated in Figure 3. Through scenarios two through four, students were required to consider possible solutions for integrating technology into their planning and instructional practices. As students worked in PBL groups to develop

scenario solutions, they reflected on the pros, cons, and challenges of learning technology integration in this manner.

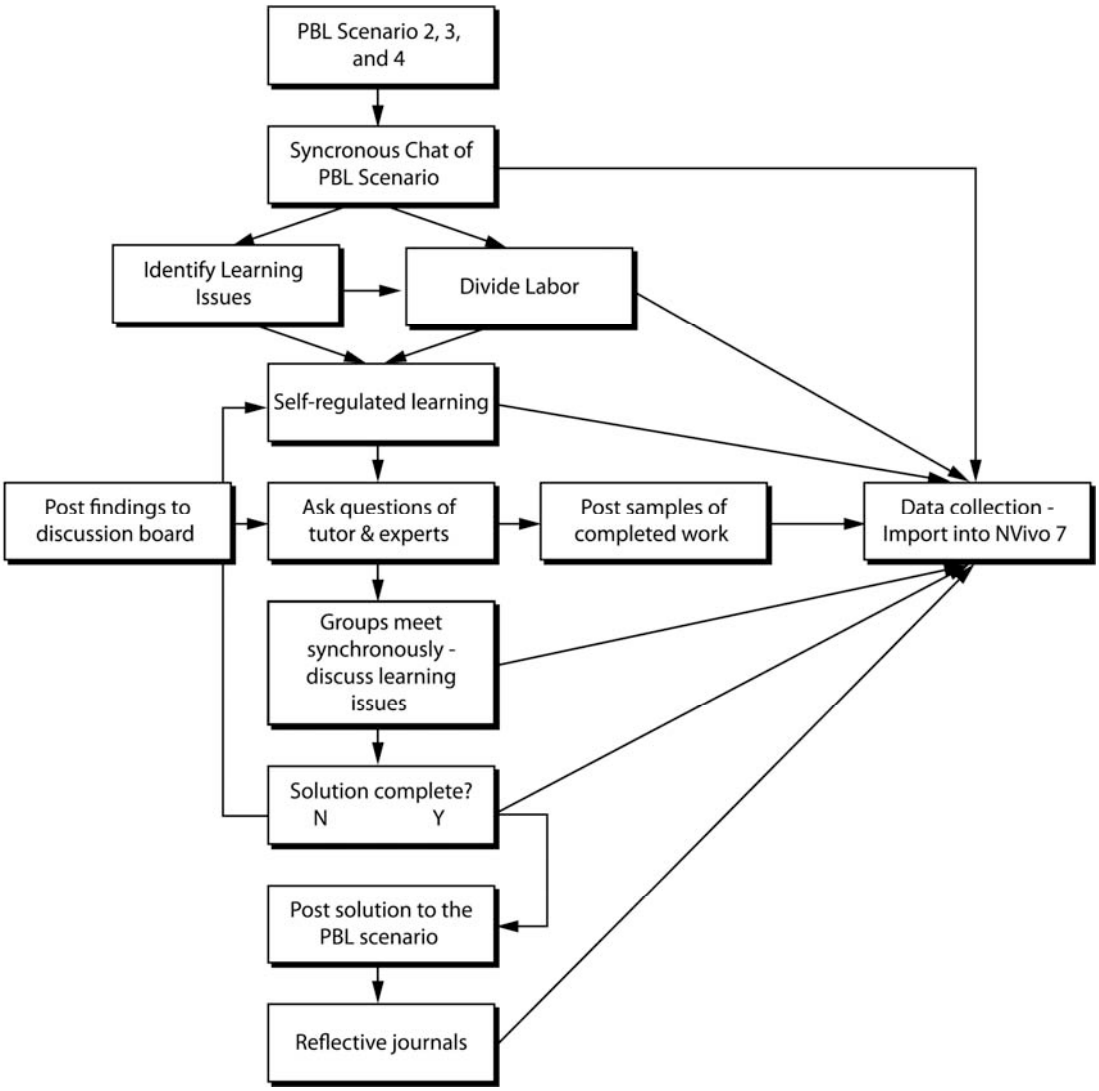

Figure 3. Initial path of the iterative process that was followed for conducting the online PBL scenarios and the data collection process.

During the course of the study, students wrote reflective journals, participated in focus groups, and case study interviews. The reflective journals focused on the participants' experience of learning technology integration and planning through online PBL; the focusing questions asked students to reflect on the positive, negative, and challenging experiences of the PBL scenario that they just completed in relation to learning technology integration. As student data was collected, it was be entered into NVivo 7 for coding and analysis. The constant comparative method (Glaser & Strauss, 1967) for data analysis was utilized.

After PBL scenarios one through four were completed, the final PBL activity focused on revisiting the first PBL scenario. PBL Groups were required to complete new technology plans that once again focused on integrating technology into their curricular areas. The new technology plan was compared to the original technology plan through qualitative content analysis (Mayring, 2000). Through this technique, evidence of concepts that demonstrate the effects of the online PBL model was analyzed for changes in planning practices.

PBL Environment of the Study

This section presents the PBL activities conducted throughout this qualitative study. As stated in the research design, participants completed a pre-technology plan at the beginning of the study. In an effort to acclimate participants to the PBL process, study activities began with a practice PBL scenario; following the practice scenario, participants were presented with PBL scenarios two through four. The study culminated with the completion of the post technology plan.

The beginning of the study was dedicated to the acclimatization of the students to their online course and gaining an understanding of the necessary requirements that were provided through the syllabus. During this week, students also completed the Participant Attribute Survey and the Self-Report on Technology Level, which was used for group formation prior to the beginning of the online PBL activities. As in most online courses, students posted personal introductions explaining their current instructional status, views on technology use, and desires for personal growth by the end of the course. This step initially marked an attempt at developing a sense of community amongst the learners.

Pre-PBL Technology Plan

Following the initial week, participants were assigned to groups based on the results of the Participant Attribute Survey and Self Report on Technology. The first task spanned a time period of three weeks and required the newly formed groups to develop a technology plan that was based on their perceptions of how technology should be used; this assignment would provide a "snapshot," or base for the qualitative content analysis that would be conducted after the final technology plan was completed at the end of the study. The assignment, Creation of a Technology Plan, presented the participants with the following task:

> This assignment requires you to work collaboratively for the next three weeks to create a technology plan for a curricular area. Considering that this is the beginning of the course, you may need to struggle with your group mates while creating this initial attempt at a plan. However, don't panic! This will provide us with a base understanding of your beliefs on

how technology should be integrated into curricular areas. This assignment is very open-ended (ED568 Instructor, January 28, 2007).

Since students would not be introduced to the online PBL method until the following unit, the aforementioned task was not presented in the form of a problem scenario.

Additionally during this time period, students engaged in an online discussion that revolved around "What is learning?" Epistemological perspectives such as behaviorism, cognitivism, and constructivism were examined in light of theoretical underpinnings as well as student's perceptions and experiences during their own educations. Appendix D provides a description of this activity in greater detail.

Online PBL Practice Scenario

The following unit marked the beginning of the participants' introduction to PBL. Participants were required to read articles that explained the pedagogical premise of this instructional method as well as view video tutorials that explained how the PBL process would work online within the learning management system. In order to ensure that the participants understood how the PBL process would be conducted online, a sample problem was constructed and posted in the Assignments Folder:

> You are sitting with your grade-level teammates enjoying your lunch when the English/Language Arts coordinator, Mrs. Wilson stops at your table. She initiates a discussion about her quest to develop a new curriculum that integrates technology into this area. She values the collective experience of your team and asks for ideas on where to begin.

She would like to start with word processing and the Internet, but doesn't want teachers to simply have their students sit down and type or perform random Internet searches. Your team agrees that there are effective ways to use word processing for creating activities that are engaging as well as using the Internet to support instruction. At this point Mrs. Wilson asks for the assistance of your team. She asks you if you could help her with the following tasks:

1. Create a list of as many ways that a word processor or Internet websites could be used for teaching.
2. How could word processors or Internet Sites be used to create activities that incorporate multiple disciplines?
3. Could the activities include topics from a real-world perspective?
4. She asks if your group could create a document that addresses the topics above and send it to her for review (ED568 Instructor, February 11, 2007).

Through use of this problem scenario, the instructor, or tutor in PBL, was able to help familiarize participants on the mechanics of the online PBL structure. PBL Group Areas were accessed and exploration commenced with respect to the discussion forums that would be utilized for communications purposes amongst group members. Also at this time, participants conducted initial test conferences with Voice over IP (VOIP) software; this enabled participants to discuss the initial problem and identify learning issues by speaking to each other through use of headsets attached to their respective computers.

Online PBL Scenario 1

Unit 4 marked the beginning of the study's online PBL scenarios. At this particular juncture in the study, participants had discussed the theoretical underpinnings of PBL and had successfully identified the necessary steps to conduct PBL in the online format. The problem scenario assigned in this unit centered on a science curriculum topic, but support from multiple disciplines was encouraged. The scenario, which presented the discovery of an alien creature, was designed to address curricular content related to our solar system as well as the topic of space exploration. The problem was presented as follows:

> The science teacher, Mr. Ford, has sent out a school-wide email requesting the assistance of any adventurous teachers that are willing to embark upon a challenging fun-filled journey. He is developing an exciting science activity that revolves around students exploring a problem that has been developed for his current unit. This unit requires students to gain an acceptable understanding of the solar system and its characteristics. However, Mr. Ford would like to support all of the subject areas that his students are currently studying (i.e. English/Language Arts, History, Math, Art, etc.) by including them in the project.
>
> A group of excited teachers respond to Mr. Ford's email and agree to meet with him to discuss the project. At the meeting, the group is presented with the following problem that the students will encounter:
>
> A strange unidentified alien creature has appeared in the student's community. The Park Side Police Department has brought the creature to

your school because Mr. Ford has a reputation for being an incredibly bright science teacher. His help has been requested in identifying what the creature is and finding out its origin. After careful examination, the only thing that Mr. Ford is sure of is that the alien creature is not from this world. Mr. Ford, never having seen such a creature, asks for the assistance of his students to act as solar system detectives. He realizes that they will need to research the planets in the solar system as well as the characteristics of the creature.

After successfully solving the mystery of the creature, the students will need to prepare a news release that describes their scientific findings and what the creature looks like. They will also need to prepare a presentation to the school board at the next local meeting. In order to do this, they will need to utilize all of the technology skills that they currently possess and find out what other applications could support this task and learn how to utilize them before the due date.

The group agrees to help with the project and immediately begins to discuss what needs to be done. Considering the problem, the teachers will need to plan for a series of lessons that will help their students to accomplish their task… keeping in mind that it should reflect all curricular areas that they are currently studying. Being a technology rich school, the teachers agree that they should focus on using technology in the lessons to support critical thinking and problem solving. In order to get a picture of what this may look like, the teachers agree to use the technology to create

samples of what the final student work may look like. The teachers also agree that they should figure out how this activity will be assessed. Mr. Ford enthusiastically thanks his colleagues for their support and begins to work on a timeline (ED568 Instructor, February 18, 2007).

Online PBL Scenario 2

The second online PBL scenario was presented in Unit 5 and again spanned a time period of three-weeks. Utilizing the same online PBL process, students were presented with a scenario in which the curricular focus centered on math and business concepts. Once again, Mr. Ford is back in the classroom and presents the following challenge to his students:

> Mr. Ford is a math teacher in the Arcadia School District. His students have been working very hard and making exceptional progress. Therefore, he has decided to prepare an activity that will challenge his students and their knowledge of concepts learned by requiring them to utilize these skills in a real world scenario. He will break his class into teams and challenge them to design and develop a business of their choice.
>
> Mr. Ford's challenge is that he will need to plan a sequence of lessons that will help the students prepare for this activity. He realizes that the students will need to incorporate skills that they have learned in all of their other subject areas…English, Social Studies, Science, Art etc. Therefore, he decides to meet with a group of colleagues from various subject areas. In discussing the project, he tells his friends that from a

math perspective the students will need to utilize a spreadsheet program to record mathematical data and perform calculations that will mirror a real business.

However, he will rely on his colleagues to provide suggestions as to how their curricula would relate to this endeavor. He knows that somehow the students will need to market their business and products as well as make presentations to investors. At this point, the group realizes that they must plan for the student teams to invest in the use of today's technology tools.

Therefore, the challenge is for this group to plan this activity, utilize multiple curricula, and integrate technology into the activity. Mr. Ford asks his colleagues to develop samples of all work that they would require the students to produce.

The next day, Mr. Ford discusses this project with his students who react with excitement and anticipation. All he has to do now is manage the development of this project and plan for its implementation. With this in mind, he begins to work with his colleagues to produce this real world activity (ED568 Instructor, March 4, 2007).

Use of spreadsheets was required in the scenario, but the open ended nature of the problem allowed for students to be creative in the production of marketing materials as well as presentations that would be made to investors of the new "start-up" business.

Online PBL Scenario 3

The final PBL scenario was presented in Unit 6 with a curricular focus on history/social studies. In this problem, Mrs. Wheeler emerges onto the scene as a teacher who has spent a considerable amount of time delivering instruction on ancient civilizations. On moving into her next unit on ancient Egypt, she ponders the use of 15 laptop computers in an effort to create a multidisciplinary web-based activity. The challenge of the Unit 6 PBL is as follows:

> Mrs. Wheeler is a social studies teacher in the Arcadia School District. Her students have been focusing on ancient civilizations since the beginning of the year. As she prepares for the next unit, Ancient Egypt, she reflects on how this civilization has had an impact on various areas of culture and intellectual growth. Therefore, Mrs. Wheeler decides to approach this unit from a multi-disciplinary perspective.
>
> Considering that the Arcadia School District has recently purchased a laptop cart with 15 computers, Mrs. Wheeler decides to develop her lessons around using the laptops to access a web-based activity. As she begins planning the activity, Mrs. Wheeler determines the features that will be important for this activity:
>
> 1. She needs to create a scenario for her students that place them in a real world situation.
> 2. She needs to place them into this real world activity by having them assume the role of a specific professional (i.e. archeologist).

3. She needs to utilize all of the various resources on ancient Egypt that already exist on the Internet.

4. The activities that she develops must encompass all of the other areas that her students are studying (i.e. art, math, science, etc.). The activity will be delivered through a web page that she has created.

5. She will need to create a series of multidisciplinary lesson plans to effectively accomplish her goal of exploring ancient Egypt.

6. In order to ensure that her students will be able to accomplish the objectives that she has set out for them, Mrs. Wheeler will create samples of all work that the students will turn in.

7. Students will need to utilize all technologies that they have learned to this present point in time.

Therefore, Mrs. Wheeler decides to meet with a group of colleagues from various subject areas and ask for their assistance in identifying how ancient Egypt has influenced their curricular areas. As she receives their feedback, she excitedly begins to develop this integrative unit on ancient Egypt (ED568 Instructor, March 25, 2007).

The major focus of this unit was to explore the possibilities for using web-based interactive assignments or activities. In addition to the online resources of the previous scenarios, this unit provided online resources that demonstrated how to obtain a provider for free web space, installing a shareware web editor, creation of a webpage, and publishing the activity to the web server.

Post-PBL Technology Plan

The final weeks of the course required participants to revisit their thoughts about a plan for integrating technology. Groups were presented with the same task that they had

received in the early weeks of the course and were once again asked to develop a plan that focused on a curricular area. Use of the previous curricular area was permitted; however, the plans were to be created anew.

Possible Research Bias

The researcher in a qualitative study is an important part of the process. Therefore, "a researcher's personal beliefs and values are reflected not only in the choice of methodology and interpretation of findings, but also in the choice of a research topic. Denzin and Lincoln (1998) support this in stating, "…qualitative researchers accept the fact that research is ideologically driven. There is no value-free or bias-free design" (p. 41). In other words, "what we believe in determines what we want to study" (Mehra, 2002). Considering this, the researcher usually begins with certain beliefs or views about the focus of the study; in essence, this complicates the researcher's ability to separate himself or herself from the subject that is being studied. To address this issue, an outside observer reviewed the transcripts in order to provide inter-observation reliability. Figure 2 illustrates this study's research design.

Sampling Design

For this qualitative study, participants were recruited from the body of students that enrolled in ED568 using a non-probability sampling method. Merriam (1998) explains that since generalization in a statistical sense is not a goal of qualitative research, non-probability sampling is the method of choice (p. 61). Online course enrollments at the institution are generally capped at fifteen students, but at times extend to a maximum of twenty students. Therefore, the sample of participants was 18 students.

Purposeful sampling was utilized for the selection of case studies participants. Patton (1990) cites that purposeful sampling is appropriate when "the investigator wants to discover, understand, and gain insight and therefore must select a sample from which the most can be learned" (p. 169). In order to establish appropriate case study participants, an initial survey was delivered to the participants; sub-sets were determined by the following categories and used to select individual cases; the survey can be found in Appendix A:

1. The participant's instructional level
2. The participant's teaching status
3. The participant's gender
4. The participant's self-reported technology expertise (Appendix B)
5. Teaching experience in years

	January				February				March				April					May		
Date	7	14	21	28	4	11	18	25	4	11	18	25	1	8	15	22	29			
				Tech Plan			PBL 1		PBL 2				PBL 3			Tech Plan				
Pre-study Survey			x																	
Reflective Journals						x		x			x			x			x			
Focus Group Interviews						x		x			x			x			x			
Case Study Interviews						x		x			x			x			x			
Participant Postings						x	x	x	x	x	x	x	x	x			x			
Content Analysis				x	x	x									x	x	x			

Figure 4. Data collection timeframe: Instruments and measures paired with their respective PBL activities and dates for data collection.

Data Collection

Initial data was collected through survey questions at the beginning of the proposed study; Figure 5 illustrates the timeframe of the study and when individual reflection journals, focus group interviews, case study interviews, and transcripts of student postings and documents were collected. All data was collected within the course management system, Blackboard. Through the initial survey, four to six participants were selected for the study as individual case studies. Proposed data collection commenced from January 2007 until April 2007.

