OVERCOMING IMPLEMENTATION CHALLENGES WITH PROBLEM AND PROJECT BASED LEARNING IN ADVANCED TECHNOLOGICAL EDUCATION PROGRAMS WITHIN COMMUNITY COLLEGES

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Abstract

Community college advanced technological education (ATE) programs need to implement dynamic and innovative curriculum to attract, retain and graduate students who are prepared for the workforce with 21st century skills. Problem and project based learning (PBL) has proven to be an efficacious pedagogical method that accomplishes these goals. The purpose of this study was to investigate how ATE instructors who teach in community colleges describe implementation challenges with PBL and how they overcome such challenges. Four ATE community college instructors, who have implemented PBL and attended PBL specific professional development workshops, participated in this study. An interpretative phenomenological analysis approach was used to examine participants’ experiences. Participants expressed initial hesitancy with some of their pedagogical choices while using PBL and that they became more confident after they gained experience implementing the curriculum. Similarly, students’ reluctance to PBL transformed into enjoyment after learning through PBL for some time. Additionally, participants found that serving as a guide to students and scaffolding them into PBL helped develop students’ trust for the teaching method. Support from administration and professional development also proved significant to participants’ implementation of PBL and overcoming implementation challenges. The findings are relevant to ATE community college instructors and administrators seeking to implement PBL. Additional research is needed to explore the role of administrators in the implementation of PBL, implementation challenges in general education courses and to measure outcome expectancy with the use of PBL.

Key words: problem based learning, project based learning, advanced technological education, community college instruction.
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Overcoming Implementation Challenges with Problem and Project Based Learning in Advanced
Technological Education Programs within Community Colleges

Chapter One: Introduction and Theoretical Framework

Statement of the Problem

Problem and project based learning (PBL) are celebrated, intuitive teaching and learning methods, which are being used in a variety of advanced technological education (ATE) programs within community colleges (Craft & Mack, 2001; Flint, 2003; Massa, Dischino, Donnelly, Hanes & DeLaura, 2012; Ostrander, 2012). However, there are limited resources for community college ATE instructors who implement PBL in their classrooms and for institutions that want to introduce and support the use of this teaching method (English 2013; Massa et al., 2012). PBL can be intimidating (Massa, et al., 2012), which is why faculty members who implement PBL seek support from their institutions, in addition to mentoring and guidance from other instructors who have experience teaching with the PBL methodology. Unfortunately, there are no documented promising practices based on research that specifically advise community colleges and community college ATE instructors on how to overcome the many implementation challenges that occur with the use of PBL and this lack of resources hinders its use. In addition, the majority of research on PBL focuses on isolated cases of implementation, such as in one class or one program, and most often the subject of these studies are not within community college settings. A lack of resources and support for the use of any new teaching method deters its use, even if proven extremely efficacious. The problem of practice under review was how community college instructors within ATE programs describe their challenges with the implementation of PBL and how they have overcome those challenges.

The shift to the use of PBL can be overwhelming for instructors who have been using a
different pedagogical approach to teaching and learning and for some it will require transference in their educational philosophy. Guidance from ATE community college educators who have experience with this transference process will help instructors and institutions that are looking to successfully implement PBL in their curriculum. For example, the adoption of PBL requires faculty to transition from teacher centric to student centric teaching and learning (Lam, Cheng & Choy, 2010). In addition, the shift from lecturer to a facilitator of learning places more responsibility on students, which might initially create student resistance. PBL practitioner Judy Fredrickson, who teaches Computer Technologies at a community college, described her first teaching experience with this methodology: “I had a lot of push back from students who felt that they weren’t being taught because they wanted a lecture. They were used to a lecture where they could sit and passively take in information” (personal communication, October 24, 2012). Further understanding of how to overcome student resistance, from experienced PBL educators within ATE community college programs, can help alleviate this problem of practice.

Additional student challenges can arise, due to the team based nature of PBL. For example, instructors need to motivate students’ desire to work and coordinate in teams, while still assessing them individually. Also, the commuter nature of community colleges and outside obligations makes the coordination of team meetings and planning even more challenging. In addition to student and faculty challenges with the adoption of PBL are administration related challenges. This study aimed to learn how ATE community college instructors, who have experience with PBL, navigate through these implementation challenges as a way to provide guidance and support to those ATE community college programs and instructors who desire to improve their practice and embark upon education reform through the adoption of PBL.
Significance Statement

Numerous national education reform efforts are underway in America. Many of these efforts are focusing on the use of PBL (English, 2013; Massa, 2008; Ravitz, 2010) and on ATE education (National Governors Association, 2007; State Educational Directors Technology Association, 2008; National Science Board, 2007; Massa et al., 2012, The White House, 2012). For example, the National Science Foundation (NSF) has funded numerous programs focused on the use of PBL in community college ATE programs (Craft & Mack, 2001; Massa et al., 2012; Ostrander, 2012). In addition, the Community College Career Fund, an 8 billion dollar investment in community colleges from the American government, aims to increase the role of community colleges as career centers that will produce skilled workers who meet industry needs, especially in the advanced technological fields (The White House, 2012). In response to this national policy that is relying on community colleges to prepare students to be skilled workers who fulfill industry’s needs, community colleges will need to implement pedagogy that teaches to numerous learning styles, while enhancing critical thinking, problem solving and team building skills, in addition to core content skills (Arrison & Olson, 2012).

Research on PBL reflects that this teaching methodology aligns with the curriculum needs for community college ATE programs and increases student motivation for learning (Allan, 2007; Bell, 2010; Blumenfeld, Soloway, Marx, Krajcik, Guzdial & Palincsar, 1991; Ellis & Hafner, 2008; Massa et al., 2012), however it also reveals that there is still resistance to this teaching method (Barron, Schwartz, Vye, Moore, Petrosino, Zech & Bransford, 1998; Blumenfeld et al., 1991; English, 2013; Massa et al., 2012). A majority of the research on the use of PBL is focused on K-12 and four year colleges and this is significant to this study. This reflects a wide spread use of this pedagogy and the need for community colleges to bridge with
the successful teaching methodologies being used in elementary and secondary schooling, as well as four year institutions. This also reflects the dire need for specific research on PBL in community college ATE programs. To support community college ATE programs through the adoption and use of PBL, promising practices from experienced implementers is essential.