PBL activity one required participant groups to create technology plans that reflect integration of technology. After completing three additional PBL activities, the participant groups were presented the same scenario as PBL activity one; Once again, they were asked to complete a technology plan that reflected integration of technology. Both plans were collected and saved for qualitative content analysis at the end of the study.

Instrumentation

At the beginning of the study, students completed an online survey in the course management system that assisted in the identification of sub-sets. This information was integral in the placement of learners into their respective PBL groups as well as identifying individual case study participants. The survey instrument can be found in Appendix A. The self-reporting assessment on technology level was completed online in

the instructional management system; the self-reporting assessment can be found in Appendix B.

Reflection journals were submitted by students through an online form that occurred at the end of each week of the PBL activity. The reflection journals focused on the positives, negatives, and challenges of the PBL activity. Appendix C illustrates the online form that was used to collect the reflection journals. After completion online, the data was sent to the researcher in an email and imported into NVivo 7 for coding and analysis.

Focus groups were conducted by using a conference phone. A record of each focus group was transcribed and entered into NVivo 7 for coding and analysis.

A series of individual phone interviews were conducted with selected case study participants. Participants were called at times that were convenient to them. The transcript of each individual interview was transcribed and entered into NVivo 7 for coding and analysis.

Students' postings throughout the PBL activities were examined and entered into Nvivo 7 for coding and analysis. Other documents, such as instructional samples, were also entered into NVivo for coding and analysis; this was performed to see if other issues emerged from the data.

After completion of the study, the initial technology plan and the final technology plan were analyzed through qualitative content analysis to determine the effects of the online PBL model on teachers' integration of technology perceptions and planning.

Table 2 illustrates instrumentation and measures by specific research question. Furthermore, this table illustrates how triangulation of data was achieved.

Table 2.

Instruments and Measures by Research Question (Triangulation of Data)

Instru-ment	Q1	Q1A	Q1B	Q2	Q2A	Q2B	Q2C	Q3	Q4
Pre-Study Survey	X								
Reflec-tive Journals	X	X	X	X	X	X	X	X	X
Focus Group Inter-views	X	X	X	X	X	X	X	X	X
Case Study Inter-views	X	X	X	X	X	X	X	X	X
Partici-pant Postings & Artifacts	X	X	X	X	X	X	X	X	X
Content Analysis of Pre- and Post Tech-nology Plans	X	X	X	X	X	X	X		X

Data Analysis

Merriam (1998) suggests that data analysis is one of the few areas in qualitative research where there is actually a right and wrong way (p. 162). In beginning the qualitative study, the researcher understands what the problem is, but is unaware of what

will actually be discovered. Therefore, it is appropriate to conduct the data analysis stage simultaneously with the data collection stage; by using the constant comparative method, analysis is conducted in an ongoing fashion where data emerges to illuminate concepts being discovered. Miles and Huberman (1994) clarify that data analysis ends when coding and recoding have run their course (p. 62). Table 3 presents the final coding scheme that emerged from the data analysis. The following areas for data collection were used in the data analysis phase.

Pre Survey: The initial survey helped to gather information that helped in the process of creating subsets of participants. This data assisted in identifying participants that were selected for individual case studies.

Focus Groups: Participant focus groups were conducted and transcribed for import into NVivo7. The data from the focus groups was coded using constant comparative analysis procedures. At the beginning of the analysis, items were coded as "free nodes" until patterns
started to emerge and were transferred to more permanent "tree nodes." Queries were conducted and models constructed that represented the relationships that were emerging from the participant data.

Individual Reflection Journals: Participants filled out individual reflections online, which were submitted to the instructor as an email. These participant journal entries were imported into NVivo 7 for coding and analysis as described in the Focus Group section. Participants reflected on the pros, cons, and challenges that emerged through learning technology integration through this instructional method.

Table 3.

Coding Structure for the Study

Code	Category	Description
PRO-INT	Pro Integration	Indicates positive perception towards integration of technology
PRO-GRO	Pro Growth	Indicates positive perception towards professional growth
PRO-PBL	Pro PBL Process	Indicates positive perception towards the use of online PBL
PRO-INT	Pro Peer Interaction	Indicates positive perception towards peer interaction
PRO-LEA	Pro Leadership	Indicates positive perception towards leadership
CON-GD	Con Group Dynamics	Indicates negative perception dealing with group dynamics
CON-COM	Con Communication	Indicates negative perception synchronous
CH-GD	Challenge Group Dyn	Indicates challenging group dynamic concept
CH-SCH	Challenge Scheduling & Time Issues	Indicates challenges related to scheduling and time issues
CH-MD	Challenge Multiple Disc	Indicates challenges related to use of multiple disciplines
CH-PLB	Challenge Pushing Learning Boundaries	Indicates challenges presented by pushing student learning boundaries
PL-RW	Planning Real World	Indicates evidence of planning for real world scenarios
PL-MD	Planning Multiple Disciplines	Indicates evidence of planning for use of multiple disciplines
PL-TPL	Planning Technology as Partner	Indicates evidence of planning for technology as a partner in the learning process

Transcripts of Student Postings (field notes): As participants progressed through the PBL activities, they were required to post in synchronous and asynchronous areas of the online courseroom. These participant submissions were imported into NVivo 7 for coding and analysis as described in the Focus Group section.

Qualitative Content Analysis: The original technology plan was compared to the final technology plan through the use of qualitative content analysis. Categories were derived directly from the textual data of the pre- and post technology plans. Evidence was imported into NVivo 7 for coding and analysis.

CHAPTER 4. DATA COLLECTION AND ANALYSIS

Introduction

The purpose of this qualitative study was to investigate how the experience of learning through an online PBL model affects teachers' perceptions of integrating technology. In order to accomplish this, various forms of data were collected, coded and analyzed in an effort to identify evidence of what participants perceived to be the pros, cons, and challenges of learning technology integration through this model. Participant perceptions were also analyzed by examining individual attributes such as age, gender, teaching status, pedagogical experience, and technological experience.

Additionally, this study explored how the use of an online PBL model affected teachers' planning for technology integration. By use of qualitative content analysis, pre- and post technology plans were analyzed to identify online PBL's impact on teachers' decisions to plan for the use of activities that utilized real world perspectives, multiple disciplines, and technology as a partner in the learning process.

Through the remaining sections of this chapter, an analysis of several types of descriptive data, that were collected in this study and focused on the integration of technology into pedagogical practices, will be presented. By use of the Constant Comparative Method (Glaser & Strauss, 1967), data was coded and organized into

themes that emerged as the analysis progressed. The findings addressed the research questions that have been previously presented in Chapter Three:

1. In what ways does the experience of learning through an online PBL model affect teachers' perceptions of integrating technology? This question addresses the following sub-questions:
    a. What do teachers perceive as the pros and cons of learning technology integration through online PBL?
    b. What do teachers perceive as the greatest challenges faced in learning technology integration through online PBL?
2. In what ways does the experience of learning through an online PBL model affect teachers' planning of technology integration? This question addresses the following sub-questions:
    a. Does the experience of learning integration of technology through online PBL help teachers to plan activities that reflect "real world" environments?
    b. Does the experience of learning integration of technology through online PBL help teachers to plan activities that utilize technology as a partner in the learning process?
    c. Does the experience of learning integration of technology through online PBL help teachers to plan multi-disciplinary activities?
3. In what ways do teachers' perceptions of learning technology integration through an online PBL model vary among the participants along variables such as gender,

age, level of technology expertise, pre-service or in-service status, and teaching experience in years?

4. What unexpected perceptions and planning practices emerge from learning technology integration through an online PBL model?

Participant Composition

The study was comprised of eighteen participants that varied with respect to teaching level, professional status, gender, age, and years of pedagogical experience. Table 4 provides an overview of the attributes that comprised the participants of this study. Elementary and Secondary participants were equally represented with the middle school participants being generally lower in numbers. With respect to professional status, there were a balanced number of participants that are currently employed in a school district (in-service) to that of participants that are not currently employed or are studying to satisfy necessary state credentials for certification (pre-service). In looking at gender, the female participants outnumbered the male participants by a ratio of 2:1. The majority of participants fell between the 20 to 30 year old range while the remaining participants fell into the 31 to 40 and 41 and above age range. Technologically, the largest portion of participants was determined to be intermediate users through the use of the Self Report on Technology that was conducted at the beginning of the course. Only three participants were identified as having advanced technological user skills.

Table 4.

Personal Attributes of Study Participants

Participant	Level	Status	Gender	Pedagogy	Age	Tech Level
1	Elementary	Pre-Service	Female	0-5	20-30	N
2	Elementary	In-Service	Female	6-15	31-40	N
3	Elementary	In-Service	Female	0-5	41-50	I
4	Elementary	In-Service	Female	6-15	31-40	A
5	Elementary	Pre-Service	Female	0-5	20-30	I
6	Elementary	In-Service	Female	0-5	20-30	I
7	Elementary	Pre-Service	Male	0-5	31-40	I
8	Middle	In-Service	Male	0-5	20-30	A
9	Middle	Pre-Service	Female	0-5	20-30	I
10	Middle	In-Service	Female	0-5	31-40	N
11	High School	Pre-Service	Male	0-5	20-30	N
12	High School	Pre-Service	Female	0-5	20-30	I
13	High School	In-Service	Male	0-5	20-30	I
14	High School	Pre-Service	Male	0-5	20-30	I
15	High School	In-Service	Female	0-5	31-40	I
16	High School	In-Service	Female	6-15	31-40	N
17	High School	In-Service	Female	6-15	31-40	I
18	High School	Pre-Service	Male	0-5	20-30	A

Perceptions of Integrating Technology – Influence of Online PBL

1. *In what ways does the experience of learning through an online PBL model affect teachers' perceptions of integrating technology? This question addresses the following sub-questions:*
    a. *What do teachers perceive as the pros and cons of learning technology integration through online PBL?*
    b. *What do teachers perceive as the greatest challenges faced in learning technology integration through online PBL?*

Throughout the course of the study, participant data was collected in the form of reflective journal entries, student interviews, focus groups, and analysis of completed work. Using these forms of data, coding and analysis was conducted to identify participant perceptions with respect to the pros, cons, and challenges of using online PBL as a model for teaching the integration of technology. Perceptions were also analyzed for online PBL's impact on the planning process for technology integration. The following sections present the findings of the data analysis.

PBL Process and Integration Pros

The Need for Integration. Considering that participants of this study focused entirely on how to effectively integrate technology into curricular areas, it could be assumed that there was at least some initial interest on the part of the participants to learn to use technology for the purpose of teaching. Examination of participant postings in

week 1 confirms this assumption and provides a glimpse into their beliefs on the value of using technology in education.

> I feel that technology is the wave of the future and it's already here. Technology enables humans to evolve quicker through means of gadgets and doohickeys. There is always something new to learn about. (Participant 3, January 17, 2007)

> In a world where students are driven by technology, are used to using it in their everyday lives more so than most teachers, and in a world where technology will continue to drive innovation, it should therefore be an integral part of education as well, teachers must find new ways to use technology in their classroom. (Participant 5, February 23, 2007)

> Technology is moving at a pace that the students understand far better than the teachers who could be using it in their classroom as an effective way of making learning real and appealing to the students. (Participant 18, February 18, 2007)

*The PBL Process***.** Even though the participants of this study felt that integration of technology was important for the future of education, the collective knowledge on the use of PBL, or its origin and philosophical underpinnings, were minimal. However, as participants progressed through the study, they started to develop an appreciation for PBL and some of its fundamental principles: creative solutions, working in groups, self-regulated learning, real world scenarios, and benefits provided by the division of labor.

Since PBL focuses on a student-centered approach, participants quickly realized the potential for coloring outside the lines and developing new and creative activities that require the integration of technology.

> The cross-curricular and technology ideas for this problem really leave things wide open for a great deal of creativity. (Participant 18, February 25, 2007)

> These assignments are forcing me to be creative and utilize more technology as well as learning these new programs. (Participant 1, February 18, 2007)

> PBL is teaching us to be creative with technology and to allow my students the freedom to learn. (Participant 4, April 1, 2007)

> I like the problem based process. This sort of outside the box thinking is what I know I need more of. There are great ideas out there and people that use technology differently than I do. This class will force me to use technology more, while re-enforcing the idea that we want our children to think and solve problems rather than regurgitate facts or data. (Participant 17, February 11, 2007)

> I am also able to explore suggestions that I find online as well as information to help me use the technology in the most effective manner. I did not think before we started our PBLs that there were so many uses of technology. I am also seeing that technology can be used in all avenues of learning. (Participant 4, March 11, 2007)

During the PBL process, groups discussed learning issues that had been identified through careful examination of the problem scenario. After labor for this problem was divided, participants moved into a self-regulated phase of the assignment. During this phase, participants reflected that they enjoyed the ability to work at their own pace while exploring curricular concepts and technological approaches.

> Because I am offered the chance to learn on my level and at my speed during the PBL process, I can explore and enhance my own technological skills while learning to incorporate them into my lessons. (Participant 13, February 18, 2007)

> This particular process of learning works for me because I am able to learn at my own pace, from my peers, and in an environment that is conducive to my lifestyle. I am excited about learning new skills that are practical and reflect the current trends of society. (Participant 7, March 25, 2007)

Even though PBL requires self-regulation at specific points in the process, participants need to be able to negotiate the complex nature of working together as a group in the online environment. If participants accept their responsibility for producing specific aspects of the solution, as decided through the division of labor, group work through online PBL can be accomplished successfully while maintaining student satisfaction.

> One of the best aspects of PBL was the division of labor and having everyone do his or her share; it was one of the most equal group activities I have ever experienced. (Participant 7, February 12, 2007)

> As always, we met and discussed the scenario and divided up the labor. It is an advantage to have three people working on the same problem in that the ideas are more varied. (Participant 9, April 30, 2007)

Finally, participants were challenged by the requirements of the online PBL process and sometimes even felt intimidated, but in the end they began to develop a sense of appreciation for the method.

> Despite the challenges I encountered during this activity, I have begun to appreciate the PBL lesson idea. I was skeptical at first as it was making things challenging for me. However, after several runs at it, and looking at this from the perspective of the children, I realize that I can teach the curriculum, while also teaching technology and a lot of other things while making every day different. (Participant 18, April 15, 2007)

> I never thought that I would say this about a PBL, because at first I was scared, but I am enjoying the process a lot. (Participant 16, March 4, 2007)

> When I become a certified teacher, I definitely plan to use a PBL model with my students. (Participant 3, February 25, 2007)

*Professional Growth***.** Through use of the online PBL method, participants began to develop a strong sense of both personal and professional growth with respect to technology integration. Participant reflections illustrated that growth occurred on the individual level as well as the through group participation.

> I grew this week in leaps and bounds. This course has taught me a lot about myself as student and ways in which technology can be included into my classroom. (Participant 4, April 30, 2007)

> I am growing as a student in ways that I did not see possible. (Participant 4, March 11, 2007)

> The group is really coming along with this final project. I think with all of the experience we have gained over the entire semester has finally paid off. We seem to be coming up with interesting uses of technology. (Participant 14, April 30, 2007)

> This week was more of a reflection week because I was able to see our group's growth, as well as my personal growth. I never thought that I could have learned this much about technology in such a little amount of time. (Participant 15, April 30, 2007)

> I have found the benefits of PBL outweigh the disadvantages. I can say that I am looking forward to discovering more about myself through the next two PBL activities. (Participant 4, March 4, 2007)

As for some of the more technologically savvy participants in the study, growth in the area of technological applications did not occur to as great an extent as those with lesser skill levels. However, in this case, the growth occurred in an awareness of current and emerging technologies and how they could be utilized in developing and delivering instruction that integrated technology.

> I do not feel that these activities have really changed the way that I will be looking at incorporation technology into my own lesson plans. It certainly makes me more aware of what technology I can use. It also makes me aware of the technology I have used and in what ways I can improve on using it in the future. (Participant 1, February 18, 2007)

For other participants, growth occurred in the form of taking ownership of their learning. One of the major principles of PBL requires the instructor, or tutor, to facilitate the instruction instead of being the purveyor of content knowledge. Due to this change in pedagogical approach, participants were often uncomfortable at first with the open-ended nature of PBL and the fact that the instructor would not provide the information to solve the problem. Participants were responsible for obtaining the necessary materials for developing creative solutions; in fact, in the end, many different solutions were developed and participants had performed as real world teaching professionals.

> I have always been one to get my monies worth from a class by asking a great deal of questions to insure that I knew what was expected of me. Through PBL there are many answers to a question. I have had to learn a different way of doing/looking at things. That is a good thing. I will be a better teacher for it. (Participant 18, February 18, 2007)

> We have not really stayed within our individual comfort level. We have each volunteered to take on a component that we are not necessarily familiar with in order to learn more about it, thus increasing the challenge and potential for learning. (Participant 10, February 25, 2007)

> This assignment required us to really explore the imaginary side of ourselves to further educate the students. Luckily our group loves to explore and go out of the lines to bring new ideas to the students. I feel so happy about this group project. (Participant 16, March 4, 2007)

Finally, participants expressed a sense of satisfaction and pride due to their professional growth through this online PBL experience. Participant reflections illustrated that they felt that they had grown with respect to technology integration, working as a team, and pushing the boundaries of their own potential.

> This was a great course! I learned so much about the many ways to incorporate technology using real world problems. I have enjoyed it immensely! (Participant 10, 2007)

> I am proud of the work that our group has done over the past weeks. (Participant 8, March 24, 2007)

> Granted, I have much more to learn and consider myself fortunate…I learned a significant amount about technology this semester. (Participant 13, April 30, 2007)

> The final week of all of the PBL projects has brought me a strong feeling of closure. I really feel as though at the end of each PBL project that I really did my best. (Participant 14, April 16, 2007)

*Peer Interaction***.** Critical to the success of PBL is the concept of peer interaction. Through the online PBL design, participants interacted in various ways. They were able to communicate asynchronously through group forums, use the chat tool for synchronous

communication through writing, as well as the use of VOIP for synchronous voice communications. Participants identified various aspects of peer interaction as being a positive force during the PBL activity.

As participants worked through the real world classroom scenarios, they were exposed to a multitude of ideas, many of which they had never thought of before by themselves. Through peer interaction, participants were able to discuss technology tools and pedagogical practices and in the end learn from each other.

> Another pro of this project is that we get to work with peers. I feel that this whole process would be much more difficult if this was being tackled alone. Not only does it allow for us to learn from one another through the sharing of ideas and differences of opinion, but also, it allows us to see how differently people can think and interpret the same issue. (Participant 14, February 18, 2007)

> It made me look at the integration of technology in my classroom differently because some of the ideas that my group presented…I would never have thought to use technology in those ways. (Participant 7, February 19, 2007)

Not only were participants able to learn from peer interaction in their own groups, they were able to learn from other groups in the class as their problem solutions were posted for all to peruse in class wide forums.

> …from reading other group's projects and reading the lessons from the people in my group, my eyes have been opened to many new ways to use technology effectively and creatively in the classroom. (Participant 14, April 30, 2007)

Communication that occurred through peer interaction also allowed for participants to strengthen their work and stay on task. It was through this communicative process online that participants were able to test ideas at various phases of the scenario and bring closure in the end to their problem solution.

> I have really been getting the hang of working with my group members throughout the PBL process. I have enjoyed this past week of brainstorming and throwing ideas off of each other. I actually just today feel that we may have a good grasp on the unit project. (Participant 17, February 18, 2007)

> Another advantage that came out of this week was having group input. This week our group was able to come together one last time and help each other out. We were each able to give constructive advice and get the most out of our experience. I never thought that I could have done group work through the computer but this class has allowed me to do so. (Participant 8, April 30, 2007)

Peer interaction online also provided another important function in the form of assistance to other learners in the group. Mirroring a real life teaching team, participants relied on each other for assistance when they were stuck or didn't know how to proceed. These interactions provided benefits that flowed in dual directions: assistance to the group mate, and secondly a feeling of value from the group mate who provided the assistance.

> Another advantage that occurred this week came along the lines that I was able to get help from my group members. There were a number of occasions that I felt lost or stuck, but having my group members really helped me. I was able to use them as a springboard. There were a number of times where I felt like giving up. It was having them there and knowing that they were there to support me and help me that kept me going. (Participant 4, April 15, 2007)

> If there is anything that I have learned during our PBL weeks is to use all of the resources that I have available such as my group mates. This was something that did not come naturally to me. I am the type of person who tries to figure everything out on my own. During our PBL, I was able to learn just how important it is to use other people as a resource. This has helped me learn more about myself and the learning process. (Participant 10, April 15, 2007)

As previously mentioned, participants that provided assistance to group mates also benefited from this peer interaction in that they felt a certain level of value and expertise helping them to grow as a professional and a person.

> The first of these advantages is that I was able to help my group mates. I find this to be something that is very valuable. I was able to voice information that was helpful and felt that I genuinely helped out my group members. (Participant 4, April 15, 2007)

> This process of learning continues to remind me that we all are unique and have strengths that everyone can benefit from, no matter what the outcome. (Participant 13, March 25, 2007)

Finally, if peer interaction and communication do not occur in online classes, students can often develop a sense of alienation or being isolated. Successful online PBL activities require peer interaction; through this communicative process students develop a sense of belonging, or connection, to their group mates.

> I feel that without PBL I would not feel so secure in this online course. It is by having conferences several times a week with my group members that I am able to check in on progress and touch base on my own progress. (Participant 8, February 18, 2007)

> My group mates have helped greatly through this process. I do not feel alone in this class and that is something that I look at as a HUGE advantage. I feel that the three of us are all working and helping out each other the best way that we can. (Participant 10, March 4, 2007)

Leadership. Another positive aspect of learning technology integration in an online PBL model was the sharing of leadership responsibilities. In many of the PBL groups, participants chose to have a group leader. The groups decided whether they would keep the same leader, or rotate that responsibility as they moved through the PBL scenarios. PBL groups that organized themselves into a structure that utilized a leader appeared to have functioned in a more productive fashion.

> Our leader this week, [participant 13], is a fantastic group leader. [Participant 13] keeps everyone up-to-date with information and is a proactive learner. (Participant 16, April 9, 2007)

> One of our group's main positive features throughout this Problem Based Learning unit has been our keen sense of collaboration. Although I was the

> group's leader during this unit, I never made any key decision on my own. We are a group that always checks with all of our members when we need to make a decision on something. (Participant 17, March 25, 2007)
>
> When we have a group leader I feel that our conversations are more direct and to the point. (Participant 4, April 29, 2007)
>
> We have also rotated the role of leader to ensure that each team member has an authentic understanding of this role. (Participant 13, February 25, 2007)

PBL Integration Cons

*Group Dynamics***.** As explained in the section on PBL Process Pros, peer interaction is an integral part of a successful online PBL environment. Through peer interaction, participants are exposed to a multitude of ideas in their own working groups, as well as other groups within the class.

However, a concern related to group dynamics emerged with respect to the pedagogical experience and teaching status of certain group members. Using the Participant Attribute Survey, groups were formed so that pre-service participants would be grouped with in-service participants. In doing so, pre-service participants would learn from those participants that are already practicing in the field of education. This appears to be of value to the pre-service participants, but some in-service participants expressed concerns over the difficulty of working with participants that lacked real world classroom experience and pedagogical expertise.

> Some of the negative aspects and challenges of learning technology integration through this online PBL activity was the dynamics of our group. Currently, I work as an educator and so does one other member of our group. I am thankful for them. The other two members do not currently work as educators and it was difficult to explain the nature of the project. (Participant 11, April 30, 2007)

Furthermore, other issues related to group dynamics emerged as concerns related to communication, isolation, and life distractions. However, these concerns appeared to be fewer in number than most other reflections.

Communication and peer interaction in the study occurred through both synchronous and asynchronous means: VOIP, chat, email, forums, and phones. In groups where the participant attributes meshed nicely, communication was conducted in an efficient and productive manner. However, some participant reflections expressed a desire for face-to-face human interaction. Desires revolved around issues related to response time, scheduling, and feelings of alienation.

> It is this human interaction with immediate responses that I still find lacking in all of these procedures. Responses may come slow through email or posting and those who work at different schedules have a difficult time responding at convenient times. (Participant 5, March 20, 2007)

> I feel like I am on an island. Not that I'm alone, the other people in my group on the same island but not at the same spot as I am. (Participant 14, February 24, 2007)

Some participants simply stated that participating in face-to-face instruction would help them to better understand concepts being presented and retain them for a longer period of time.

> I would learn much more and be able to retain the information faster if I could attend a workshop or mini sessions to practice some of the features. (Participant 13, April 15, 2007)

> There are advantages to taking on-line courses but as an educator I find that certain skills would be best learned in a traditional forum. (Participant 13, April 15, 2007)

> When it comes to group based work, which PBL is, I feel that people need to be able to meet, not just talk or email. (Participant 5, April 30, 2007)

*Synchronous Communication with VOIP***.** Synchronous communication is an integral part of conducting online PBL. Participants need to be able to communicate in order to identify the learning issues, divide the labor, and discuss goals and timelines for moving forward with the creation of their solution. However, several participants reported difficulties and frustrations with using the free VOIP software.

> This week was far better then last week. Our group got through our Skype session with a few less technical issues and we managed to all be able to hear each other for at least half of our meeting! I have become frustrated with Skype, as it seems that the past few weeks have been difficult and full of problems. (Participant 17, April 9, 2007)

> Unfortunately, we continue to have glitches with Skype, such as being knocked off requiring all of us to hang up and start again. (Participant 13, April 1, 2007)

> I am sick of Skype. Over the last month we have tried on several occasions to have a group meeting and Skype has been challenging even when on its best behavior. The idea is that we use technology to enhance the learning experience, but in this case it has been a detriment. Participants get booted from conversations, the level of feedback is like talking to someone with the mute button on, which causes static, while the inability of others to follow conversations has created a general lack of trust of the program. (Participant 18, April 29, 2007)

> We have had so many problems with Skype. The connection will only allow two people connected. If there are any more people on there, for example in our group we have four, Skype will disconnect us from talking to each other. (Participant 16, April 25, 2007)

However, some PBL groups reported no technical issues and used Skype to accomplish their objectives.

> Also, since this is an online class, getting to meet with the group through Skype has been tremendous…we get to meet but never leave the house. (Participant 14, February 18, 2007)

> We continued with our weekly Skype chats on Tuesday, Thursday, and Saturday morning. The Skype sessions were most valuable for our group since this was our major form of communication. We utilized the headset feature as well as the chat feature. (Participant 5, February 18, 2007)

> My group mates and I met again on Skype this past Tuesday night and spoke to each other about our own ideas as well as when each piece was due, making sure that we were all on the same page. (Participant 17, February 25, 2007)

PBL Process and Integration Challenges

*Group Dynamics***.** One of the challenges that quickly emerged during the study was the concept of working together in a group in the online environment. Participant feelings varied throughout the study partly in relation to the following factors: group composition, working styles, work ethic, and attention to communication.

As discussed earlier in chapter 3, the composition of PBL groups were determined by the Participant Attribute Survey and the Self Report on Technology. However, the use of these two instruments for group formation did not take into consideration the differences in personalities that exist amongst group members. It appears that as the study moved forward, participants gained a better understanding of each other's characteristics as well as strengths and weaknesses.

> Things are actually becoming more positive then negative in our group, at least from my perspective. I think everyone is finally on the same page. I think we have gotten used to each other enough to know what each person can and will bring to the table every week. At first I didn't think this was going to work at all but I have found, especially over the last two projects, that we are able to work together quite nicely at times. (Participant 16, April 30, 2007)

Another challenge that emerged with consideration to group formation was the varying levels of work ethic and work styles. During the course of working on the PBL scenarios, participants needed to negotiate group meetings, learning issues, division of labor, and the setting of goals for creation of the problem solution. During this period of time, it was evident that not all group mates shared the same working styles or work ethics.

> I do not mean to place blame on everyone else… but I am concerned about our project. It seems that there is not as much cohesive thought, encouragement and brainstorming as I would have liked. (Participant 3, February 18, 2007)

> Once we were able to establish the challenge of coordination and planning, things really took shape easily, despite the problems that we experienced with one of our group members. (Participant 10, April 30, 2007)

> The process of not being face to face shows the distinct working styles of individual group members. It really is a compromise when having to integrate several different work and communication styles when the PBL process is online. (Participant 6, March 4, 2007)

However, in the groups where participants were willing to be flexible and negotiate the needs of its members, the issue of group dynamics worked in favor of a symbiotic relationship.

> I am fortunate that my group members and I are on the same page for most of what we have created and have not had any major glitches compared to some of our other classmates. This type of learning is not for everyone, but it's been working for me so far. (Participant 13, March 4, 2007)

*Scheduling and Time Issues***.** Besides issues of group dynamics, participant reflections addressed concerns about challenges associated with scheduling. Considering that many students take online courses for the flexibility that they afford, synchronous sessions that are required through the online PBL process often produce difficulties with respect to scheduling group meetings.

> The reason I took an online class was to be able to complete the work on my own timetable since I teach, coach and have a family. The fact that I will now be tied to others is a bit of a challenge. If there was one project that would be one thing, however, we have 5 different projects that must be completed. This requires coordination as well as a great deal of communication in order to have something that looks polished. Coordination takes time, and that is something that I do not have a great deal of, so we shall see how this works. (Participant 18, February 11, 2007)

> I am a firm believer of group work. However, I am not used to this type of online setup. My work schedule changed this week and I do not know how easy it will

> be for our group to coordinate for a synchronous meeting to discuss our project. It would definitely be easier to post and reply at your own convenience. (Participant 3, February 18, 2007)
>
> I think the biggest challenge of the PBL activity is finding a time to get together with all of the group members. (Participant 7, February 12, 2007)
>
> It is also very challenging having a common meeting time with the rest of the group since we all have very busy schedules and they may be changing from week to week, it is difficult to anticipate what is going to happen over the course of a week. (Participant 5, February 18, 2007)

Moreover, issues of scheduling appear to have had an effect on communication within groups. When working in groups online, synchronous meetings tend to also serve as deadlines for completing materials that are necessary for the group's solution. Therefore, if communication breaks down through lack of synchronous communication, groups begin to experience a breakdown in productivity.

> The challenges that I have found this week were a breakdown in group communication and not having enough time in the week to get everything I wanted to done in a timely manner. (Participant 4, February 25, 2007)
>
> Our group did not meet synchronously this Problem-based learning scenario. The work was divided up early and everyone seems to be taking a more independent stance on this project. Instead we communicated via email and by checking each other's forums. This is not exactly how I wished to work with my group, but our schedules seem to clash and the only way we can work with each other is asynchronously. (Participant 3, April 15, 2007)
>
> Although I have extreme freedom in this lesson I find that I have tended to forget about it from time to time. I have to remind myself to work my portion of the lesson and need to get it done. I need more deadlines and in my head I try to make them, it is just that sometimes other things tend to get in the way. (Participant 4, February 25, 2007)
>
> The biggest drawback here was trying to work with four people online and meet the deadlines. As seen by group II"s final project, much of the work was done, but we really had to communicate and see what the other people were doing in order to insure some semblance of unity. Even then I failed to attach a piece of our team's work, (partly because it was not emailed directly to me) and this looks bad. (Participant 18, April 30, 2007)

> Two days ago I posted a comment on each of my group member's forums with suggestions or questions about their planning. As of today, there is no feedback left for me or answered questions. Perhaps it is a case of continued distraction, or perhaps we as a group have not been able to mesh our schedules and work styles together as successfully as I had anticipated. (Participant 3, February 18, 2007)

When group communication is conducted successfully, participants report improved productivity and progress. However, lack of synchronous online sessions can cause frustrations when participants had ideas and wanted input and feedback from their group mates.

> Our sessions have been productive; however, there have been many scheduling conflicts within our group this week, so it has been hard to connect on a few occasions. This is one of the obstacles with problem based learning, especially in an online course... I have found that when I have time to work and have an idea to discuss, my group mates are not available. We have used the chat feature in Skype, so that we can answer each other's questions when we become available. (Participant 10, February 25, 2007)

Some scheduling issues were not the result of challenges brought on by participant communication and coordination, but emerged due to the university calendar. On a few occasions during the study, PBL activities were interrupted due to holiday schedules and school being closed.

> The second thing about this project that created a challenge was how it landed between spring break. We never met during spring break on Skype and there was no email except to pick the product. It was really hard to get in touch with everyone. Normally our group is really good about meeting, but I think the break created a challenge. (Participant 16, March 24, 2007)

> The other issue was completing work over the Easter break. I forgot when the hotlist was due and even though I had the assignment completed, I did not post it on time. (Participant 5, April 14, 2007)

Other scheduling challenges simply emerged due to life distractions. Considering that this study was conducted in the northeastern part of the United States in the winter, weather related issues appeared even though the course was online. Additionally, familial

events, or emergencies, create distractions that tend to disrupt the scheduling and progress of PBL groups.

> The first week of PBL 4 was not as successful as we had hoped. A series of events kept us from developing a plan early during this activity. We had a Skype meeting planned for Wednesday evening that two of us missed. I admit the snowstorm threw me off track and I simply forgot about the meeting. There was a death in one member's family and another got engaged. Needless to say, it was a week full of distractions. (Participant 3, February 18, 2007)

*Use of Multiple Disciplines***.** One of the integral pillars of PBL is the use of multiple disciplines in the design of instructional activities. In this study, each of the online PBL scenarios required that participants utilize various disciplines in the creation of the problem solution. Therefore, participants who were required to teach multiple curricular areas, such as the elementary participants, were able to adapt more readily to this situation. However, those participants who were not currently teaching, or had very specific curricular foci, found this multi-faceted approach challenging.

> This week offered many challenges for me. I had to temporarily wear the hats of many educators in different academic areas. I was forced to think like a science teacher, a math teacher, a technology teacher, art teacher and an english teacher. (Participant 11, February 25, 2007)

> One of the things that is essential to the process of PBL is that I get to work through problems that I would typically not look at. This can be both a positive and a negative. In one sense, I am now working through a problem that forces me to look at other disciplines and find a different and creative way to present that information to students. (Participant 5, February 18, 2007)

> One challenge of fitting all the subjects the students would be studying into the plan is that I am writing a lesson plan on something I have very little knowledge about. (Participant 7, February 27, 2007)

In order to move forward with the multiple discipline approach, participants found themselves being faced with reeducating themselves with respect to content that they may have been introduced to many years ago. Even though the PBL scenarios were open-

ended and embraced a student-centered approach, participants needed to have a basic understanding of the core curricular content of the scenario in order to develop appropriate lessons that addressed technology integration.

> This problem has been a more challenging for the group since we actually needed to re-educate ourselves on the solar system before we could get started. We all had a basic understanding of our solar system; however, it has been a long time since we actually needed scientific facts and characteristics on each of the planets. In order to proceed, we needed to do a little research. We each did a quick overview on two planets and forwarded our findings to group mates. (Participant 10, February 25, 2007)

> I had to search for information just as any student would because it has been almost twenty years since my last business class therefore I could not remember what one had to know before they set up a business. I knew exactly what I wanted to do, but I needed help getting there. The difficulty in this, for me, was the simple fact that I was forced to think differently. (Participant 12, March 25, 2007)

> The major challenges to technology integration were that we had very limited experience in other subject areas that we needed to write lesson plans for, which hindered our ability to include and incorporate technology into these plans. (Participant 1, March 4, 2007)

In some cases where lack of content knowledge emerged as an issue, Participants reflected that lack of breadth in-group formation exacerbated the problem. This was largely due to the fact that the Participant Attribute Survey did not collect any data on the subject area focus of group participants. Therefore, curricular foci were not used in the formation of groups.