The adoption of any new teaching methodology within a community college system is challenging and will be more successful if there is less ambiguity and clear expectations (Badway, 1998), which research on identifying and overcoming PBL implementation issues can provide. Literature reflects that the choice to adopt the PBL methodology has been influenced by pre service training, self-motivation and outcome expectancy (English, 2013; Lam, Cheng & Choy, 2010; Massa et al., 2012), while the choice to sustain this adoption requires continued support and guidance (English, 2013; Lam et al., 2010). In order to avoid a misuse of time, funding and human resources, community college ATE programs and instructors will need specific guidance based on research to support them in the adoption of PBL and to help them overcome challenges, once they have implemented PBL curriculum. For example, administrative support of these factors, through release time and providing trainings on site would encourage the use and effectiveness of PBL, though this is not a common practice on community college campuses. Lina Matthews, a faculty member in a community college who gained administrative support to train all faculty members on the use of PBL advises, “you can’t rush the diffusion of getting it out there” personal communication, January 17, 2013). As a way to support community college administration, faculty and ATE programs in the implementation of PBL it will be beneficial to understand how those faculty who are implementing PBL have addressed and overcome obstacles related to this teaching method.
Research Question

How do community college instructors in advanced technological education programs describe implementation challenges with problem and project based learning and how have they overcome those challenges?

Paper Contents and Organization

This thesis includes numerous aspects: the theoretical framework that supports and advised this research project, the research design, data collection and analysis, trustworthiness, an explanation of the protection of human subjects, recommendations for practice and further research, references and appendices. The framework that shaped the study is a position taken by McLaughlin (1987) that redirected the way in which education reform and implementation in the classroom is understood. The literature review defines PBL and establishes its place and use within advanced technological education (ATE) programs within community colleges and other public universities and colleges. The literature review also highlights the need for more research on this subject. A qualitative Interpretive Phenomenological Analysis (IPA) approach within a constructivist-interpretivist paradigm was employed to examine how community college instructors with ATE programs overcome perceived obstacles that occur with the use of PBL. Primary data was collected through open ended, one-on-one interviews from community college instructors who implement PBL within ATE programs. Data analysis followed the six steps that Smith, Flowers and Larkin (2013) recommend for an IPA study to identify how study participants made meaning of their own experiences. Validity was sought through the use of Yardely’s (2000) four principles, as outlined in Smith et al. (2013).

I maintained ethical conduct, protected study participants in numerous ways and received informed consent from all participants. The participants of this study were not a vulnerable
The results of this study are portrayed in the findings and analysis section, in addition to the recommendations for practice. Additional research needs are also presented. Literature cited within the dissertation is included in the full reference section. Appendices include the recruitment letter, consent form signed by all participants, the interview protocol and schedule, and the IRB approval form.

**Theoretical Framework**

This study was designed through the lens of the implementation framework defined by McLaughlin (1987). McLaughlin’s Theory of Implementation (1987) provided a useful framework to study how PBL implementers within ATE programs in community colleges define implementation challenges and how they overcome them, because it focuses on education reform and the macro and micro factors that serve as obstacles and facilitating factors to the implementation of new innovations in the classroom. McLaughlin’s (1987) framework is built upon a response to implemented public policies and the attempts at education reform in the public schools. It was a useful framework for this study because it provided a method for analyzing factors that influence education reform by individual educators. Community colleges, and more specifically community college ATE instructors, must also respond to public policy, national funding and industry requirements and are being called upon to solve a national crisis: the need to attract, retain and graduate advanced technological experts.

**Origin and evolution.** Prior to the 1980s, policymakers held a straightforward understanding of how educational reforms were implemented. External sources (legislation, regulation or educational research) identified what was considered best practice, and the assumption was that implementers would follow the exact rules and processes dictated by outsiders. In other words, the beliefs were that local leaders would behave rationally and follow
the directives from outsiders (McLaughlin, 1987; Pressman & Wildavsky, 1973).

However, local schools didn’t behave like policymakers expected. Local schools adopted new processes in idiosyncratic ways or were resistant to change. Educational research revealed that even the best planning and highly promising reforms would not be implemented without taking into account local factors, including local capacity and local will for change (McLaughlin, 1987). An important finding from this research was that change depends on what Weatherly and Lipsky (1997) have called the “street level bureaucrat” (McLaughlin, p. 172) – the public school educators on the ground who were responsible for the implementation and whose “attitudes, motivations and beliefs” shaped their professional responses (McLaughlin, p. 172).

Foundations of McLaughlin’s framework extend from what McLaughlin (1987) classifies as the first two phases of implementation analysis and the research conducted by the Rand Corporation, sponsored by the U.S. Office of Education between 1973 and 1978. The analysis of implementation processes began in the 1970s as a response to mandated federal reform attempts in numerous sectors in the U.S. that were failing (McLaughlin, 1987). This response came after the observation that implementers were resistant to embracing reform for policy’s sake (McLaughlin, 1987). The “myth of the rational man” (McLaughlin, 1987, p. 172) and the recognition of implementation issues were first classified by Pressman and Wildavsky (1984) in 1973. These first generation implementation analysts claimed that local factors and individuals have the most significant impact on outcomes. They also began to identify how institutions, within themselves, affected the implementation of policy initiatives. Second generation implementation analysts moved further and began to look at the relationship between policy and practice (McLaughlin, 1987). During this time, the Rand studies began.

The Rand studies were an analysis of four federally funded education programs, which
were aimed at encouraging and supporting innovative teaching and learning in the public schools. The funded programs were:

- Title III of the 1965 Elementary and Secondary Education Act (ESEA) [which] provided support for local innovative projects;
- Title VII of ESEA [which] supported district bilingual education efforts;
- Programs financed by the 1968 Vocational Education Act [which] encouraged practitioners to develop new approaches to career education; and the Right-to-Read program. (McLaughlin, 1990, p. 11)

These studies were significant to developing an implementation analysis framework for education, because they specifically related to education reform and the use of innovations in the classroom. In addition, they began to look at how those in the education system thought about planned change (McLaughlin, 1990). The findings of these studies provide insight into how teachers affect the implementation of change in the classroom and the obstacles and factors to consider. “Second generation change analysts … recognized that teachers’ responses to planned change efforts may instead represent best efforts to do their job” and to successfully provide for their students (McLaughlin, 1987, p. 175). MacLaughlin (1987) used the work of the first and second implementation analysts as foundation for a third generation of implementation analysis, a framework that integrates the “macro world of policymakers with the micro world of individual implementers” (p. 171).

**McLaughlin’s implementation framework.** McLaughlin (1987) presents the implementation of new innovations, such as new pedagogy, as a multi-stage, evolutionary process. Citing Majone and Wildavsky (1977), McLaughlin (1987) posited that change is innovated and implemented by individuals, not organizations, and that implementation challenges are never completely solved, but rather evolve. In addition, McLaughlin (1987)
expressed that the motivation of individuals, in regards to implementation processes of new innovations, often relates to factors outside of policy, as previously presented by Yin (1981). Implementation across layers of governance from policy makers and institutions is difficult because “policy makers can’t mandate what matters” (McLaughlin, 1987, p. 172). Another important aspect that McLaughlin’s framework highlights is that the implementation process of new innovations is not always linear or predictable (McLaughlin, 1987).

McLaughlin’s (1987) framework outlines two main stages of implementation. The first stage, the challenges of implementation (external policy), includes learning the rules, in addition to “clear goals, well specified statutes and effective authority” (McLaughlin, 1987, p. 174), as previously defined by Elmore and McLaughlin (1982) and Sabatier and Mazmanian (1980). According to McLaughlin (1987), once the first phase of implementation challenges are understood the second stage of implementation, the quality of implementation (internal factors), can be addressed. Such factors include “commitment, motivation and competence” (McLaughlin, 1987, p. 174) of the implementers. McLaughlin (1987) also posited that once the external factors have been overcome, they recede in importance and internal factors dominate.

However, McLaughlin (1987) explained that the analysis of an implementation’s success or failure is complicated. McLaughlin (1987) advanced that motivation or lack of motivation to embrace the implementation of new pedagogy can be misinterpreted and that there may be different successes and challenges, depending upon which stage of implementation is being evaluated. Due to these complexities, McLaughlin (1987) suggested that a balance of pressure and support is necessary to enable the implementation of education reform. Lastly, McLaughlin (1987) claimed that implementation must happen slowly and cited Meyer and Rowan (1977) as support for this claim.
Model of McLaughlin’s Implementation Framework

Application of theory. McLaughlin’s (1987) Implementation Framework provided numerous lenses to help investigate how ATE community college instructors described challenges to implementing PBL curriculum and how they overcome those challenges. Elements of this framework that helped to analyze this problem of practice are the focus on macro and micro factors that challenge and facilitate the implementation of new innovations, a suggested need for pressure and support when implementing new innovations, deciphering whether or not
challenges evolve, and if macro factors recede in importance once they are understood. For example, through open ended, one-on-one interviews study participants were asked to describe their experience with PBL from what first encouraged them to use the teaching methodology and through the external and internal factors that served as challenges and facilitating influences to overcome those challenges. Interview questions were designed to help determine if pressure and support plays a necessary role in the implementation process of PBL. The questions also provided insight into whether or not external/macro factors such as receiving grant funding, administration support and/or an understanding of the benefits of PBL recede in importance while internal factors, such as an implementer’s need for confidence, motivation and student buy in become the dominant challenges. In addition, interview participants who have taught PBL in more than one course were sought to help determine if PBL challenges ever fully resolve or if they continue to evolve.
Chapter Two: Literature Review

In the face of this evolving global world that requires more advanced skills, problem and project based learning (PBL) has been identified as a way to serve educators who are seeking different and more successful ways of teaching and motivating students. This literature review will define and establish the use of PBL in advanced technological education (ATE) programs within community colleges and other public universities and colleges, as well as reflect a dire need for more research on this subject. A review of PBL in ATE programs reveals that this teaching method has proven to be efficacious for students in community colleges and other higher education institutions, and that it provides them with the skills needed for advanced technological careers. In addition, those who taught with and evaluated this pedagogical approach view PBL in high regard, but also experienced challenges and uncertainties with its use. The scarcity of literature on how instructors overcome the challenges associated with the implementation of PBL lends an explanation for why this teaching method has not become a mainstream practice. Additional research on ATE instructors’ experiences with PBL and how they overcome implementation challenges will help to make PBL more accessible.

Defining PBL

Problem and project based learning is defined as one pedagogical practice - PBL. PBL is a student centered, inquiry based teaching methodology that provides students with active learning experiences, which increases intrinsic motivation and requires collaboration amongst students to design innovative solutions to real world problems (Bell, 2010; Blumenfeld et al., 1991, Hmelo-silver, 2004; Massa et al., 2012; Ravitz, 2010). An instructor’s role in the use of PBL is to serve as a facilitator of the learning process, allowing students to investigate and solve numerous solutions to the problems presented, instead of lecturing and prescribing learned
knowledge (Massa, 2008). Medical schools have a long history with the use of PBL. It was first used in the late 1960s for training physicians (Jones, 2008), however advocacy for experiential education and learning through projects and problem solving began before then. Inquiry based, student centered, experiential learning has been encouraged as a promising practice by numerous, historic educational theorists and practitioners, including Dewey (Hansen, 2007), Freire (2010) and Xingzhi (Weijia & Kaiyuan, 2007). The literature classifies PBL as an efficacious pedagogy that provides students with the 21st century skills needed to attract, retain and prepare students to become advanced technological experts (Bell, 2010; Craft & Mack, 2001; Massa et al., 2012; Woszcyna-Birch, 2009).

**PBL in ATE programs within Higher Education**

Numerous ATE programs in higher education have implemented and evaluated the use of PBL (Craft & Mack, 2001; Delale, Liaw, Jiji, Voiculescu, & Yu, 2011; Jones, 2008; Massa et al., 2012; Nasr & Ramadan, 2008; Noravian, 2013; Woszcyna-Birch, 2009). PBL is identified as a teaching method that will help reform ATE education and prepare students with the skills necessary for today’s advancing world. A major supporter of these efforts has been the National Science Foundation (NSF). Another common acronym used in the literature, which incorporates ATE is STEM (Science, Technology, Engineering and Math). There is limited discussion on PBL in ATE and STEM programs, and there is little research overall on the effectiveness of PBL in the two-year, public higher education sector (Major & Major, 2013). To provide a larger breadth of research, this literature review includes the research on PBL in ATE programs within community colleges and PBL in ATE programs within public and private higher education institutions in America. The literature on PBL in ATE programs mostly reflects student
perspectives, however one study did include research on educators in the role of students and their experiences learning through the PBL approach.