> I think one of the challenges that we as a group have faced is that we are all similar in our backgrounds for education and what we teach. When we went to expand to a multi discipline approach to the problem, we all backed off the math and science portions of the project because we had little background in those areas. (Participant 1, February 18, 2007)

*Pushing Participant Learning Boundaries***.** One specific goal of the online PBL scenarios was to push participants to move beyond their current technological comfort

level and explore options at a new and different level. As indicated by the Self-Report on Technology, technological competency for participants in the study varied across a wide spectrum of abilities. However, due to the open-ended nature of the online PBL scenarios, participants were able to strive for technological growth at their individual level and expand their current understanding of how to effectively integrate technology into their planning practices. Participant reflections ranged from voicing a need to expand and improve technological explorations in general to participants who struggled with trying to limit the scope and amount of integration occurring in group lessons.

> I have gotten comfortable with three of four types of technology and now I stick with them. I can't allow myself to get too comfortable because as I have said from the start, I want my students to come into the classroom wondering what is going to happen today. I need to keep the students on their toes, and now that I have been exposed to other types of technology besides the three or four that I have used over and over again, I think it is time for me to broaden my horizons somewhat. (Participant 14, April 16, 2007)

> A final challenge was choosing the right areas of integration. We really had to buckle down and only choose a few areas for our project. This was difficult because there were so many ways we could have implemented our idea. It was hard because we did not want to overwhelm ourselves or fall short of our goals. (Participants 4, April 22, 2007)

> This week I found that there was a lot of technology that I wanted to incorporate into my lesson. It was hard to narrow it down to the ones that were the most important. It was hard trying to tie everything together without leaving out information. I am still trying to incorporate everything that I want to and feel that should be included. (Participant 8, April 29, 2007)

> A challenge that I faced this week was wanting to put more technology into my lesson plan. It got to a point where I had to pull back on the technology. However, I wanted to show what I knew. I was able to strike a happy balance. (Participant 15, April 30, 2007)

> Some of the other problems I have faced are the ideas that I come up with in my own head are pretty grand as to what I would like to accomplish. Introducing the technology for these projects can be somewhat challenging at times. It often times requires a lot more understanding of programs and even having to learn new ones as well. (Participant 1, February 18, 2007)

Other challenges that stretched the boundaries of participant learning emerged from a basic understanding of activities that utilized technology in an inquiry-based format.

> The biggest problem I was having, technology wise, with this project was the idea of a webquest. I had never heard of a webquest before so I was really having difficulty deciding what to do. I knew I was going to continue with Language Arts, and I knew the idea was Ancient Egypt, but I really had no idea what to do with it… Believe it or not, I got my answer from my younger brother. I asked him if he knew what a webquest was and he told me that his teachers use them all the time. I couldn't believe it. It just made me realize how much technology has changed since I went to school. He showed me a print out version of his math webquest. At that moment the example given to us of Ancient Greece didn't seem unrecognizable anymore. I must admit that this is my favorite project we have done. (Participant 16, April 9, 2007)

In the end, participants generally reflected that their technological growth would be a continuous process due to the enormous amount of resources that are available and the speed at which technological advances occur.

> I have learned this week that I have so much more to learn about technology. Trying to keep abreast of everything that is available regarding this topic is an enormous task, yet exhilarating at the same time. (Participant 13, April 29, 2007)

Planning for Technology Integration – Influence of Online PBL

2. *In what ways does the experience of learning through an online PBL model affect teachers' planning of technology integration? This question addresses the following sub-questions:*

a. *Does the experience of learning integration of technology through online PBL help teachers to plan activities that reflect "real world" environments?*

b. *Does the experience of learning integration of technology through online PBL help teachers to plan activities that utilize technology as a partner in the learning process?*

c. *Does the experience of learning integration of technology through online PBL help teachers to plan multi-disciplinary activities?*

An integral part of the analysis of this study revolved around the qualitative content analysis of a pre and post technology plan. Prior to beginning instruction that utilized the online PBL model, participants were required to create a technology plan that provided a "snapshot" of their perceptions of technology integration.

Following the creation of the pre-technology plan, participants worked in collaborative online PBL groups and were presented with several scenarios to consider with respect to technology integration and its planning process. The online PBL scenarios are described at the beginning of this chapter.

At the culmination of the study's PBL activities, participants were once again asked to create a technology plan that integrated technology into their curricular areas. The directions provided for this activity reflected the same request as the pre-technology plan.

The qualitative content analysis that followed focused on three concepts: real world activities, technology as a partner in the learning process, and multiple disciplines.

Elementary Group 1

The first elementary group consisted of participants who varied in many areas except gender. Participants for this group consisted of all females. Table 5 shows the complete attribute set for the participants in this group.

Table 5.

Participant Attributes of Elementary Group 1

Participant	Status	Gender	Pedagogy	Age	Technology
15	In-Service	Female	6-15	31-40	N
4	Pre-Service	Female	0-5	20-30	N
10	In-Service	Female	0-5	41-50	I

Pre-PBL Technology Plan for Elementary Group 1

Elementary Group 1 completed their first technology plan, U2 Tech Plan, prior to participating in any PBL scenarios. The plan consisted of several lessons that focused on a theme of Benjamin Franklin, as well as integrating technology into different curricular areas.

Real World Environments. Evidence of planning for activities that revolved around real world scenarios in this technology plan were minimal. Instructional activities did include collaboration among students in a group, but the activities lacked a design foundation of actually putting the students in a real world scenario where each member of the group could assume a role. One of the activities, designing the front page of a newspaper called the Pennsylvania Gazette, actually could have been planned from the standpoint of a newspaper office with each student being assigned an individual role.

Partner in the Learning Process. With regard to using technology as a partner in the learning process, Elementary Group 1 planned for the use of computers with Internet access in two of their three instructional activities, but once again in a minimal capacity. In the first activity, students were asked to visit various Internet sites in order to collect information on Franklin that would be used to create a timeline. Upon completion of the timeline, students were required to visit the ReadWriteThink Printing Press (http://interactives.mped.org/view_interactive.aspx?id=110&title=). This site was used in the first plan to assist in the creation of the previously mentioned Pennsylvania Gazette. The site is user-friendly, but only provides students with the ability to type text into predetermined text boxes and add images to predetermined locations as well. In this respect, the ReadWriteThink Printing Press serves mainly as a productivity tool, a tool that helps students produce work.

Moreover, in the second activity, students were once again required to use the Internet as a research tool. However, this time they were using the Internet to find facts about Franklin's life that would be use to create a game titled "Ben Franklin Jeopardy." In this activity, simply visiting Internet sites and creating questions about Franklin and his life leads to, at best, rote memorization of factual information, the lowest level of learning, or surface knowledge. In order for this activity to utilize technology as a partner in the learning process, it would need to be designed as what Jonassen (2000) calls an Intentional Information Search (p. 177).

The third instructional activity utilizes a plan for creating meteorological instruments. Even though these items are integrally related to Franklin, the plan does not call for the use of technology in the completion of the instructional activity.

Multi-Disciplinary Activities. In the final area, use of multiple disciplines in the planning process, Elementary Group 1 showed some signs of a developmental level. The plan produced for the U2 Tech Plan assignment encompassed the disciplines of social studies, language arts, and science.

However, each of the tech plan lessons is self-contained to a specific discipline. The first lesson focuses on language arts skills necessary for the creation of a newspaper. In the second activity, students employ social studies facts in the creation of a board game. Finally, in the third lesson, students depend upon scientific knowledge in the creation of meteorological instruments.

Even though multiple disciplines are addressed in the aforementioned plan, none of the lessons actually integrate multiple disciplines into a single lesson. In this respect, curricular areas remain isolated from one another.

Post-PBL Technology Plan for Elementary Group 1

Real World Environments. In the post-PBL technology plan, Elementary Group 1 demonstrated considerable movement toward the use of real world scenarios in the planning process of their lessons. Focusing on a "green" theme for Earth Day, Elementary Group 1 designed a real world scenario that asked students to solve a problem that resulted from a letter that was presented to them by their principal. In the letter, the principal announces that the school district has purchased two acres of land that is adjacent to their playground. However, due to the presence of a creek and a considerable amount of debris, the school board has decided that it is too unsafe for the

children to be playing on. Therefore, any student caught on the newly acquired land will be subject to disciplinary consequences.

This letter provides the setting for a real world activity where students can actually assume a role and participate in the development of a solution to a problem. The activity, which is explained in greater detail in the next section, presents how the use of technology can be utilized as a partner in the learning process.

Partner in the Learning Process. Throughout this real world activity, the plan calls for the use of technology as a partner in the learning process to accomplish the desired outcomes of each lesson. In order to achieve this, students were asked to utilize the following technological tools: word processor, spreadsheets, Power Point, digital cameras, Smart Boards, and the Internet.

In the first activity, students are required to construct a letter that responds to the principal's announcement and notifies him of their intention to find a solution for using the newly acquired space. The letter explains that the students will create and design a plan for cleaning up the land and using it in a safe manner; this is due to a recent science lesson on the environment and recycling. To accomplish this, the students are asked to use a word processor in constructing the letter to the principal. As mentioned previously, students' using a word processor for typing demonstrates the use of technology merely as a productivity tool.

However, the next lesson in the plan requires the use of spreadsheets to design a playground layout and estimate the cost of necessary building materials by using basic formulas for addition, subtraction, and multiplication. Students begin the activity by researching existing designs on the Internet at Peaceful Playgrounds

(http://www.peacefulplayground.com/resources). Issues of safety and acceptable construction materials are discussed within smaller groups in the class. Students also explore the possibility of creating a pond for use in the study of science.

As a culminating activity, the students design a newsletter that informs the parents of the progress that the class is making. The newsletter also presents articles on ecological topics, as well as digital photographs of the project.

In the end, Elementary Group 1 has designed a series of lessons that flow nicely together and use technology for purposes greater than productivity. Therefore, Elementary Group 1 demonstrates a move to an established level for technology as a partner in the learning process.

Multi-Disciplinary Activities. In the final area, use of multiple disciplines in the planning process, Elementary Group 1 demonstrated that they had moved from a developing level to that of having demonstrated an established level in this area. The plan produced for the U7 Tech Plan assignment encompassed the disciplines of math, science, language arts, ecology, and art.

The major difference in this section, as compared to the U2 Technology Plan, was that lessons were planned and multiple disciplines were utilized within individual lessons. The planning for the second lesson required the use of math skills in the formation of the playground design. It also required artistic vision and planning with regard to the placement of items in the plan. The third activity combined language arts and science in the creation of the project newsletter.

Table 6 presents the findings of the qualitative content analysis for Elementary Group 1.

Table 6.

Effect of Online PBL on Elementary Group 1 Planning

	Real World	Tech as Partner	Multiple Disciplines
Pre-PBL Tech Plan	Minimal	Minimal	Developing
Post-PBL Tech Plan	Established	Established	Established

Elementary Group 2 Planning

The second elementary group consisted of participants who varied in many areas. However, Table 7 demonstrates that this group possessed a reasonably high level of technology expertise with no participants falling within the novice level.

Pre-PBL Technology Plan for Elementary Group 2

Elementary Group 2 completed their first technology plan, U2 Tech Plan, prior to participating in any PBL scenarios. The plan consisted of several lessons that focused on a theme of Black History. Designed for a third grade level, the plan calls for the use of activities that will be completed by individuals, small groups, and the entire class. The first lesson addresses the identification of famous black individuals. The second and third lessons address concepts of place value and the history of Rosa Parks. The final lesson plans for the exploration of African American scientists.

Table 7.

Participant Attributes of Elementary Group 2

Participant	Teaching Status	Gender	Pedagogy	Age	Technology
13	In-Service	Female	6-15	31-40	A
16	Pre-Service	Female	0-5	20-30	I
18	In-Service	Male	0-5	31-40	I
17	Pre-Service	Female	0-5	20-30	I

Lessons for this plan were based on the National Technology Standards for Students, or NETS. The plan also provides course objectives and goal statements pertaining to its Black History theme. Assessment rubrics and references for this plan were also provided. Finally, the overview of the plan states the curricular areas to be covered, as well as the types of technology to be employed.

Real World Environments. Planning that occurred for this assignment followed a very traditional format. Participants designed lessons that were basically teacher directed. Components of the planning process included the use of the following: anticipatory set, accessing prior knowledge, direct instruction, group work, individual practice, and assessment procedures.

Considering that the planning process followed a traditional format, it is not surprising that none of the lessons call for the use of real world scenarios in their procedures. Furthermore, problems are not presented that require the students to work collaboratively, or assume the role of real world individuals. Therefore, Elementary Group 2's U2 Tech Plan is assessed as meeting a minimal level in this area.

Partner in the Learning Process. Considering Elementary Group 2's level of technology expertise, it is not surprising that the planning process called for the use of several types of current and emerging technologies.

The first lesson demonstrated a developing use of technology as a partner in the learning process. The anticipatory set was accomplished by having the students listen to a podcast of Martin Luther King's "I Have a Dream" speech. Following this, additional video streams of famous black individuals were presented. Students used these media presentations to select a person and used the Internet to research facts about them and how they became famous. The concluding activity provided the students with the freedom to present their information in the modality that they preferred. This could range from acting as the individual creating a PowerPoint presentation, or developing their own video montage.

The second lesson on place value demonstrates minimal use of technology. The planning for this lesson was restricted to the use of two Internet sites. The first site, Larson Math (http://www.larsonmath.com), operates mainly on a computer-based instruction model where students receive instruction, drill and practice, and complete a final assessment. The second site, Super Kids (http://www.superkids.com), simply allows the students to create their own math worksheets. Neither of these sites provide for the use of technology in assisting higher order thinking, or the development of problem solving skills.

The third lesson on Rosa Parks showed promise technologically as a partner in the learning process. The planning process for this lesson calls for the use of a blogging site (http://classblogmeister.com). A blog, or web log, is an online publishing tool that allows

students to practice their communication skills through authentic communication. In this lesson, students were asked to create a blog that addressed the following questions:

> Have you ever stood up for something, like Rosa Parks, that you thought was right? Did it turn out to be worth it? Why? How did you feel during and after the event?

After the blog postings were completed, students were asked to critique peer postings, providing both positive and constructive criticism.

The final lesson basically utilized the Internet to search for information about black scientists. Students were presented with a list of scavenger hunt questions and asked to search the Internet to find the answers to those questions. Even though this qualifies somewhat as an intentional search, it utilizes technology moderately as a partner in the learning process. Therefore, Elementary Group 2 is assessed as meeting a developmental level in this area.

Multi-Disciplinary Activities. Elementary Group 2's pre-technology plan demonstrated considerable development with respect to use of multiple disciplines. The plan produced for the U2 Tech Plan assignment encompassed the disciplines of social studies, language arts, math, and science.

Even though Elementary Group 2's plan provided for various curricular areas, lesson three was the only activity that included more than one discipline. In the "Rosa Inspired blogging" lesson, students were required to focus on the areas of social studies and language arts. Lesson one focused mainly on social studies and lesson four addressed issues related to science.

However, lesson two was totally off base with respect to the Black History focus. This lesson provided instruction on place value, but had no connection whatsoever to the

planned theme. Therefore, Elementary Group 2 demonstrated that issues of connectivity within its planning process needed to be addressed.

Post-PBL Technology Plan for Elementary Group 2

Real World Environments. Elementary Group 2 begins their U7 technology plan assignment from a very realistic and real world perspective. The plan begins with each of the participants writing a letter to their principal presenting their case for increased attention in the area of technology. The letters are written in a professional manner where the teachers take on the role of a technology advocate, anchoring their requests by describing the benefits that students will receive.

> Although it may seem that the children of the current generation are all up on their technology skills, knowing how to shuffle from one song to the next on their iPod can only go so far. Our schools need to be better prepared to teach these children real technology skills. (Participant 17, May 5, 2007)

> The NCLB Act tells us that all teachers must be highly qualified and state certified. To be highly qualified, teachers need to stay current with how children learn and technology is a large part of that process. Without incorporating specific technological criteria on a daily basis, these children will fall behind in a world surrounded by technology. With the use of this technology, schools would have a greater chance that No Child [is] Left Behind. (Participant 13, May 6, 2007)

Furthermore, the letters to the principal request resources that are deemed necessary for integrating technology into their planning practices. Requested resources include the following: TVs, DVDs, laptops, printers, LCD projectors, Microsoft Office, Photoshop, Timeliner, Kidspiration, DreamWeaver, Go Live, NVu, scanners, Smart Boards, podcasting software, Skype, and Wireless Internet connectivity.

Following the letters to the principal, Elementary Group 2 participants developed a six-week plan for each of their curricular areas, as well as detailed lessons for that plan.

Even though the U7 Technology Plan was far more complex than that of the U2 Technology Plan, the planning process with respect to real world activities did not seem to increase in frequency.

The first plan, titled "A Moment in Time," was the best example of planning for real world activities. In this plan, students focused on the curricular area of social studies and examined the experiences of immigrants coming to the United States. Students are required to devise a plan that assists immigrants with finding employment in this new and strange land. Each member of the group assumed a role for this activity and played the part of the following: employment specialist, recruiter, interviewer, and organizer.

Partner in the Learning Process. Even though Elementary Group 2's U7 Technology Plan demonstrated a developmental level with respect to real world activities, the group's planning for technology integration increased in the amount of technology used, but only on a developmental level as a partner in the learning process.

Various technologies, as mentioned in the previous section, are included in the six-week lesson plans. Almost all lessons included some type of research using the Internet. Three of the plans called for a PowerPoint presentation while another called for the use of Excel in looking at numeric data about states. Another simply used Word to type a list of state facts, or math word problems.