**National Science Foundation and ATE Reform**

PBL has been looked at as a teaching methodology that can successfully reform ATE to help attract, motivate, retain and graduate students who meet national standards, and the National Science Foundation (NSF) has funded many of these efforts. The NSF has been funding ATE PBL curriculum reform efforts since as early as 1996 (Craft & Mack, 2001). Six ATE projects involved PBL in education reform efforts (Craft & Mack, 2001; Delale et al., 2011; Jones, 2008; Nasr & Ramadan, 2008; Massa et al., 2012; Woszcyna-Birch, 2009) and six projects received support from the NSF (Craft & Mack, 2001; Delale, et al., 2011; Massa et al., 2012; Nasr & Ramadan, 2008; Noravian, 2013; Woszcyna-Birch, 2009). In addition, the NSF funded a study that evaluated the use of PBL in an ATE program, as part of a larger research grant awarded to the Foundation for California Community Colleges (Noravian, 2013). Three studies combined ATE, PBL and community colleges (Jones, 2008; Noravian, 2013; Woszcyna-Birch, 2009).

Research that combines ATE, PBL and community colleges is significant because it is extremely rare. Two studies that combined ATE, PBL and community college students sought to evaluate curriculum reform efforts that included the use of PBL (Jones, 2008; Woszcyna-Birch, 2009), while one study more specifically sought to evaluate the efficacy of PBL (Noravian, 2013). Furthermore, Noravian’s (2013) study investigated how the use of ill-structured, less-structured and well-structured problems in PBL impacted students’ self-esteem and identity as technicians. Study participants were community college students in a bridge (developmental) program, previous to taking college level courses in their major. According to Noravian (2013), the participants represented a typical community college student population. “They mostly came
from working-class families and were the first in the immediate family to attend college. Fifty percent of the participants were African American while the other 50% were White” (Noravian, 2013, pp. 20-21). Another community college, in New York, sought the use of PBL as a way to reform a nursing program and to help students develop better critical thinking and communication skills. The NSF did not fund this program. Consequently, the program was looking to meet national standards, the National League for Nursing’s call for nursing programs to provide effective and innovative teaching and learning that appropriately prepares students for their field (Jones, 2008). Another curriculum reform project that combined ATE, PBL and community college students came from The Center for Life Support and Sustainable Living, housed at a public university in Connecticut (Woszcyna-Birch, 2009). Program participants were community college and university students who were placed in interdisciplinary teams during an intense, three-week winter intersession. Goals of the curriculum reform included efforts to attract and retain a diverse student body interested in STEM. In addition, the program sought to provide students opportunities to apply science, engineering and technology knowledge and professional skills to real-world problems that address life support and sustainable living issues (Woszcyna-Birch, 2009). The NSF did not fund this program, though the final student presentations, which were developed through the use of PBL curriculum, were presented to the NSF (Woszcyna-Birch, 2009).

Four ATE programs, all with an engineering focus, were funded by the NSF and sought to improve teaching and learning through the use of PBL (Craft & Mack, 2001; Delale, et al., 2011; Nasr & Ramadan, 2008; Massa et al., 2012). All of these programs aimed to provide students with the skills that would prepare them for workplace. For example, the South Carolina Advanced Technological Education (SCATE) center began a large-scale education reform effort
for engineering education in South Carolina, one of the first education reform efforts of its kind in the United States (Craft & Mack, 2001). Similar to what Woszcyna-Birch (2009) reported, SCATE’s reform efforts included goals to increase program quality, as well as attract, retain and graduate a diverse body of students (Craft & Mack, 2001). A Mechanical Engineering program at a public college in New York also sought major programmatic and curriculum reform to provide the appropriate “cyber learning” that meets contemporary societal and industry needs and to provide hands on learning through projects (Delale et al., 2011, p. 4). Similar to what Jones (2008) reported, the program was also seeking to meet national standards, a call from National Academy of Engineering that urged “engineering educators and curriculum developers to adapt their programs to address the complex technical, social, and ethical questions raised by emerging technologies. … and tackle modern day issues” (Delale et al., 2011, p. 3). Another project that was funded by the NSF is the Photon PBL project developed by the New England Board of Higher Education (NEBHE). The purpose of this project was to design “institutional modules, called PBL challenges, developed in partnership with the photonics industry and university research labs” as a way to meet the need for training and resources for STEM educators looking to implement PBL in their classrooms (Massa et al., 2012, abstract). In addition, NEBHE conducted a pilot study on pre-service teachers in a Teaching Technology & Engineering K-12 course that sought to determine the “knowledge, skills and attitudes” of these their experiences with the PBL modules (Massa et al., 2012, abstract). Professional development has been used in numerous programs as a way to support and spread the implementation of PBL.

**PBL Professional Development**

Four pieces of literature discuss the role of PBL focused professional development as a way to improve ATE programs. For example, one of SCATE’s first goals was to develop
“exemplary faculty” and transform teaching and learning at 16 technical colleges in South Carolina, including training on PBL, in their effort to increase retention and graduation rates (Craft & Mack, 2001, p. 427). Similarly, the primary investigator and facilitator of a nursing program who also sought to incorporate PBL as a way to increase retention and graduation rates, gained professional development training on PBL before implementing the new curriculum (Jones, 2008). A Mechanical Engineering program also introduced new PBL teaching strategies to all instructors in the program, as a way to help their instructors prepare students with necessary skills (Delale et al., 2011). Massa et al. (2012) studied STEM educators who took a class that was entirely focused on experiencing PBL, as a way to help them implement PBL. Based on this study, NEBHE recommends further research on a larger and more diverse population of educators using PBL (Massa et al., 2012). Although these studies discussed the use of professional development work for instructors who sought to implement PBL in ATE programs, there was no discussion about how the professional development work influenced the implementation and if it helped instructors overcome implementation challenges.

ATE programs are looking to PBL as a way to reform curriculum practices, attract and retain students, and prepare students with the skills needed for the workplace, as advised by seminal scholars (Barron et al., 1998; Blumenfeld et al., 1991; Hmelo-Silver, 2004). PBL in engineering programs is most often discussed amongst the literature on PBL in ATE. In addition, nursing, sustainability and STEM education programs have also implemented PBL as a way to meet national expectations and better serve students. A review of the literature also illuminates that the NSF has played a consequential role in the support of PBL in ATE programs. Additionally, numerous ATE focused programs incorporated professional development training to support and encourage the implementation of PBL, though follow up research on the impact of
such training was not discussed. Furthermore, the literature on PBL in ATE programs is primarily focused on students’ experience with PBL and how it proves to be a valuable instructional practice for them.