In examining technology use in this plan, the activity that utilized Excel in the collection and analysis of data on states most closely reflected technology as a partner in the learning process. With the curricular focus of mathematics, this lesson requires students to design a spreadsheet that would be used to make comparisons, such as square

miles or populations, with that of other state facts. Students are required to consider questions such as the following:

> If one million additional people moved into your state, how would this change the number of people per square mile? What if everyone from California moved to your state and everyone from your state moved out? What would the population be per square mile? What would the population per county be? (Participant 18, April 29, 2007)

Finally, in another lesson, students are required to utilize a teacher created webquest on Lewis and Clark. Webquests are inquiry-based activities that utilize the web for the purpose of knowledge acquisition and integration that might require the use of higher level thinking skills. However, the plan neglects to address specific objectives, or questions that would be used to achieve this outcome. Considering this, technology use in this final technology plan remained on a developmental level.

Multi-Disciplinary Activities. In the final area, use of multiple disciplines in the planning process, Elementary Group 2 demonstrated that they had moved from a developing level to that of having demonstrated an established level. The plan produced for the U7 Tech Plan assignment encompassed the disciplines of social studies, math, language arts, technology, and art.

The major difference in this section, as compared to the U2 Technology Plan, was that lessons were planned that utilized multiple disciplines within individual lessons. Evidence of this can be found in the lesson "A Moment in Time." In this lesson, the plan calls for the integration of social studies concepts of immigration with that of artistically restoring immigrant photos with technology applications. Students are also required to work on their language arts skills by completing an Internet Workshop Journal.

In another lesson plan that focused also on a social studies curricular theme, students are asked to participate in a webquest, which normally requires a multi-disciplinary approach. In addition to this, students utilize math concepts in analyzing the stock market crash.

Table 8 presents the findings of the qualitative content analysis for Elementary Group 2.

Table 8.

Effect of Online PBL on Elementary Group 2 Planning

	Real World	Tech as Partner	Multiple Disciplines
Pre-PBL Tech Plan	Minimal	Developing	Developing
Post-PBL Tech Plan	Developing	Developing	Established

Middle School Group 1 Planning

The middle school group consisted of participants who varied in all areas except pedagogical experience. Table 9 shows that this group possessed a reasonably low level of pedagogical expertise with no participants falling in a category above five years of classroom experience.

Pre-PBL Technology Plan for Middle School Group 1

Middle School Group 1 completed their first technology plan, U2 Tech Plan, prior to participating in any PBL scenarios. The plan consisted of several lessons that focused on a theme of the1920s. Designed for a seventh or eighth grade level, the plan utilizes a

fairly rigid didactic approach. The first lesson addresses the origins of 1920s culture and prominent figures. The second and third lessons address concepts of the Harlem Renaissance, as well as business, economy, and the stock market crash of the 1920s. The final lesson calls for the use of a PowerPoint Jeopardy game as a review. As a culminating project, students participate in a simulation game revolving around the stock market.

Real World Environments. Planning that occurred for this assignment followed a very traditional didactic approach. Lessons designed for this plan were basically teacher directed; components of the planning process include the use of chapter notes in which students are required to copy for study purposes. Vocabulary words are identified in the notes by being underlined. Fill-in-the-blank worksheets are provided for the following day's quiz.

Table 9.

Participant Attributes of Middle School Group 1

Participant	Teaching Status	Gender	Pedagogy	Age	Technology
1	In-Service	Male	0-5	20-30	A
7	Pre-Service	Female	0-5	20-30	I
9	In-Service	Female	0-5	31-40	N

In this plan, the only evidence that reflects the use of real world activities exists in the form of the culminating stock market game. Students begin this activity by receiving instruction on how to purchase shares of stock such as Wal-Mart, IBM, Intel, GE, and

Microsoft. Next, they are assigned designated stocks and required to analyze, track, and graph their daily progress.

The simulation activity has the potential for a promising real world activity, but the planning process does not address any aspect of placing students in positions that exist within the real stock market.

Partner in the Learning Process. Technology used in Elementary Group 2's U2 Technology Plan consists of teacher directed presentations. Notes have been typed in a word processor for display on a projection device. Planning also calls for additional content to be presented in the form of a PowerPoint presentation that consists of bulleted items on the Harlem Renaissance. This clearly demonstrates that technology use by students is not considered at this point in the plan.

However, students are required to track, analyze, and graph their stocks using a spreadsheet program while participating in the stock market game. On a daily basis for one week, students track their stock's data and enter it into Excel. Next, using a line graph, students create a graph to demonstrate the performance of their stock. Finally, they are required to write a summary that identifies what you can speculate from its performance trend. Students are required to address the following questions:

> Would you want to invest in these stocks? Is this enough information to make up your mind? What would you do if you wanted to buy stocks? (Participant 1, February 4, 2007)

Considering Elementary Group 2's level of pedagogical expertise, the minimal use of technology as a partner in the learning process may be typical of teachers with this level of inexperience.

Multi-Disciplinary Activities. Middle School Group 1's pre-technology plan demonstrated minimal development with respect to use of multiple disciplines. The plan produced for the U2 Tech Plan assignment focused mainly on the discipline of social studies; however it could be argued that the Stock Market game requires students to utilize math skills in the form of purchasing stocks and graphing their performance.

Post-PBL Technology Plan for Middle School Group 1

For the U7 Technology Plan, Middle School Group 1 continues with a curricular focus on social studies, but moved their thematic focus to that of the Cold War. In comparison to the original U2 Technology Plan, this plan provides a higher level of development providing seven individual lessons: Dropping the Bomb, Propaganda and George Orwell's 1984, Living in the Cold War, Communism Vs. Democracy, Cuban Missile Crisis, Using Art to Interpret Historical Events, and Song Analysis.

Real World Environments. Similar to the U2 Technology Plan, planning that occurred for this assignment followed a very didactic approach. In many instances, the lesson plan calls for a very traditional teacher-directed approach.

> The students will read from the textbook and various articles about the Cuban Missile Crisis. (Participant 9, April 29, 2007)
>
> The teacher will lead the students through an online research inquiry concerning the Cuban Missile Crisis. (Participant 9, April 29, 2007)
>
> The teacher will define propaganda and go through examples of its use in history. (Participant 7, April 29, 2007)

Nonetheless, the U7 Technology Plan differs from the first technology plan in that it utilizes, to some extent, the use of student groups to complete specific activities.

None of the planned activities for this assignment were created with a focus on scenarios from the real world perspective. However, there were possible situations for this to occur. For example, in the lesson entitled "Living in the Cold War", students are required to seek out a person that lived during the Cold War era and interview them. This assignment could have been approached from the perspective of a news agency that was commissioned to create a documentary about issues of this politically charged era. Students could have been assigned specific roles, given a project plan, and provided with a budget and timeline for completion.

Partner in the Learning Process. In the area of technology as a partner in the learning process, Middle School Group 1 increased its use of technology, but only to a developing level. In many instances, lessons that are planned for this assignment utilize technology as a productivity tool.

In the lesson "Dropping the Bomb," students are provided with a copy of a primary document on President Truman's August 6, 1945 press release. The lesson plan calls for groups of students to analyze the document according to questions that have been provided by the teacher. After completing the analysis, one student is simply required to type the answers for the group using a word processor. Finally, a group member is asked to email the answers to the teacher.

Additionally, this lesson calls for students to use a teacher created website that presents questions and a series of web links for searching for the answers, a "hotlist." However, when examining Bloom's cognitive domains, the questions are written at a very low level and do not require the use of technology to facilitate an understanding of desired outcomes.

In another lesson entitled "Cuban Missile Crisis," students are asked once again to use a hotlist to research events leading to this impasse. After gathering facts, students use Microsoft Publisher to create a timeline; this activity also demonstrates a low level of technology use for critical thinking.

Even though most of the technological examples in this plan demonstrate a minimal level of use with respect to technology as a partner in the learning process; however, two lessons, "Using Art to Interpret Historical Events" and "Propaganda and George Orwell's 1984," demonstrate a developing level of technology use. Both of these lessons utilize technology to create a computer-generated work of art. One plan requires students to create a work of art that represents how they feel after listening to an audio file of Winston Churchill's speech, "The Iron Curtain." The other plan addresses issues of propaganda and asks students to create a collage of propaganda/advertisements that are used in society today.

Multi-Disciplinary Activities. Middle School Group 1's post-technology plan demonstrated a developing level with respect to use of multiple disciplines. Whereas the first technology plan mainly addressed the curricular area of social studies, the second technology plan encompassed the curricular areas of social studies, art, and language arts.

The major difference in this section, as compared to the U2 Technology Plan, was that lessons were planned that utilized curricular areas other than social studies. In spite of this, lesson five "Communism Vs. Democracy" was the only activity that included more than one discipline in its plan.

Table 10 presents the findings of the qualitative content analysis for Middle School Group 1.

Table 10.

Effect of Online PBL on Middle School Group 1 Planning

	Real World	Tech as Partner	Multiple Disciplines
Pre-PBL Tech Plan	Minimal	Minimal	Minimal
Post-PBL Tech Plan	Minimal	Developing	Developing

High School Group 1 Planning

The Secondary Group 1 consisted of participants that varied in all categories. Table 11 shows that this group possessed a reasonably low level of pedagogical expertise with only one participant falling in a category above five years of classroom experience. However, the group possessed a solid level of technology expertise with three participants falling within the Intermediate range.

Table 11.

Participant Attributes of High School Group 1

Participant	Teaching Status	Gender	Pedagogy	Age	Technology
5	In-Service	Male	0-5	20-30	I
12	In-Service	Female	6-15	31-40	N
3	Pre-Service	Female	0-5	20-30	I
14	Pre-Service	Male	0-5	20-30	I

Pre-PBL Technology Plan for High School Group 1

Real World Environments. High School Group 1 completed their first technology plan, U2 Tech Plan, prior to participating in any PBL scenarios. The plan submitted for

this group consisted of a single lesson plan that focused on American and European women's roles during WWII. While a single lesson can hardly be considered a technology plan, it provides a glimpse into the viewpoints of the participants in this group. The lesson plan does not specify a target grade level, but has been designed for a secondary history curriculum; state standards for this lesson are provided.

The lesson plan follows a didactic design where the teacher initiates a discussion on the role of women during WWII. After this discussion, students are encouraged to consider choosing a person, organization, or specific topic to research. Periodic posts of their research findings are required on a class blogging site with a final submission due at the end of the activity.

Upon evaluation of this lesson, High School Group 1 does not provide any evidence of planning for the use of real world scenarios for this assignment.

Partner in the Learning Process. Technology used in High School Group 1's U2 Technology Plan requires student use of computers for the purpose of online research. Before the students are allowed to begin the research process, they are provided with a series of podcasts on effective research strategies. Additional web sites are provided to supplement the podcasts. Finally, as students move through the research process, they are required to utilize a class blogging site to post their research findings.

Even though several uses of technology are planned for in this lesson, they merely serve as avenues to receive and deliver information. If the design of the lesson utilized the blogging site for the purpose of research collaboration, it would fit the role of a partner in the learning process. However, students are only required to post periodic

progress on their individual research. Consequently, technology in this plan is used at a minimal level.

Multi-Disciplinary Activities. As previously stated, this plan consists of one lesson, which focuses on the curricular area of history. Students are required to submit postings to a class blogging site, so it could be argued that it supports the curricular area of English. Nonetheless, planning for the use of multiple disciplines for this assignment is minimal.

Post-PBL Technology Plan for High School Group 1

For the U7 Technology Plan, High School Group 1 continues with a curricular focus on history, but moves their thematic focus to the Renaissance. In comparison to the original U2 Technology Plan, this plan provides a higher level of development providing five individual lessons: The Renaissance through Internet Investigation, Renaissance Newsletter: The Sciences of the Renaissance and Today, A Taste of Pi, Art of the Renaissance, and The Modern Day da Vinci Notebook.

Real World Environments. High School Group1 begins their U7 technology plan by presenting a series of lessons that have the potential for real world scenarios, but fall short of making the necessary connections to the time period.

The plan begins with a presentation of their culminating project for this unit, "The Modern Day da Vinci Notebook." As the participants move through the lessons of this plan, they are to construct a diary in a Gregg Ruled StenoBook that follows the format used by Leonardo da Vinci. The design of this lesson does not make any mention of real word connections, but could have very easily. By providing a scenario that asked them to

take on the role of the great Leonardo da Vinci, students could have been motivated to research the Renaissance genius and mirror his actions through the creation of a diary.

Additionally, in the lesson entitled "Art of the Renaissance," students study architecture of the time period. After an initial teacher-led presentation, research commences with the outcome being the creation of a house that is designed in the style of this period. Once again, this lesson could have been presented by using a scenario that requires students to take on the role of a Renaissance architect.

The remaining lessons of the plan provide no real opportunities for the creation of real world scenarios. Therefore, High School Group 1's planning for the use of real world scenarios remains at a minimal level.

Partner in the Learning Process. Even though High School Group 1's U7 Technology Plan demonstrated a minimal level with respect to real world activities, the group's planning for technology integration increased with respect to the amount of technology used, but only on a developmental level as a partner in the learning process.

In examining the details of the plan, various technologies are included in the five lesson plans. Almost all lessons included some type of research using the Internet. One of the lesson plans call for a PowerPoint presentation, while another calls for the use of Excel in calculating Pi. Even though use of a spreadsheet in this manner could be considered using technology as a partner in the learning process, the plan does a relatively poor job of relating the calculation to that of the Renaissance theme.

Nonetheless, one lesson did demonstrate the use of technology as a partner in the learning process. The lesson entitled "Art of the Renaissance" focused on developing an architectural plan for a home during this time period. The plan calls for the students to

use a computer-assisted drawing program to complete this activity while asking them to reflect on how difficult it might have been for architects of this time period to accomplish a similar task.

> Through this exercise, the students will gain an understanding for how hard it is to design a home using a computer program. This will hopefully allow them to gain some appreciation for how hard it must have been for architects of the Renaissance. (Participant 14, April 29, 2007)

Other lessons in this plan call for the use of technology for research, or as a productivity tool. Therefore, High School Group 1's planning for technology use as a partner in the learning process moves from minimal to a developing level.

Multi-Disciplinary Activities. High School Group 1's post-technology plan demonstrated considerable development with respect to use of multiple disciplines. The plan produced for the U7 Tech Plan assignment encompassed the disciplines of history, language arts, math, science, and art.

Even though High School Group 1's plan provided for various curricular areas, lesson five was the only activity that included more than one discipline within its plan. The culminating activity entitled "The Modern Day da Vinci Notebook," requires students to journal their progress throughout all lessons of the plan. In this respect, the students are reflecting on how all of the curricular areas come together for this time period. Therefore, High School Group 1's plan moves from a minimal level to that of an developing level in this area.

Table 12 presents the findings of the qualitative content analysis for High School Group 1.

Table 12.

Effect of Online PBL on High School Group 1 Planning

	Real World	Tech as Partner	Multiple Disciplines
Pre-PBL Tech Plan	Minimal	Minimal	Minimal
Post-PBL Tech Plan	Minimal	Developing	Developing

High School Group 2 Planning

The High School group 2 consisted of participants who varied in all areas except pedagogical experience. Table 13 demonstrates that this group possessed a reasonably low level of pedagogical expertise with no participants falling in a category above five years of classroom experience.

Pre-PBL Technology Plan for High School Group 2

High School Group 2 completed their first technology plan, U2 Tech Plan, prior to participating in any PBL scenarios. The plan consisted of several lessons that focused on a theme of incorporating technology and artistic development in the curricular area of history. Designed for a twelfth grade level, the plan consists of two lessons, one that focuses on issues of U.S. involvement in World War II and another that requires collaboration with the Graphic Arts department in developing an informational website on the topic. Both lessons provide state standards and performance objectives.

Table 13.

Participant Attributes of High School Group 2

Participant	Teaching Status	Gender	Pedagogy	Age	Technology
11	In-Service	Female	0-5	31-40	I
2	Pre-Service	Male	0-5	20-30	N
6	Pre-Service	Male	0-5	20-30	I
15	In-Service	Female	0-5	20-30	A

Real World Environments. High School Group 2 completed their first technology plan, U2 Tech Plan, prior to participating in any PBL scenarios. The first lesson, "WWII – U.S. Involvement," follows a fairly didactic approach, whereas the second lesson, "World War II Website," employs a small group structure that follows a teacher developed plan.

In evaluating this plan, it is clear that it does not provide any evidence, or reflection of the use of real world activities. The web design activity has the potential for a promising real world activity, but the planning process does not address any aspect of placing students in collaborative positions that exist within a real world company whose focus is creating websites. Therefore, High School Group 2's U7 Technology Plan in this area falls within the range of a minimal level of real world planning.

Partner in the Learning Process. Technology used in High School Group 2's U2 Technology Plan requires student use of computers for the purpose of creating an informational website on World War II. In addition to creating a website, the first lesson provides a series of URLs in the resources section, but does not clearly reference their use or purpose within the procedure of the lesson.

Since the website lesson is being delivered in the graphic arts class, it is assumed that the students have received prior training for this activity. The actual lesson begins with a review of web concepts such as table formation, button creation, font usage, and Flash animation techniques. Students also discuss issues of acceptable and unacceptable use of copyrighted materials; additional topics, such as APA citations and web site building techniques, are addressed. It is stated that students will use Adobe CS for image creation, whereas the web development lesson utilizes Adobe Dreamweaver.

The students are provided seven weeks for this activity and work in collaborative small groups. Construction of the website begins with the development of a site map which organizes how they will present the findings of their research on the topic. Upon completion of the site map, students are expected to construct their website, provide textual information and graphics, test all links, and produce a quality finished product.

Therefore, the web site plan provides a technology tool for students to create a product that portrays their understanding of the concepts being studied and can be considered a partner in the learning process. However, since the first plan provides only a series of URLs that have little connection to the stated objectives, High School Group 2's plan for this area falls within the developing range.

Multi-Disciplinary Activities. As previously stated, this plan consists of two lessons, which focus on the curricular areas of history and graphic arts. In the first lesson, which addresses U.S. involvement in World War II, planning does not provide any evidence of using multiple disciplines.

However, the web site development lesson specifically states that the creation of the web site project is to be completed in conjunction with the History department.

Information that is derived from the first lesson plan is integral for the completion of this assignment.

Even though this plan is shallow in depth, it does provide evidence that thought has been given to the connection between the curricular areas of history and graphic design. Therefore, this area of the plan falls within the developing range.

Post-PBL Technology Plan for High School Group 2

For the U7 Technology Plan, High School Group 2 changes its curricular focus from history to that of career development. In comparison to the original U2 Technology Plan, this plan provides a higher level of development providing four individual lessons: Career Package Portfolio, Creating Financial Responsibility Through the Use of a Budget, History of American Finance, and Stationary Design.

Real World Environments. High School Group 2 begins their U7 technology plan assignment from a very realistic and real world perspective. The plan begins with the creation of a problem scenario that describes a high school teacher attempting to prepare her students for life after high school.

> Ms. Segal is a 12th grade English teacher in the Dreaming Town School District. Her students have been focusing on their future after high school. Some are planning on attending college, some to a trade school, and some into the work force. As the date of graduation draws near, she begins to focus on the career development materials that she feels her students will need to begin a successful life after they leaver her and move on, whatever their post secondary choices may be. Considering that she has access to an entire computer lab, she has decided to implement the use of computers, the Internet, Microsoft Word, PowerPoint, Excel, and Adobe Creative Suites. (Participant 15, April 29, 2007)

The scenario continues by stating that the students will need to develop and write a resume, as well as a cover letter and thank you letter. They will also work through the

process of searching for a job online. Additionally, students develop their own logo, business cards, and letterhead for creating their resumes. Finally, they will need to demonstrate how to forecast and balance their money for the following year.

Considering that High School Group 2's U2 Technology Plan was assessed at a very minimal level, this plan provides evidence that the participants have made significant progress in this area and have firmly established the use of real world scenarios in their planning.

Partner in the Learning Process. In the area of technology as a partner in the learning process, High School Group 2 increased its use of technology, but only to a developing level. In many instances, lessons that are planned for this assignment utilize technology simply as a productivity tool.

In the first lesson on the history of American finance, PowerPoint is used to provide a teacher-directed discussion on this topic. Use of the Internet is called for, but only as a resource for research. Moreover, the lesson entitled "Career Package Portfolio" utilizes a word processor for the creation of a resume, cover letter, and thank you letter. Both of these examples point to using technology to produce a piece of work rather than as a tool for higher-level thinking.

However, in the lesson entitled "Creating Financial Responsibility Through the Use of a Budget," students are required to create their own budget by entering formulas into a spreadsheet program. As students enter and manipulate data in the spreadsheet, they are able to make decisions that will help them to plan for their financial future. Furthermore, the lesson entitled "Stationary Design," calls for students to use a graphics program in the creation of a logo that will be used on their own stationary. This software

tool allows participants to produce a logo. In doing so, the tool serves as a vehicle for thinking and working creatively.

Multi-Disciplinary Activities. In the final area, use of multiple disciplines in the planning process, High School Group 2 demonstrates that they have moved from a developing level to that of an established level. The plan produced for the U7 Tech Plan assignment encompassed the disciplines of history, math, english, technology, and art.

The major difference in this section, as compared to the U2 Technology Plan, was that the planning process incorporated the use of multiple disciplines in the development of final products for the proposed problem scenario. The concepts presented in this plan flow nicely from the presentation of the history of finance, to the creation of a budget, and then finally to the development of a career portfolio package; each of the lessons being supported by the aforementioned curricular areas.

Table 14 presents the findings of the qualitative content analysis for High School Group 2.

Table 14.

Effect of Online PBL on High School Group 2 Planning

	Real World	Tech as Partner	Multiple Disciplines
Pre-PBL Tech Plan	Minimal	Developing	Developing
Post-PBL Tech Plan	Established	Developing	Established

Participant Attributes – Influence of Online PBL

3. *In what ways do teachers' perceptions of learning technology integration through an online PBL model vary among the participants along variables such as*

gender, age, level of technology expertise, pre-service or in-service status, and teaching experience in years?

Participant Perceptions Based on Age

Participant Perceptions: 20 – 30 Years Old. Analysis of a query for perceptions of the 20 to 30 year old participants showed evidence of very positive feelings towards learning technology through the use of an online PBL model. Various participants took a global view in stating the importance of technology in education and that all teachers should become proficient; by doing this, teachers can better prepare their students for a future that requires the use of technology in work environments as well as daily life.

> Technology is our future and should be a part of our educational plan. (Participant 15, April 30, 2007)

> …technology will continue to drive innovation and therefore should be an integral part of education as well, teachers must find new ways to use technology in their classroom. (Participant 5, April 30, 2007)

> In our ever advancing age of technology, it is beneficial in just about all teachers planning to utilize technology. (Participant 17, February 18, 2007)

Even though the 20 to 30-age range viewed technology as important for the future of their students, participant perceptions of learning technology through online PBL was extremely positive as is evidenced in the following statements.

> Online PBL has opened my eyes to the world of technology. I am loving learning what all of the programs have to offer. I look forward to more exploration in the future. (Participant 4, February 25, 2007)

> This online PBL process is starting to change the way I feel about technology integration. This by no means finding a website and getting answers to a question anymore. Technology integration is broad and can really allow students to use their imaginations and creativity and run with a problem in order to solve it in whatever way they see fit. Online PBL allows for true learning and growth to take place. (Participant 17, February 18, 2007)

> As I sit down and plan my final unit in the last few weeks of school, I have thought about the impact that technology could play in those lessons and finding a way to integrate it more often in the class and engage the students more. This is the greatest value of PBL instruction and my work throughout this class. (Participant 5, April 28, 2007)

> I have learned a lot about myself as a student through doing our online PBL. I found myself digging deeper than I ever thought possible. I am also now able to look for connections everywhere. (Participant 4, March 4, 2007)

Finally, participant perceptions of learning technology integration through online PBL demonstrated a feeling of growth in awareness of technologies that were available to them, but also reflected a sense of understanding how to plan for the integration of technology into their curricular areas.

> I really took a lot away from the semester including what it means to truly integrate technology into a curriculum. I actually had already fulfilled my technology class requirement at another school, but I'm really glad I choose to take this class. It was well worth it! (Participant 17, April 30, 2007)

> This class has thus far shown me many new ideas and tools for the classroom and I think that there is only more to come. (Participant 15, February 25, 2007)

> As this class comes closer to its completion I feel satisfied with what I have accomplished. I feel more technologically savvy as well as better adjusted to group work, of which will serve me well in the future. (Participant 17, April 9, 2007)

> I have to admit that I have learned a great deal from this class. I never knew how to plan for technology use when creating lesson plans, or how many types of technology are available to use. This is such an amazing experience. (Participant 16, April 30, 2007)

Participant Perceptions: 31 – 40 Years Old. Analysis of a query for perceptions of the 31 to 40 year old participants showed evidence of very positive feelings towards learning technology through the use of an online PBL model. Perceptions were similar to the 20 to 30-age range, but differed in several ways. The 31 to 40-age range, while agreeing on the importance of technology, provided perceptions that indicated a lesser

degree of comfort, or familiarity with the use of technology as a partner in the learning process.

> Learning about technology, is something that I have needed to do for quite a while. I have not been using it in my classrooms, and even though it has been relatively available to me personally, I have not made any effort to learn about its uses. Having to do this course with only technology as a guide and as a communication tool has forced me to quickly learn what I have been missing. (Participant 8, February 17, 2007)

> I love the process of learning and incorporating technology into my thinking about how to teach my students. I was always afraid that I did not know enough to really teach using a computer as a major part of the lesson and learning, but I now know that a big part of that knowledge is not just taking the leap to learn more, but also allowing the students to be the guides to what they need to know and how they can use the computer to get there. (Participant 11, March 25, 2007)

However, throughout the study, participants of the 31 to 40-age range were very thoughtful about how online PBL impacted the planning process and its affect on learning.

> One of the best things about doing this PBL in such a rich technological atmosphere, is it really shows the student, me, exactly how this would work for students that are becoming much more "dependent" on technology in their every day lives. Having to rely on the technology in front of me to communicate with my colleagues gives a very clear picture of what is possible. It makes doing all kinds of "out of house" projects so much more accessible, and allows me to learn the best ways to pull in some of the resources that I need to know to be a good teacher. (Participant 8, February 17, 2007)

> Ever since the Tech Plan that was due a few weeks ago, my understanding of technology and how to use it in the classroom has grown. (Participant 14, March 2, 2007)

> When we first started these projects I thought they were going to be easy. I have found over the past couple of weeks that they really have changed my thinking about technology in the classroom and have challenged me to think about creative ways to integrate technology into the classroom on an everyday basis. (Participant 14, March 10, 2007)

> I am learning more ways to incorporate technology in my lesson plans. The best way I have learned is by reading my peers' lesson plans. Not only the people in

> my group, but other groups as well. It is very interesting to see how people interpret the same information. The different lesson plans and the different ideas have helped me realize other ways to go about writing a lesson plan and incorporating technology into those plans. (Participant 12, April 22, 2007)

Participant Perceptions: 41 - Above Years Old. Analysis of a query for perceptions of the only 41 and above participant showed evidence of very positive feelings towards learning technology through the use of an online PBL model. Even though this range consisted of only one participant, the viewpoint expresses feelings that reflect a positive tone towards the use of online PBL for learning technology integration.

> The problem based learning approach is working for me. I like the challenges that are presented and I love that the problem that was presented this week. It is a good experience to jump into a problem knowing that the solutions that I come up with are practical and will work in my classroom. It is a more meaningful process to solve real world problems. (Participant 10, February 18, 2007)

> I am really enjoying the online problem-based learning approach, since it makes the solution real and practical. I think that we have done a pretty good job keeping the solution within the realm of a third grader. I have run many of our ideas by my own third grade daughter who has made some good suggestions and given advice to keep it real. (Participant 10, March 24, 2007)

Furthermore, the participant in the 41 and above age range provided evidence that the online PBL approach was also beneficial in assisting with pushing the boundaries of student learning and the consideration of designing activities that focused on multiple disciplines.

> Our group has been very flexible overall. We have not really stayed within our individual comfort level. We have each volunteered to take on a component that we are not necessarily familiar with in order to learn more about it, thus increasing the challenge and potential for learning. (Participant 10, April 15, 2007)

> The activities that we were able to come up with were great ideas to keep a student engaged throughout the learning process. And many of the ideas incorporated lessons that utilized multi-disciplines. (Participant 10, April 15, 2007)

> This was a great course! I learned so much about the many ways to incorporate technology using real world problems. I have enjoyed it immensely! (Participant 10, April 29, 2007)

Participant Perceptions Based on Gender

Perceptions of Female Participants. Analysis of a query for perceptions of females in this study consisted of a subset of 12 participants. Overall, the perceptions of this group demonstrated a strong attitude that supported the use of online PBL in the teaching of technology integration and planning.

> Online PBL has impacted the way I will implement integrating technology in my classroom. (Participant 7, April 30, 2007)

> Online PBL forced me to think about what things I have learned from this class that I now feel are imperative for our youngsters to learn and why. (Participant 16, April 30, 2007)

One perception that surfaced provides an insight to a possible area of concern. Participants addressed a concern about the financial support that is necessary when planning and developing ideas of this type. If appropriate technologies are not purchased, the skills learned in this course will not be realized.

> Technology is our future and should be a part of our educational plan. The one aspect that is sad about technology is that as much as we develop these ideas and concepts, if our schools don't invest in the technology, they will never happen. (Participant 15, April 29, 2007)

Perceptions of Male Participants. Analysis of a query for perceptions of males in this study consisted of a subset of 6 participants. The general perceptions of this group demonstrated a positive attitude that supported the use of online PBL in the teaching of technology integration and planning.

> As I sit down and plan my final unit in the last few weeks of school, I have thought about the impact that technology could play in those lessons and finding a

> way to integrate it more often in the class and engage the students more. This is the greatest value of the PBL instruction and my work throughout this class. (Participant 5, April 28, 2007)

> Technology is something that, if used correctly, can keep students on their toes all the time. They can have a fun and different adventure every day of the week. I have learned so much in the past three PBL projects, however, I think now is the time to start making the jump into deeper uses of technology. (Participant 6, March 10, 2007)

However, not all perceptions of this subset were without concern. One participant stated concerns about the focus on learning and the role that technology plays in this endeavor, even going as far as questioning technology in general.

> I still feel as though technology is a very important part of education and needs to be integrated in any way possible. However, when I say that I don't mean that it should be used simply because it is there. (Participant 18, February 24, 2007)

> The Americans spent millions designing a pen that would write in space. The Russians took a pencil. Who is to say which was better? (Participant 18, March 26, 2007)

Even though it can be expressed that technology should be viewed as a partner in the learning process, this participant also questioned when technology should be introduced and how basic facts should be acquired.

> Technology is constantly changing and will often make things easier. However, it is important to remember that the children need to know the basics first. They need to know how to read, write, multiply and gather "facts", in order to be able to use technology well. Can technological advances help this process? Yes, but we still must be careful to make sure that the children can accomplish these tasks with pencil and paper as well. (Participant 18, February 11, 2007)

Nonetheless, in the end, the participant with concerns about technology and the degree to which it is used appeared to concede its place within the learning environment.

> Ultimately I learned that technology has a place in the classroom. It has a place in education. It has a place within society, but we must insure that we provide the children with the problem solving skills, and the ability to think, that will make them use technology well in the future. (Participant 18, April 29, 2007)

Participant Perceptions Based on Technology Expertise

Perceptions of Novice Technology Users. Analysis of a query for perceptions of novice technology users in this study consisted of a subset of 5 participants. The general perceptions of this group demonstrated a positive attitude that supported the use of online PBL in the teaching of technology integration and planning.

However, participants of this subset expressed concerns initially about learning technology integration while being fully immersed in an online course due to their limited technological expertise.

> I am not a technology person, but I am beginning to enjoy the process more and more. This will not only make my job easier, make me a better teacher, but in many ways will help me understand my students who are being raised in a technologically rich society. (Participant 8, April 29, 2007)

> I find it interesting the way in which I am both learning about and participating in the process. Though exciting, it can be frustrating at times because my technological capabilities are very limited and I worry that I am holding my classmates behind due to my limits. (Participant 12, February 9, 2007)

As the study progressed, participants expressed a deep level of anxiety at times when trying to complete required technological tasks. However, participants who persevered reflected on the learning experience as a positive move towards learning and using technology in their classrooms.

> I sat down and almost cried when I could not get the top of page to stay on. It was only until I took a Motrin that I felt like In could face the webpage again after the headache subsided…Eventually I managed to create a webpage. But boy, was it many man-hours, curses and sweat. I will have to say it was worth it. (Participant 12, April 9, 2007)

Other novice participants described how the online PBL experience changed the way they thought about teaching and the use of technology as a learning tool. Reflections

indicate that these participants have embraced integrating technology and look forward to positive growth in this area for the future.

> Online PBL has taught to think outside of the box. This is something that I look forward to doing in the future. (Participant 4, February 11, 2007)

> This online PBL unit has allowed me open my eyes in the fact we are able to use technology for so much more than I thought of in the past…I cannot wait to uncover many more possible ways to incorporate technology. I have learned to dig past the superficial in terms of technology and get to the nitty gritty of good information. (Participant 4, February 18, 2007)

In the end, the group of novice technology users expressed strong satisfaction with their growth in learning to integrate technology through their online PBL experience.

> I never thought that I could have learned this much about technology in such a little amount of time…This course has taught me a lot about myself as student and ways in which technology can be included into my classroom. (Participant 4, April 29, 2007)

> The most positive thing that I can think about in the course was the way we were expected to come up with ideas that we would use out in our careers. Most classes teach you this and that, and only a small margin is actually useful in the field. I found everything that I learned to be of use, and am looking forward to using more and more technology in my classroom. I also loved the PBL's. For my students, this is one of the only ways that they will actually buy into their education. If you give them a problem that actually relates to their world, they are much more likely to want to learn from it. (Participant 8, April 29, 2007)

Perceptions of Intermediate Technology Users. Analysis of a query for perceptions of intermediate technology users in this study consisted of a subset of 10 participants. The general perceptions of this group demonstrated a somewhat positive attitude towards the use of online PBL in teaching technology integration and planning.

However, participants of this subset expressed concerns that ranged from trying to integrate technology into curricular areas that they were unfamiliar with, to aspects of group dynamics in the online realm.

> One challenge of fitting all the subjects the students would be studying into the plan is that I am writing a lesson plan on something I have very little knowledge about. I am making it as accurate as possible, but it is outside of my comfort zone as far as content knowledge is concerned. (Participant 7, February 27, 2007)

On the other hand, other intermediate participants viewed working with curricular topics outside their area of specialization as a positive experience.

> One of the things that I think is essential to the process of PBL is that I get to work through problems that I would typically not look at. This can be both a positive and a negative. In one sense, I am now working through a problem that forces me to look at other disciplines and find a different and creative way to integrate technology. (Participant 3, February 18, 2007)

Group dynamics and the process of working collaboratively in the PBL environment were expressed by some as being moderately beneficial towards learning technology integration.

> I actually find the readings to be very helpful in my own ideas towards integrating technology in my classroom and it having a practical application that can positively affect my students, but am not really seeing the benefits of the group activities towards my understanding and application of technology. I like bouncing ideas off of other people, but I feel like that can be done in my own conversations with teachers that I work with. (Participant 5, February 18, 2007)

Nonetheless, other participants viewed the group aspect as being beneficial due to the supportive nature that the group environment can provide.

> At the very beginning of this process I felt a little uneasy about how to start this activity and how it was going to be completed. Some of the advantages of this activity were that it was done in a group so, if there were questions, there were peers there to help figure out the correct answer. (Participant 14, February 8, 2007)

However, in the end, the majority of participants of this group viewed online PBL as an effective way to learn technology integration.