**Student Experiences with PBL**

Engineers and scientists are problem solvers — individuals who skillfully apply their knowledge to tackle real-world problems by designing experiments, building prototypes, analyzing and interpreting data, and presenting experimental results to peers, supervisors and customers. It follows that in order to attract more students into STEM careers, students must be provided with meaningful learning experiences that motivate and excite them — learning-experiences that relate directly to the world in which they live. (Massa, et al., 2012, np.)

The literature on PBL in ATE programs predominantly presented findings related to students. Moreover, the literature explains PBL as an extremely efficacious pedagogy, with minimal challenges, for students. The literature reveals that students enjoy PBL, often prefer it to traditional teaching and learning methods, and that this preference might connect to increased academic success. Additionally, the literature on PBL in ATE programs also expressed an increase in students’ intrinsic motivation and that PBL successfully prepares students with 21st century skills. PBL did pose some challenges for students, especially in relation to group work.

**Benefits of PBL.** The use of PBL in ATE within higher education provides numerous benefits to students. Findings confirm that PBL meets a national need to prepare students with the necessary 21st century skills and the “demands for new global innovation economy” (Massa et al., 2012). In addition, students often enjoy PBL more so than traditional teaching and learning methods. Furthermore, students and evaluators deemed PBL curriculum to be relevant
and to meet learning objectives. Another positive finding was that PBL motivates students towards academic success and helps them develop a professional identity (Novarian, 2013).

Brophy & Alleman (1991) contend that curriculum content should be designed so students can apply it to life outside of school and the literature expresses that PBL achieves this goal. Hmelo-Silver (2004) claims that PBL curricula should “provide students with guided experience in learning through solving complex, real-world problems” (p. 239). Several studies that evaluated students’ use of PBL in ATE courses present findings that support this claim. Novarian’s (2013) study on community college students in developmental industrial systems courses espoused that PBL provided a pedagogical framework for real world, applicable teaching and learning. Additionally, findings presented that students learned the skills needed to be a technician and to develop identities as technicians (Novarian, 2013). Further findings express that the use of PBL in ATE increases students’ ability to successfully solve real world problems applicable to the workplace, increased professionalism, growth in maturity and improved communication skills (Craft & Mack, 2001; Jones, 2008; Woszcyna-Birch, 2009). In addition to preparing students for the workplace, the use of PBL in ATE improved student motivation.

Hmelo-Silver (2004) posited that one of the main goals of PBL is to increase intrinsic motivation. The literature portrayed students in PBL ATE classrooms as presenting regular and active participation (Keller, 2002) and in some cases increased participation and ownership of the learning process (Craft & Mack, 2001; Jones 2008). For example, undergraduate nursing students noted that PBL increased their motivation to seek information (Jones, 2008). In addition, engineering technology students were motivated to work on projects unsupervised and attended labs when class was not in session (Craft & Mack, 2001). One reason for students’
increased intrinsic motivation with PBL curriculum might relate to students’ enjoyment of the PBL process and preference of it to more traditional pedagogical methods.

PBL encourages that instructors provide student centered learning experiences and move away from teaching methods that include systematic test taking and memorizing information from textbooks. Two thirds of students who took a PBL thermodynamics course reported that they preferred the student centered PBL method to the traditional teaching approach (Nasr & Ramadan, 2008). In addition, students reported that the real world experience of PBL made it easier to “retain, recall and comprehend information,” in comparison to learning from a textbook, and that they prefer working in groups rather than individually (Jones, 2008, p. 282). Craft & Mack (2001) also found that students showed a better understanding of material through the use of PBL. In addition to PBL proving enjoyable, students and evaluators viewed the teaching methodology as academically effective.

According to the literature, PBL provides a pedagogical framework that allows students and instructors to meet and exceed course objectives. After completing an undergraduate PBL course in scientific methods, students were satisfied with their learning and felt that course objectives were met (Keller, 2002). Students in a thermodynamics course classified the PBL structure of the course as relevant to their learning needs (Nasr & Ramadan, 2008). Students enrolled in a winter intersession that challenged students to apply STEM and professional skills to problems that address sustainable living issues, through the use of PBL curriculum, reported that they were pleased with the program’s outcomes (Woszcyna-Birch, 2009). After completing a PBL based engineering and technology course, pre-service teachers showed a significant increase in content knowledge (Massa et. al, 2012). Another common benefit to students was a significant increase in their critical thinking skills, after completing a PBL based course (Jones,
2008; Massa et al., 2012; Woszcyna-Birch, 2009). According to Jones (2008), PBL allowed for a “development of deep, rather than superficial learning, and encouraged students to question assumptions and become more analytical” (p. 282). Although there is much that students gain from experiencing PBL, there are some aspects that students found to be challenging.

**Student challenges with PBL.** Although the literature on PBL in ATE programs lists numerous benefits for students, it does not present many challenges. One repeated challenge was with group work. Students found it challenging to find time to meet with their group members outside of class (Nasr & Ramadan, 2008). In addition, some students were resistant to group work and student centered work (Keller, 2002). Several students also asked for more traditional teaching and learning, such as material that they could take notes on and tests (Keller, 2002). Delale et al. (2011) conveyed that although there was a showing of grade improvements in some PBL courses, grades also worsened in other courses. In addition, contrary to Hmelo-Silver’s (2004) claim that PBL increases intrinsic motivation, results of a study on pre-service STEM teachers, who were involved in experiential learning of PBL in a Teaching Technology & Engineering K-12 course, reflected a significant increase in external motivation, but not in intrinsic motivation (Massa et al., 2012). These results might relate to the reality that the pre-service teachers were taking a required course (Massa et al., 2012).

The literature provides a thorough analysis of the student experience with PBL in ATE. Student reports claim PBL to appropriately meet their learning expectations, and to be a gratifying and at times preferable learning process. PBL helps to increase intrinsic motivation, critical thinking and professionalism skills. Although findings in the literature reflect that students did struggle with some aspects of PBL, including group work and a lack of more defined guidelines, overall challenges were nominal. In addition to the portrayal of students’
perspectives of PBL in ATE programs, it is imperative to understand instructors’ experiences and how to support them in the facilitation of this role.

**Instructor Experiences with PBL**

The portrayal of the instructor experience with PBL is equally important to the student experience, though its representation in the literature is less comprehensive. This dearth of literature reflects a need for more research on how to support ATE instructors with the implementation of PBL within community colleges. To provide more of a breadth of understanding, including the challenges that hinder the longstanding adoption of PBL, this review of the literature on the instructors’ role in PBL will include seminal texts and significant studies, including non-ATE studies, in addition to the literature on PBL in ATE higher education programs. Common implementation challenges with PBL relate to time, assessment and the shift into becoming a facilitator of the learning process.

Song, Hannafin and Hill (2007) posit that an educator serving as a facilitator helps to reconcile disconnects in learning that can exist between teacher and student. Although PBL curriculum has been shown to accomplish this, it has not become a more main stream education practice. The lack of longstanding implementation of PBL in classrooms proves true what Apple (2008) proclaimed: “it is clearly very difficult to make lasting transformations in curricular policies and processes” (p. 35). Massa et al. (2012) postulates that one of the challenges for instructors seeking to implement PBL in the ATE classroom is the lack of instructional resources and training. Seminal scholars Blumenfeld et al. (1991) connected the overall scarcity of PBL implementation to an absence of defined guidelines for assessment and for instructors, and a lack of time, funds, and ability to change. Seminal scholars Barron et al. (1998) also explained that although the efficacy of PBL has been proven, educators using this
teaching model have been in the minority for numerous reasons, including a lack of resources, large class sizes, administrative challenges, and an absence of time for curriculum design.

The literature on the implementation of PBL confirms that time can often be a challenging factor. For example, the evaluation of PBL in a thermodynamics course highlighted that the instructor needed to plan for more interaction time with students during class and allow students a significant amount of in class time to work in their groups (Nasr & Ramadan, 2008). Keller (2002) also noted that students needed additional time in class because they struggled to find time outside of class for group work, a common element of PBL. In addition, due to lack of instructional tools and models for PBL in ATE programs, those seeking to use and extend the use of this pedagogical method have to dedicate a great deal of time to developing innovative curriculum and training educators (Craft & Mack, 2012; Keller, 2002; Massa et al. 2012).

Another challenge posed to instructors who implement PBL is assessment. If PBL is to become a more widely used teaching method, then research that reflects guidelines for how to most effectively assess students’ work and research on promising practices for instructors is needed. For example, after completing a study on the impact of PBL on students learning the human services field, Allan (2007) noted that a main problem is related to difficulty with assessment. Ellis and Hafner (2008) determined that “[a]n assessment of the assignment is difficult and time consuming” (p. 180). Nasr & Ramadan (2008) reported challenges with carrying out proper assessment while also assuring appropriate skill acquisition. Keller (2002) reported an increase in student grades through the use of PBL and that some colleagues praised this, while others were concerned with grade inflation. Studies that reveal how often to assess students during the project work, such as daily, weekly or at the end of the
project, and how varying methods influence student performance are needed. Another common challenge for instructors is managing the shift from lecturer to a facilitator of learning.

Hemlo-silver (2004) classified that the role of instructor in PBL is to facilitate collaborative learning and to help guide knowledge acquisition through open ended questioning and this has proved challenging for instructors. According to Massa et al. (2012) instructors have found the facilitation aspect of PBL to be intimidating. Lam, Cheng and Ma (2009) explained that hesitance to PBL occurs because the practices involved with PBL often “bear little resemblance to either their current practices or to the methods they [instructors] had learned and experienced as students themselves” (p. 566). Keller (2002) expressed feelings of guilt related to serving as a facilitator and allowing students to find answers to problems on their own, instead of feeding them information. Furthermore, Craft and Mack (2001) encourage that faculty should serve as coaches, not lecturers, and that they should contextualize learning for students.

To help this transformation from lecturer to facilitator, SCATE has provided professional development training to instructors who are looking to reform their teaching practices to the PBL approach. However, English’s (2013) noteworthy study on K-12 instructors’ implementation of PBL found that even the most motivated instructors still need support while implementing PBL and a lack of support will deter its use. Lam et al. (2010) advised that understanding the different motivational factors that drive instructors to implement new innovations can help those seeking to implement education reform. Hmelo-silver (2004) posited that there is dire need for evidence based instructional strategies that help classify which aspects of PBL lead to certain outcomes and that this research can aid instructors in their implementation.

Conclusion

PBL in ATE programs has been represented in the literature as an extremely efficacious
teaching method, though there has been resistance to this teaching method for numerous reasons. Instructors’ hesitance to PBL relates to the need for more training and best practice guides aimed at supporting PBL practitioners. As the literature reflects, students enjoy PBL and it has proven to increase students’ motivation and academic success. At a time when community college education strives to provide students with the skills needed for this changing world, PBL should be recognized and instructors who teach through PBL should be supported. PBL provides students with practical education that can be used in their work and life. National organizations, including the NSF, understand the value of PBL and have become a major supporter of its implementation and research on this implementation. Due to PBL still being an uncommon practice in classrooms, educators would benefit from a promising practices and assessment guide that is developed from research. This should include a compilation of feedback from instructors, which details how they overcome implementation challenges and sustain the use of PBL in their classrooms. Due to the proven efficacy of PBL, but limited amount of research on how ATE community college programs and instructors overcome implementation challenges with PBL, the research topic for this study was relevant and justified.
Chapter 3: Methodology

The purpose of the study was to identify promising practices for overcoming implementation challenges with PBL in Advanced Technological Education (ATE) programs within community colleges. The study was best served by a qualitative Interpretative Phenomenological Analysis approach within a constructivist-interpretivist paradigm because it sought to capture the lived experiences of how instructors within ATE programs in community colleges have overcome implementation challenges with the use of PBL pedagogy, how they make meaning of those experiences and how their meaning making relates to the phenomenon (Ponterotto, 2005). In addition, participants were studied as separate cases and patterns and differences between each case are highlighted (Smith, 2011).

Research Question

The research study sought to answer one question:

How do community college instructors in advanced technological education programs describe implementation challenges with problem and project based learning and how have they overcome those challenges?