> Utilizing technology in my planning also pushes me to learn more about what is available to use in the classroom… I gained a great deal from the ideas of the people in my group. MS Paint, for example, I have never used this for an assignment before this project. (Participant 7, February 27, 2007)

> I feel that overall we came up with some good ways to incorporate technology into our individual content areas. The Language Arts plan calls for writing letters and a newsletter using Word, and digital photography…. In the subject area of Math I chose to do a spreadsheet… The final plan pulls in a great deal of the technology that we used and explored during the semester. (Participant 11, April 29, 2007)

> My opinion about integrating technology has changed a little bit from when this class started. I felt that technology should be used all the time and thought it was the best tool. However, I have learned over the past couple of weeks that it is harder to implement then I thought. As a teacher you can't just throw on a movie or use PowerPoint to get all of your ideas across. Some serious thought needs to be put into making technology a useful part of the classroom setting. (Participant 14, February 24, 2007)

> Technology, is used in the correct manner, could change education all together. With students being able to communicate with other students across the globe. The possibilities are endless. (Participant 14, March 10, 2007)

Perceptions of Advanced Technology Users. Analysis of a query for perceptions of advanced technology users in this study consisted of a subset of 3 participants. The general perceptions of this group demonstrated a very positive attitude towards the use of online PBL in teaching technology integration and planning.

Participants of this subset expressed a lower level of concern about learning new technologies, but felt that the PBL scenarios provided them an opportunity to push themselves to find new ways to integrate technology.

> Introducing the technology for these projects can be somewhat challenging at times. It often times requires a lot more understanding of programs and even having to learn new ones as well. I think this is also a positive for me as well.

> These assignments are forcing me to be more creative and utilize more technology as well as learning these new programs. (Participant 1, February 18, 2007)
>
> My knowledge base of technology abilities is better than I realized. Most of the assignments were second nature to me, however the online PBL assignments became more of a challenge and pushed me to be more creative and imaginative. (Participant 15, April 29, 2007)
>
> It certainly makes me more aware of what technology I can use. It also makes me aware of the technology I have used and in what ways I can improve on using it in the future. (Participant 1, February 18, 2007)
>
> I feel that with my background I find it very easy to come up with technology to put into solutions. I am not sure however if I am utilizing the technology to its fullest. I often wonder whether I should allow for more technology to be developed by the students or is it simply enough to incorporate technology on my own. (Participant 13, February 18, 2007)

Nonetheless, even this group of advanced technology users found specific challenges along the way. Some challenges related to the focus on multiple disciplines, while another concern related to the skill levels of members in their working groups.

> The major challenges to technology integration were that we had very limited experience in other subject areas that we needed to write lesson plans for, which hindered even more our ability to include and incorporate technology into these plans. (Participant 1, April 29, 2007)
>
> Being around technology for so long, I assume that everyone understands how to use it. It was sometimes frustrating when my group members couldn't understand what I was talking about. (Participant 15, April 29, 2007)

Additionally, a concern was raised that related to a very important issue outside of this study, standardized testing and the pressures to meet state and federal mandates for performance.

> As I sat and planned this great school experience and daydreams of it happening, reality set in. I looked at my school, a school that a project like this should be able to happen, and I looked at our current emphasis on test scores and stats. We spent an entire day discussing why our scores were off a point or two. We spent another day discussing the test, a half-day hearing about stats - over and over again. We

> talked and talked and talked - never dreaming or being encouraged to use different types of learning. (Participant 15, March 3, 2007)

Overall, this group of advanced technology users voiced support for using online PBL in learning how to use and plan for technology integration.

> I have really enjoyed online PBL. The activities are engaging and I think we as a group have done really well in working together to come up with answers and technological ideas for answering the question. (Participant 1, February 11, 2007)

> I thoroughly enjoyed learning and expanding my knowledge of computers and technology integration. I learned a significant amount about technology this semester. For instance, I was not aware of the many free programs that are available for people to use. I am amazed at how much is out there and realize that I have to continue to grow in order to ensure that my own future is successful. (Participant 13, April 29, 2007)

> This class has really allowed many students to open their minds to try and combine what they know about teaching and technology and bring it together in the classroom to help our students. I now seek out different technology ideas that I know will interest my students and I actually find myself making suggestions to other teachers in my building on ways that they can spruce up a lesson with a little bit of technology. (Participant 15, April 30, 2007)

Participant Perceptions Based on Pedagogical Expertise

Pedagogical Expertise of 0-5 Years. Analysis of a query for perceptions of participants with pedagogical expertise within the range of zero to five years consisted of a subset of 14 participants. The general perceptions of this group demonstrated a very positive attitude towards the use of online PBL in teaching technology integration and planning.

Participant reflections provided evidence that they were thinking about technology in new and different ways; new technologies were now available to them, and considerations were also given to the planning process and how technology could be effectively integrated.

> These PBL units have changed my opinion on technology and opened my eyes to the various ways in which technology can be used, in a effective way in the classroom. Webquests, podcasts, blogging, and smartboards are all ways in which education is making a change for the better. (Participant 14, April 1, 2007)
>
> I feel as though each week steers us in a new direction in terms of thinking about the useful ways to incorporate technology. (Participant 6, March 10, 2007)
>
> Some aspects that I have found truly helpful are simply thinking about technology every time I decide to incorporate a new lesson into my teaching or when I am trying to collaborate with teaching partners. (Participant 10, April 29, 2007)

Pedagogical Expertise of 6-15 Years. Analysis of a query for perceptions of participants with pedagogical expertise within the range of six to 15 years consisted of a subset of 4 participants. The general perceptions of this group demonstrated a very positive attitude towards the use of online PBL in teaching technology integration and planning.

This subset of participants reflected on a number of aspects related to the online PBL experience. Some participants contemplated the need for continued growth, as well as the need to share their newly developed skills with others teachers.

> I have begun thinking of additional ideas that will further assist me in my future goals related to technology integration. (Participant 12, April 29, 2007)
>
> I like to think of myself as a fairly competent writer and that I can assist my peers with my skills in a number of ways; and now, I am happy to add technology integration as another one of my strengths. (Participant 13, April 30, 2007)

Participants of this subset also discussed the positive aspects of working with their peers together online. Through this interaction, group members provided constructive criticism and worked collaboratively to bring out the best in each other.

> I feel that I have learned through this process how to guide my peers effectively and also how to take guidance and criticism from my peers with grace and respect. We ask our students to peer-evaluate all of the time and yet I found it to

> be an area that I was uncomfortable with. Learning in this group format is helping me to get over this. I have realized that listening to their opinions and changing my work based on my own thoughts as well as theirs can only better the quality of my work. After all, four heads are definitely better then one! (Participant 8, April 29, 2007)

> I like how our group has really molded. We have gotten to know each other and we are doing well working as a team. We know each other's strengths and weakness by now, which is helping to guide and direct us in a quick manner. (Participant 17, March 11, 2007)

In the end, participants of this subset provided positive evidence for the use of online PBL in teaching technology integration. One participant even went as far as stating an aspiration for teaching at the higher education level.

> My goal upon graduation is to teach at a University level so that I can give back to those seeking the same skill sets. (Participant 13, April 30, 2007)

Pedagogical Expertise of 15-Above Years. There were no participants that fit into this attribute category; therefore, no analysis for this category was possible.

Participant Perceptions Based on Teaching Status

Perceptions of Pre-Service Participants. Analysis of a query for perceptions of pre-service participants consisted of a subset of seven participants. Participants in this subset demonstrate that online PBL for learning technology integration was received in a very positive manner. Concepts identified as being beneficial range from learning a considerable amount of new technologies to interactions with in-service teachers and the real world knowledge gained from their experiences and expertise.

> As this class comes closer to its completion I feel satisfied with what I have accomplished. I feel more technologically savvy as well as better adjusted to group work, of which will serve me well in the future. (Participant 17, April 9, 2007)

> There are many positives that can be seen in learning technology integration through online PBL. One of the most positive aspects that I have found during this week is that there is a lot of freedom to take the lesson in any way that I want to. (Participant 4, February 25, 2007)

> I have learned more from my peers in this class then any class I have ever taken before. Seeing how my peers have interpreted the same information is very helpful. My eyes have been opened to the many different uses of technology and I am excited to get into the classroom and use what I have learned. (Participant 14, April 30, 2007)

Perceptions of In-Service Participants. Analysis of a query for perceptions of pre-service participants consisted of a subset of 11 participants. Although the perceptions of both in-service and pre-service subsets reflected a positive position for the use of online PBL for technology integration, the in-service subset appeared to embrace a more realistic view in considering the implementation of this instructional method; a common complaint from in-service participants is that many schools are pushing their teachers to teach to the test. With this in mind, using technology as a partner in the learning process should not be affected, but it would have an impact on the implementation of an instructional method such as PBL since it generally is a pedagogical commitment for a curricular area.

> With core curriculum, and standardized testing sometimes we are lucky if we are allowed to change a word in the "script." I hope that we will learn that one of the best ways for students to learn is to have a little fun while they are doing it. (Participant 8, April 10, 2007)

> A project like this one could easily happen in my school, but not in these days of testing and AYP. (Participant 15, March 3, 2007)

Unexpected Perceptions – Influence of Online PBL

4. *What unexpected perceptions and planning practices emerge from learning technology integration through an online PBL model?*

The fourth research question was designed to allow for any emerging themes that did not fit within the previous three research questions. However, after an analysis of study data was completed, all themes produced by this study fit within the categories put forth in research questions one through three.

Conclusion

This study examined the effects of an online PBL model with respect to participant's perceptions to technology integration and effective planning practices. Through PBL reflective journal entries, participants provided evidence that demonstrated positive feelings towards the use of this online PBL model for learning technology integration concepts. The reflections of this study that fell within the Pro category far outweighed the reflections in the Con category. Many participant reflections suggested that by participating in this experience they were able to address specific needs for learning technology applications, as well as gaining a better understanding of how to plan for the effective use of technology as a partner in the learning process.

However, the category related to Challenges was strongly represented in participant reflections. Even though challenges were raised, they generally were not negative in nature and in the end participants felt that they benefited from the struggles that they encountered.

From the perspective of using this online PBL model for planning the integration of technology, participant PBL groups demonstrated that progress was made towards the use of real world scenarios, multiple disciplines, and using technology as a partner in the learning process. Table 15 reflects the overall growth results of the content analysis. Finally, through the analysis of online PBL reflections, participants in various attribute subsets demonstrated a general appreciation for the PBL method. By using the PBL method in the planning of instructional activities, participants began to move towards accepting this instructional method as an approach that they would consider using in their own classrooms.

Table 15.

Content Analysis of PBL Group Progress

	Real World	Tech as Partner	Multiple Disciplines
Elementary 1 Pre	Minimal	Minimal	Developing
Elementary 1 Post	Established	Developing	Established
Elementary 2 Pre	Minimal	Developing	Developing
Elementary 2 Post	Developing	Developing	Established
Middle 1 Pre	Minimal	Minimal	Minimal
Middle 1 Post	Minimal	Developing	Developing
High School 1 Pre	Minimal	Minimal	Minimal
High School 1 Post	Minimal	Developing	Developing
High School 2 Pre	Minimal	Developing	Developing
High School 2 Post	Established	Developing	Established

CHAPTER 5. RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

Overview

This section will review each of the research questions presented previously in this qualitative study. Emergent themes will be summarized and recommendations for further study will be presented. Finally, conclusions to this study will be offered.

Pros, Cons, and Challenges

Perceptions of Online PBL Positives

In general, participants of this study perceived learning technology integration through an online PBL model in a positive manner. Through analysis of study data, several positive themes were identified: the need for integration, the PBL process, professional growth, peer interaction, and leadership.

Rogers (2000) states that technology integration should be an integral focus of all teachers, undergraduate or graduate, as it will continue to play a very important role in educating the students of tomorrow. Participant reflections of this study generally agree with this premise as a theme emerged which suggested the importance for current students to be technologically savvy in order to function in a world that is driven by technological innovations.

A theme also emerged that suggests use of the PBL process, in learning technology integration, was a positive experience. Since PBL is a student-centered approach, participants enjoyed the flexibility to express their ideas creatively and the ability to think outside the box. They also reflected that being able to share ideas within a group, as well as divide the labor for creating a solution, as being beneficial aspects of this process.

With respect to the personal and professional growth theme, participant reflections indicated a high level of satisfaction. Participants reported a sense of accomplishment in learning technology integration; an integral part of this feeling came from the ability to work individually, as well as in collaborative groups.

Even though self-regulated learning was perceived as a postive, Minasian-Batmanian (2002) found that peer interaction was very beneficial to learning. Participant reflections of this study support this claim as a theme emerged citing the benefits of sharing their thoughts, or ideas with members of their group. Furthermore, participants also reported that being able to peruse the solutions of other groups allowed them to further see how other members of the class attacked the PBL scenario.

Finally, some participants viewed the ability to provide assistance to other members of the group, be it in the form of technology assistance, or pedagogical assistance, as a positive experience and producing feelings of leadership. In many ways, this theme reflects the real world aspect of PBL where teachers often support each other in day-to-day issues.

Perceptions of Online PBL Negatives

The analysis of participant data in this study identified two negative aspects, or themes, related to learning technology integration through online PBL: group dynamics and synchronous communication through VOIP. Even though these two areas emerged as negatives, participants in some groups reported varied levels of dissatisfaction.

Group dynamics in any instructional setting can prove challenging, but even more so when the group work is conducted online. In the case of this study, a theme emerged where in-service participants raised concerns about having to assist pre-service participants with unfamiliar pedagogical, or professional concepts. However, as stated previously, some participants actually looked at this as a positive way to establish their leadership skills. Additionally, some participants reported feelings of isolation and life distractions as other areas for concern; however, these reflections were infrequent.

Perceptions of Online PBL Challenges

The analysis of participant data in this study identified four themes, or areas of challenge, related to learning technology integration through online PBL: group dynamics, scheduling and time issues, use of multiple disciplines, and pushing the boundaries of student learning. Even though the preceding categories are listed as challenges, participants generally perceived them as leaning towards the positive category.

Evensen and Hmelo (2000) suggested that group interaction and collaboration is advantageous, if not integral in the PBL environment. Participants in this study were carefully placed in groups using a Participant Attribute Survey, as well as a Self Report

on Technology. However, themes emerged that suggest consideration should be given to additional attributes. Among those attributes to be considered are personality, working styles, and work ethic.

In addition to this, group interaction also helps students to synthesize new information, creating new understandings, or cognition from their experiences (Seifert & Simmons, 1997). Nonetheless, in the online environment, students must be able to schedule the necessary time for this collaboration to occur. In many instances, participants reported that the scheduling of synchronous meetings was a very challenging objective to accomplish; difficulties ranged from changing work schedules to that of family commitments.

Even though participants reported that issues of group dynamics proved challenging, they also identified the use of multiple disciplines in PBL to be equally challenging. Nonetheless, Barrows (1999) suggests that the use of multiple disciplines is integral in tying core curricula together in a meaningful way. In order to accomplish this, participants were forced to look at other unfamiliar disciplines. This required them to spend additional time learning core concepts before being able to move forward with the PBL scenario.

Finally, participants reported finding challenges in moving beyond their technological comfort level. Even though participants varied with respect to their technological expertise, Savory and Duffy (1996) suggest that PBL and its use of ill-structured problems provides opportunities for learners of all levels to be challenged. Novice participants reported being challenged, and sometimes frustrated, with the technological tasks presented to them. However, completion of PBL tasks and the

creation of a collaborative solution often left the participants with a feeling of satisfaction and reward. For those participants with intermediate, or advanced technology skills, PBL allowed them to reflect on their current use of technology and encouraged them to move beyond their present comfort levels.

Planning Practices

Real World Environments

Murphy (2002) suggests that it is imperative that students be presented with authentic scenarios that situate the learning within the context of complex real world environments. Therefore, this study attempted to examine if the use of an online PBL model helped participants to plan activities that reflect real world environments.

A qualitative content analysis of work completed in this area demonstrated that 3 out of 5 participant PBL groups achieved progress with respect to planning activities that utilized real world environments. Both elementary groups and the second high school group, made significant progress towards achieving this objective.

Elementary Group 1 embraced a Green Day scenario that required students to create a solution for the building of a new playground. Elementary Group 2 developed a scenario titled A Moment in Time*, which* required students to devise a plan that assisted immigrants in finding employment in this new and strange land. Finally, High School Group 2 prepared a scenario that prepares students to enter the work force in a lesson titled Career Package Portfolio.

Technology as a Partner in the Learning Process

Jonassen (2000) proposes that in order for technology to be considered a partner in the learning process, it should be utilized as a vital thread in all curricula; furthermore, it should be used as a tool to construct key understandings. One group from each teaching level, or 3 out of 5 participant PBL groups, achieved a move from a minimal to developing level.

In some instances, technology was used as a simple productivity tool. However, in the groups that showed developmental progress, planning included various forms of technology: word processors, spreadsheets, presentation software, drawing programs, digital cameras, smart boards, and the Internet. Elementary Group 1 utilized these tools in the development of their playground layout, as well as record keeping for the project budget. Middle School Group 1 planned for the use of technology in the creation of computer-generated artwork. Finally, High School Group 1 focused on the use of drawing technology to design an architectural plan for a house that reflected the characteristics of the Renaissance period.

Use of Multiple Disciplines

Out of the three areas under investigation, Use of Multiple Disciplines was the only area where all groups demonstrated positive growth. As a matter of fact, three groups moved from a developmental level to that of an established level. All groups planned lessons that addressed multiple curricular areas, but three of the groups developed plans that utilized multiple disciplines within individual lessons.

Attribute Based Perceptions

Perceptions Across Gender

Reflections presented by both genders suggest positive feelings towards the use of an online PBL model for technology integration.

Of the 12 female participants, reflections support the use of online PBL with females suggesting that this experience will have an impact on the way they integrate technology into their classroom settings. With this in mind, females raised concerns over school districts investing the necessary funds to accomplish this integration.

Male participants generally reflected that learning technology integration through an online PBL model was a positive experience. However, participants stressed the need to understand when and how to utilize technology, reflecting that technology should not be used for technology's sake. Nonetheless, in the end, male participants provided evidence that supports learning technology integration through an online PBL model.