The research question aligns with the proposed methodology, a qualitative Interpretive Phenomenological Analysis approach, within a constructivist-interpretivist paradigm. Open ended, one-on-one interviews provided the best method for determining the answers to this research question. The method allowed participants to respond sincerely, without restrictions and according to their unique experiences without “influence” (Patten, 2002, p. 77). Participants were able to freely describe personal and outside barriers that have led to implementation challenges with the use of PBL curriculum and how they have overcome those challenges.
Research Paradigm

The constructivist-interpretivist paradigm laid the appropriate foundation for the study because it sought to bring to consciousness the lived experiences of those involved with the phenomenon (Burrell & Morgan, 1979; Ponterotto, 2005). During the process of teaching with the PBL pedagogy, participants lived with and became experts on the phenomenon and how to overcome challenges implementing PBL in a community college ATE program. The study’s aim was to bring the participants’ perceptions of that experience to consciousness. Determining how participants perceive PBL related challenges and how to overcome them was essential to the study because it aspired to present findings that come directly from experiential experts as guidance to other instructors who want to adopt PBL. The role of the researcher was important to this process.

Within a constructivist-interpretivist paradigm the role of the researcher is to help bring consciousness to the meaning that participants hold in their mind about their lived experience with the phenomenon (Ponterotto, 2005). Meaning in the study was made from the participants of the action, community college ATE instructors who have taught PBL, not from one who has observed them in this action (Burrell & Morgan, 1979). The researcher’s role was to help bring such realities to the surface through interactive dialogue with participants and by co-constructing meaning of such dialogue (Ponterotto, 2005). This occurred through open ended, one-on-one interviews with participants. In person interviews were conducted, and although the questions were of a “semistructured nature” (Patten, 2010, p. 77), follow up interviews were not necessary. In person, semi structured interviews helped to bring forth the genuine experiences of the study participants that might otherwise be outside of their consciousness, a main assumption of the constructivist-interpretivist paradigm (Ponterotto, 2005). Interviews allowed for the stories of
how the participants, ATE community college instructors, have overcome implementation challenges with PBL. The constructivist-interpretivist paradigm fit well with a qualitative approach to the study because it allowed the researcher to be interactive with participants, findings to be co-constructed and participants’ lived experiences to become concrete.

**Research Design**

The research question lends itself to a qualitative approach because it was open ended, allowed findings to directly emerge from participants’ perspectives, and it did not seek a particular finding. A qualitative approach also aims to provide rich descriptions and details of processes related to the phenomenon in study participants’ own words, within their own context (Miles & Huberman, 1994). In alignment with this approach, the study attempted to gain a specific understanding of how participants overcome PBL implementation challenges, in their own words, based on their unique experiences. Another goal was to identify patterns and themes from within these experiences (Bogdan & Biklen, 2003). In addition, intent of the study was to learn which particular events within the PBL implementation process led to “fruitful consequences,” the ability to overcome challenges with the implementation of PBL (Miles & Huberman, 1994, p. 1). A detailed account of participants’ perceived experience with the phenomenon and the meaning they made of these perceptions, in their own words, was needed to fulfill a goal of the study: to provide a promising practices guide for PBL instructors.

The researcher plays a specific role within a qualitative study, serving as the main instrument for data collection and analysis. In serving this role, I loosely structured the interview process so findings could emerge naturally and freely from participants (Bogdan & Biklen, 2003). A qualitative approach to data collection and analysis includes the use of data reduction (Miles & Huberman, 1994). In alignment with this approach I took notes during the interview,
made notes on interview transcripts, summarized ideas from transcripts, and clustered ideas and themes from the transcripts. I also became detached from pre-existing perceptions about how to overcome implementation challenges with PBL curriculum, a critical element of a qualitative approach (Miles & Huberman, 1994). The research tradition within a qualitative approach that provided the study rich and detailed findings in participants’ own words was Interpretative Phenomenological Analysis.

**Research Tradition**

A contemporary approach to qualitative inquiry, Interpretative Phenomenological Analysis (IPA), was used as the research tradition for the study. IPA was developed and first introduced by Smith, in 1996 (Smith et al., 2013). IPA seeks to understand the experiences of people through their own perspective, which is accessed by the researcher. Smith et al. (2013) explained that IPA is a “double hermeneutic” because the researcher is trying to make sense of the participants who are trying to make sense of their experience. In addition, IPA encourages that researchers use verbatim quotes from interview transcripts to provide a precise and detailed portrayal of findings (Smith et al., 2013). IPA best served this study because it sought to present an extremely detailed account of ATE community college instructors’ lived experience with the implementation of PBL, how they express meaning about overcoming implementation challenges, and how they made sense of such meaning. In addition, the study sought to understand the commonalities and differences within each PBL implementation experience, which reflects a main aspect of IPA (Smith et al., 2013). There are three main philosophical tenets that contribute to the whole of IPA: phenomenology, hermeneutics and idiography.

**Phenomenology.** Smith et al. (2013) credit four major contributors to phenomenology: Husserl, Heidegger, Merleau-Ponty and Sartre. According to Smith et al. (2013), Husserl, who is
often referenced as the largest contributor to phenomenology, was concerned with bringing the consciousness of an experience to the forefront and in doing so determining the essential qualities of that experience. Furthermore, Husserl proposed that by transcending the experience we could illuminate it for others (Smith et al., 2013). This aspect particularly related to the study because it illuminates how ATE community college instructors overcome implementation challenges with PBL as way to help guide others through the implementation of PBL. In addition, Husserl’s philosophy encourages that researchers bracket out their own perceptions about the phenomenon, take into account the aspects of everyday living and reflect on those experiences (Smith et al., 2013). Smith et al. (2013) express that Heidegger, a student of Husserl’s, shifted from the transcendental view of phenomenology to the hermeneutic principles of experience. Heidegger encouraged that we look at the relationships and practical activities that convey the phenomenon, in addition to how we are involved in the world and make meaning of that (Smith et al., 2013). This aspect of Heidegger’s philosophy relates to this study because it encouraged the researcher to learn how the instructors view themselves as educators and how their relationships with students, members of industry and administrators influence their view and the implementation of PBL. According to Smith et al. (2013), Merleau-Ponty also posited that how we view ourselves in the world influences how we in turn view the world. In addition, he believed that we view ourselves as different from and outside of the world that we live in and that no two beings could entirely share the same experience (Smith et al., 2013). Merleau-Ponty’s philosophy expresses why it is important to study numerous ATE community college instructors who have implemented PBL. Studying numerous instructors has provided a breadth of the challenges that could arise with the implementation of PBL and different ways to overcome those challenges. Lastly, Sartre’s influence on phenomenology was to postulate that
we are always in the process of becoming ourselves (Smith et al., 2013). This aspect of phenomenology directly connects to the McLaughlin’s (1987) theoretical framework that was used for the study, which advances that implementation issues never resolve but continue to evolve. The study set out to learn if Sartre and McLaughlin’s (1987) theories proved true for community college ATE instructors who implement PBL. In addition to phenomenology, another major theoretical aspect of IPA is hermeneutics.