Perceptions Across Age

The analysis of participant perceptions with regard to age showed a positive reception by all age ranges to learning technology integration through an online PBL model. Depending upon the age range, participant perceptions varied slightly and this may be due to experiences that are related to other variables, such as technology expertise, or pedagogical expertise.

Nonetheless, the 20-30-age range provided evidence that reflects strong feelings toward the use of technology in the instructional process. Participants suggested that technology is extremely important for our future and teachers must find new ways to use

these tools in their classrooms. This subset consisted of participants who appeared to be comfortable with technology use, but reflections suggest that this age range felt proud of their accomplishments with regard to technology integration.

The 31-40-age range also provided positive reflections on the use of an online PBL model for learning technology integration. However, this group appeared to be less comfortable, or familiar, with the use of technology tools. Therefore, participant reflections provided evidence that feelings of stress or frustration occurred from time-to-time. In the end, participant reflections demonstrated a deep sense of satisfaction for staying the course and accomplishing their course objectives.

The 41 and above age range consisted of only one participant. However, this participant provided evidence that suggests a positive attitude towards using online PBL to learn technology integration. This participant reflected that the use of real world scenarios helped to understand how technology could be used as a partner in the learning process. Additionally, this participant provided evidence that suggest the use of collaborative groups as being a positive factor in helping learn new technology concepts.

Perceptions Across Technology Expertise

An analysis of participant reflections based on technological expertise demonstrates positive feelings toward learning technology integration through an online PBL model. Even though each of the technology levels reported positive feelings, they provided varied reasons for supporting online PBL.

The novice technology subset consisted of five participants. Participant reflections suggest a strong feeling of accomplishment with what they learned through this

experience. However, it was not without cost; participants reported high levels of anxiety at times when trying to learn new concepts due to their limited expertise. Even so, participants who persevered provided reflections that demonstrate a deep sense of satisfaction and accomplishment.

The intermediate technology subset consisted of 10 participants. Participants in this group demonstrated positive attitudes towards the use of online PBL for learning technology integration. Even though participants viewed this experience as positive, some participants reported difficulties with respect to integrating technology into unfamiliar curricular areas, whereas other participants viewed this as beneficial. Differences of opinion also existed within this group where group dynamics were concerned. Even so, participants of this subset by and large regarded the use of an online PBL model as beneficial towards learning technology integration.

The advanced technology subset consisted of three participants. Participant reflections provided evidence that this subset's technology skills did not grow to as great an extent as the previous two groups. However, participants suggested that use of the online PBL model helped them to evaluate their current uses of technology and push to expand and improve their integration strategies.

The advanced technology subset did raise one concern; school districts have placed a great deal of importance on producing high-standardized test scores. In order to accomplish this objective, participants feel that instructional strategies are limited and producing activities such as the ones conducted in this study would be difficult.

Perceptions Across Teaching Status

An analysis of participant reflections based on teaching status demonstrates positive feelings toward learning technology integration through an online PBL model. Participants were broken down into two subsets: pre-service and in-service.

The pre-service subset consisted of seven participants. Participant reflections provided evidence that this group viewed interactions with practicing teachers as extremely beneficial in learning technology integration, as well as many other concepts related to the profession. Participants of this group also reflected on the amount of new and emerging technologies they were able to learn through this model, some stating that it was the most that they had ever learned in a course. Many aspects of the online PBL model could be responsible for this including participants' ability to view the final solutions of other groups at the end of each unit. This sharing of ideas helped participants gain a glimpse into the strategies used by others in constructing their PBL solutions.

The in-service subset consisted of 11 participants. Participants of this subset reflected positively on the use of online PBL as a method for teaching technology integration. However, this group took a more realistic view and considered the political issues that sometimes get in the way of implementing new instructional methods; the current focus on standardized testing was reported as a concern of this type.

Perceptions Across Pedagogical Expertise

An analysis of participant reflections based on pedagogical expertise demonstrates positive feelings toward learning technology integration through an online

PBL model. Participants were broken down into two subsets: 0-5 years experience and 6-15 years experience.

The group of participants with 0-5 years experience was the largest subset within this attribute set. Reflections demonstrated a very positive attitude towards the use of online PBL for learning technology integration. Participants stated that they had begun to think about technology integration in new and different ways. New tools had been identified, and more importantly, participants considered how they could plan for their effective integration.

The subset with 6-15 years of experience consisted of four participants. Participants of this subset reflected on the positive aspect of working together with peers online. In this model, peers were able to provide constructive criticism and help each other to grow stronger technologically. In the end, this subset provided evidence for the use of online PBL for learning technology integration.

The subset with 16 and above years experience consisted of zero participants. Therefore, no analysis was conducted for this attribute.

Unexpected Perceptions

The fourth research question asked, "What unexpected perceptions and planning practices emerge from learning technology integration through an online PBL model?" Considering that the aforementioned research questions are broad in scope, participant reflections did not provide any evidence that supported the creation of additional themes. Perceptions that did emerge fit within the categories of pros, cons, or challenges.

Recommendations

General Recommendations

Problem-based learning, whether conducted face-to-face or online, depends to a great extent on student's abilities to work productively in collaborative groups. This study placed participants into groups based upon personal attributes consisting of gender, age, teaching status, technology expertise, and pedagogical expertise. At no point did the grouping of participants take into consideration aspects of personality. An analysis of participant reflections suggested that conflicts due to personality differences impeded the progress of PBL groups at certain times during the study. Therefore, it may be beneficial to consider administering a personality test, such as the Myers-Briggs Personality Indicator, to improve the identification of participant attributes prior to group formation. By considering personality types in the formation of PBL groups, participants may find themselves in groups that provide for an enhanced learning environment.

Additionally, participants reported having difficulties dealing with unfamiliar curricular areas, or multiple disciplines. In developing successful PBL groups, it may be wise to consider the curricular expertise of participants and attempt to vary the group's composition with this in mind. This may help to eliminate the possibility of a PBL group being comprised of participants with only one area of curricular expertise such as math.

Furthermore, in order for groups to successfully identify learning issues, divide labor, and construct a viable solution to PBL problems, participants need to be able to depend on each other to fulfill project responsibilities in a timely fashion. If participants fail to deliver components assigned to them, they negatively impact the development of

the entire group's solution. Therefore, it may be beneficial to have group participants develop a learning team agreement prior to beginning PBL activities. This agreement would be completed by group members and include the following: identification of group leader, statement of expectations, communication protocol, and consequences for failure to meet deadlines.

With respect to developing a communications protocol, participants would benefit from determining a common synchronous meeting time at the beginning of the course. Establishing this common meeting time at the beginning of the course would eliminate frustrating weekly negotiations.

Finally, communication tools are integral for conducting PBL in the online environment. This study utilized free voice-over-IP software for group members to conduct their synchronous meetings. Even though some groups reported having no issues with the program, VOIP can have issues sometimes when initiating communications between several members in a conference call. Therefore, it may be beneficial to explore other communications media. However, this platform requires the purchase of a license, which can prove to be prohibitive.

Recommendations for Further Research

Recommendations for further research regard group dynamics, learning styles, standards-based scenarios, and identifying optimal tools for conducting PBL in the online environment. Considering that online PBL is in its infancy, research on these topics would help to increase the knowledge base in this area.

Even though the topics of group dynamics and learning styles, in and of themselves, have a wealth of research devoted to them, neither has been examined within the context of PBL in the online environment. As mentioned previously in the general recommendation section, the development of online PBL groups is an integral task and plays a vital role in the success of participant learning. Further research on how to construct successful PBL groups in the online environment would be beneficial taking into consideration participant personalities, as well as learning styles.

Furthermore, participants in this study raised concerns about the current focus on standardized testing and the difficulties it presents when trying to develop new instructional activities such as online PBL. However, if PBL scenarios were developed based upon state curricular standards, it may be possible to improve standardized testing scores, as well as improve higher level thinking skills through motivating student-centered activities. Further research would need to examine the development of standards-based online PBL scenarios and its relationship to student scores.

Finally, conducting PBL in the online environment depends upon the utilization of technological tools. Participants need to be able to communicate effectively and efficiently in both asynchronous and synchronous modes. Even though asynchronous forums have been widely used in online classrooms, research on the use of new technologies, such as web 2.0 tools, for online PBL would be beneficial. Tools such as Wikis now exist and provide students with new and improved ways to collaborate. However, research should be conducted to examine how to best utilize these new technological tools for online PBL.

Conclusions

This study examined how the experience of learning through an online PBL model affects teachers' perceptions of integrating technology. It also investigated how the use of an online PBL model affected teachers' planning of technology integration. Additionally, participant perceptions of learning technology integration through online PBL were analyzed based upon personal attributes.

Based upon this study's qualitative analysis, participant reflections demonstrated a positive acceptance to the use of online PBL for learning technology integration. Participants reflected on technology's importance in today's society and the need to produce technologically literate students.

The online PBL process, which immersed students in technology itself, also emerged as central to learning effective methods of technology integration. Through the online PBL process, participants provided evidence of growth, both on a personal and professional level. Real world classroom scenarios provided the opportunity for participants to interact with their peers collectively, as well as work individually, in the creation of problem solutions, leaving them with a sense of profound satisfaction.

However, participant reflections of this study uncovered two negative themes: group dynamics in the online environment, and issues with communication technologies. PBL groups in this study were formed based upon participant attributes such as gender, age, pedagogical experience, technological experience, and teaching status; however, participant reflections suggest that it may be necessary to consider other attributes as well when forming groups.

Communication in this study was conducted asynchronously and synchronously. Synchronous communication was conducted through VOIP; however, participant reflections suggested that group members were often randomly disconnected, leaving them angry and frustrated. In PBL groups where participants collaborated efficiently, communication was less of a problem, but in groups where difficulties existed, participants were often frustrated by response time, scheduling of conference times, and feelings of alienation.

Participant reflections of this study also identified several challenges: group dynamics, scheduling and time issues, use of multiple disciplines, and pushing student-learning boundaries. Even though some reflections identified group dynamics as a negative aspect of the online PBL process, participant perceptions changed toward the positive as group members gained a better understanding of each other's strengths and weaknesses.

Scheduling conflicts provided participants with challenges as well, as they attempted to find available times to meet synchronously. Participants reflected that synchronous meetings infringed upon the flexibility that online courses provide.

Other challenges emerged simply through pushing the boundaries of student learning. Participants reflected that having to learn new technologies, work in collaborative groups, and explore curricular areas that were unfamiliar to them pushed them beyond their current technological and pedagogical comfort levels. This appeared to be true regardless of participant levels of expertise: novice, intermediate, or advanced.

A qualitative content analysis of a pre- and post technology plan was conducted in an effort to examine the effect that online PBL has on teachers' planning for technology

integration. Three areas were identified for analysis: real world environments, technology as a partner in the learning process, and use of multiple disciplines. Upon completion of the qualitative analysis, all online PBL groups experienced growth from one level to another, with all groups making progress in the area of multiple disciplines.

Furthermore, participant perceptions were analyzed in an effort to distinguish what affect personal attributes had on teachers' views of learning technology integration through online PBL. Once again, participants provided positive reflections towards the use of an online PBL model.

Participant perceptions across age showed younger and older participants to be extremely positive towards using online PBL for learning technology integration. However, participants in the 31 to 40 and 41 and above age ranges provided evidence that suggested a lesser degree of technological comfort; however, these participants showed a greater sense of pride in their accomplishments as they moved through the online PBL process.

Participant reflections across gender established that both male and female participants accepted online PBL as a positive way to learn technology integration. Male participants, however, stressed the need to use technology effectively as a partner in the learning process and not simply for the sake of using technology.

Participants in this study varied according to their technological expertise. All levels reflected positively towards the use of online PBL for learning technology integration. Novice users experienced a higher level of anxiety due to their lower levels of expertise, but were rewarded with higher levels of satisfaction with their

accomplishments. Advanced users, however, reported growing less technologically, but being inspired to evaluate new technologies and how to integrate them effectively.

Participants in this study also varied across pedagogical expertise with all levels reporting positive attitudes towards using online PBL for technology integration. Participants with 0-5 years experience reflected on how they were thinking about using technology, as well as the part it played in the planning process. Participants with 6-15 years of experience provided reflections that suggested the positive nature of working with peers and learning from their ideas on using technology effectively.

As far as teaching status, participants of this study were divided into two categories: pre-service teachers, and in-service teachers. Pre-service participants provided extremely positive perceptions on using online PBL to learn technology integration; however, since these participants had no real world teaching experience, they appeared to view things from a more idealistic perspective. On the other hand, in-service teachers expressed the need for technology integration, but viewed things from a more realistic perspective due to their real world experiences where issues such as standardized testing and school budgets play important roles in how technology is used.

Finally, additional research is needed in the area of online PBL. Group dynamics play an integral role in the successful construction of PBL solutions; topics such as group formation need to be studied and evaluated from the perspectives of participant personalities and learning styles. Moreover, online PBL is conducted in the virtual environment; therefore, additional research should be conducted on the use of emerging technology tools, evaluating their impact on current online PBL models such as the one utilized in this study.

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APPENDIX A. PARTICIPANT ATTRIBUTE SURVEY

Name	Participant Attribute Survey
Instructions	Please complete the following survey questions. These questions are confidential and will help to determine PBL groups and research study subsets.
Multiple Attempts	Not allowed. This Survey can only be taken once.
Force Completion	This Survey can be saved and resumed later.

Question 1	Please select the instructional level of your current teaching position or the level that you would like to teach.
	Elementary Middle School High School

Question 2	Please select your current teaching status: pre-service for those not currently teaching and in-service for those who are currently employed as teachers.
	Pre-Service (Not currently teaching) In-Service (Currently employed as a teacher)

Question 3	Please select your gender (male/female).
	Male Female

Question 4	Please enter the range of your teaching experience in years.
	0 to 5 years of experience 6 to 15 years of experience 16 years and above

Question 5	Please select your age.
	20 to 30 years old 31 to 40 years old 41 to 50 years old 51 years and above

APPENDIX B. SELF-REPORT ON TECHNOLOGY LEVEL

Name	Self-Report on Technology Level
Instructions	The following assessment helps to identify your current level of technology expertise. Since this assessment has no bearing on your grade in this course, it is very important that you answer these questions honestly. This assessment will help to ensure that you start this course at the appropriate technology level.
Multiple Attempts	Not allowed. This Survey can only be taken once.
Force Completion	This Survey can be saved and resumed later.

Question 1	What is the main purpose of a word processor (i.e. Microsoft Word)? – 10 Points
	Create webpages Create electronic slides Typing Numeric calculations

Question 2	I am able to start the program Microsoft Word. – 10 Points
	Yes No

Question 3	I am able to start the program Microsoft Word. – 10 Points
	Yes No

Question 4	I am able to format text in a Microsoft Word document. – 10 Points
	Yes No

Question 5	I can add images to my Microsoft Word document. – 10 Points
	Yes No

Question 6	I can add a hyperlink to my Microsoft Word document. – 10 Points
	Yes No

Question 7	I can create a table in my Microsoft Word document. – 10 Points
	Yes No

Question 8	I can turn a Microsoft Word document into a webpage. – 10 Points
	Yes No

Question 9	What is the main purpose of presentation software (e.g. Microsoft PowerPoint)? – 10 Points
	Create webpages Create electronic slides Typing Numeric calculations

Question 10	I can start Microsoft PowerPoint. – 10 Points
	Yes No

Question 11	I can format text in Microsoft PowerPoint. – 10 Points
	Yes No

Question 12	I can apply a design template in Microsoft PowerPoint. – 10 Points
	Yes No

Question 13	I can add images in Microsoft PowerPoint. – 10 Points
	Yes No

Question 14	I can add transitions to Microsoft PowerPoint. – 10 Points
	Yes No

Question 15	I can create animation in Microsoft PowerPoint. – 10 Points
	Yes No

Question 16	I can turn a Microsoft PowerPoint into a webpage – 10 Points
	Yes No

Question 17	What is the main purpose of a spreadsheet program (e.g. Microsoft Excel)? – 10 Points
	Create Webpages Create electronic slides Typing Numeric calculations

Question 18	I can create a new Microsoft Excel workbook. – 10 Points
	Yes No

Question 19	I can enter text, data, and formulas into a Microsoft Excel workbook. – 10 Points
	Yes No

Question 20	I can format the rows and columns of a Microsoft Excel workbook. – 10 Points
	Yes No

Question 21	I can create charts/graphs using Microsoft Excel. – 10 Points
	Yes No

Question 22	I can use functions to perform calculations in Microsoft Excel. – 10 Points
	Yes No

Question 23	I can move and copy data in Microsoft Excel workbook. – 10 Points
	Yes No

Question 24	I can turn a Microsoft Excel workbook into a webpage. – 10 Points
	Yes No

Question 25	What is the main purpose of a web editor (e.g. NVu)? – 10 Points
	Create webpages Create electronic slides Typing Numeric calculations

Question 26	I have created a webpage. – 10 Points
	Yes No

Question 27	I have created a website of multiple pages. – 10 Points
	Yes No

Question 28	I can use a .bmp image for a webpage. – 10 Points
	Yes No

Question 29	Images are included with webpages when uploaded. – 10 Points
	Yes No

Question 30	I know how to do basic coding with HTML. – 10 Points
	Yes No

Question 31	I know how to upload webpages. – 10 Points
	Yes No

Question 32	I know what URL means. – 10 Points
	Yes No

APPENDIX C. PROBLEM-BASED LEARNING REFLECTIVE JOURNAL

Problem-Based Learning Reflective Journal

Directions: Please write your reflective journal and press the submit button. In this journal entry, you should focus on the positives, negatives, and challenges that you experienced during this PBL activity. How has this activity affected your thoughts about technology integration and planning for future teaching activities?

Name:

Date:

PBL Activity Completed: (i.e. PBL 1, PBL 2, etc.)

Reflective Journal:

Submit Reset