**Hermeneutics.** Smith et al. (2013) explained that hermeneutics lays an important theoretical foundation for IPA because it is concerned with interpretation. Its roots began with the interpretation of biblical texts and have since extended to theoretical concerns with the method and purpose of interpretation (Smith et al., 2013). In addition, they classified that three significant hermeneutic theorists are Schleiermacher, Heidegger and Gadamer and they explain their influence as follows. Schleiermacher claimed that the author imposes meaning on writing through the techniques and intentions used to create it. According to Schleiermacher’s philosophy, interpretation is a combination of skill and intuition, not something that follows set guidelines. Schleiermacher’s approach to hermeneutics validated the researcher’s intended approach to analyzing the data. The researcher sought to determine findings from what participants expressed and from what participants did not express. In addition, the researcher established meaning through patterns of commonalities and differences between each participants’ experience. Heidegger also believed that our access to understanding our lived experience and being in the world is through interpretation. Heidegger extended his theoretical principles relating to phenomenology and the illumination of meaning to then hermeneutically making sense of that meaning. However, Heidegger warns that although it is virtually impossible to erase our preconceptions of the new meaning that comes to consciousness, we
should be fully aware of that reality as we attempt to bracket out our preconceived notions. Gadamer is also concerned with the role that history plays in interpretation and encourages the researcher to spend time trying to identify preconceived notions during the interpretation process. Furthermore, Gadamer argued that the phenomenon could influence perception, which can in turn influence interpretation. Gadamer believed that one who understands the phenomenon could use this understanding to help in the questioning of the phenomenon and the interpretation. In relation to Gadamer’s theoretical underpinnings, the researcher’s experience with the implementation of PBL was a benefit to the study. The last major tenet to influence IPA is idiography.

Idiography. Smith et al. (2013) explains that idiography is the third major tenet of IPA because it relates to analytic procedures. More specifically, idiography is concerned with the “particular” at two levels (Smith et al., 2013, p. 29). Additionally, they postulate that analysis must have depth and it must show commitment to the understanding of how the phenomenon is expressed by those who experienced it in a particular context. In doing so, analysis moves from the specific to the general (Smith et al. 2013). This theoretical aspect of IPA allowed the researchers to determine findings that express a single and collective experience of how ATE community college instructors identify and overcome implementation issues with PBL.

Role of the Researcher

The use of a qualitative methodology includes the “axiological assumption” that the researcher openly reveals and discusses all biases (Creswell, 2013, p. 20). Furthermore, the close relationship with study participants that occurs through the framework of the constructivist - interpretivist paradigm assumes that the researcher’s bias impacts the study (Ponterotto, 2005). The researcher reduced bias by seeking clarity of participants’ perceptions through a semi
structured interview process, member checking and peer review.

Participants

Purposeful homogenous sampling was used to choose participants for the study. Participants who possess similar characteristics were sought and interviewed (Smith et al., 2013). For the purpose of the study, the similar characteristics sought were instructors who identify as having implemented PBL curriculum within an ATE program in a community college and having received PBL focused professional development. Four community college ATE instructors who previously attended PBL focused professional development training through New England Board of Higher Education served as participants in this study. Participants were current instructors at a community college who have taught many courses that involve PBL and that are a requirement towards an ATE degree. The courses taught included a general education course and major specific courses. The courses had varying levels of PBL. Study participants taught different core subject matters and have been implementing PBL for different lengths of time. Variation amongst participants was sought to increase the validity of the findings. A small sample size is recommended with IPA (Smith, 2011). Four participants was a realistic number for the timeframe of this study. This number of participants provided rich data to illustrate how ATE instructors in various community colleges identified and have overcome implementation challenges with PBL curriculum.

Recruitment and Access

Participants were recruited with the assistance from the New England Board of Higher Education (NEBHE). NEBHE made initial outreach phone calls to participants who met the study’s criteria, followed by a recruitment letter that thoroughly described the study and their role as participants, if they chose to participate in the study. The researcher participated in
writing the outreach letter by NEBHE to participants and approved its final draft. The researcher formally communicated with potential participants who responded with interest to the researcher by e-mail. The researcher confirmed and arranged their participation by e-mail and phone, as recommended by Rubin and Rubin (2012). The researcher fully explained the goal of the study and participants’ potential role (Rubin & Rubin, 2012). In addition, NEBHE provided participants with a $25 gift card for their participation in the study.

Data Collection

Data was collected through semi-structured, open ended, one-on-one interviews, which is recommended for an IPA study (Smith et al., 2013). Meeting IPA requirements, comfortable rapport was built amongst participants before interviews began. Qualitative research suggests that participants be interviewed in the setting where they experienced the phenomenon (Miles & Huberman, 1994), yet IPA suggests that the researcher ask where the participants feel most comfortable (Smith et al. 2013). In attempt to satisfy IPA and qualitative standards, the researcher asked participants if there was a place on their campus that is quiet, without distractions and where they would feel comfortable being interviewed. Participants chose the location for their interview. Quality data was collected from participants about their experience with the phenomenon (Smith et al., 2013).

As recommended by Smith et al. (2013), the researcher held extensive interviews with study participants. Participants were informed in advance of the time expectations and that they could stop the interview at any time, with no consequences (Rubin & Rubin, 2102). With the use of IPA it is important to build rapport with participants before beginning the interview and then also hold interviews that are long enough to gain rich detail of the phenomenon (Smith et al., 2013). Through previous e-mails, phone conversations and before each interview began the
researcher spent time building rapport with participants. As recommended by Smith et al. (2013), the researcher designed and used a flexible interview schedule with open ended questions that encouraged participants to fully tell their stories, and then mostly listened to their responses. The interview protocol and schedule is attached as Appendix C. Interviews ranged from 40 – 50 minutes in length. As recommended by Miles & Huberman (1994), the researcher took notes in a journal fashion about any additional aspects that seemed significant, such as facial expressions, body movement, tone and volume. Rubin & Rubin (2012) suggest having two recording devices, in case one does not function properly. The interviews were be audiotaped with a digital recorder and with the Microsoft Word’s Audio Notes to ensure accuracy in capturing and reporting participants’ statements.

Participants agreed to respond to follow up questions via e-mail, if necessary. One follow up question was asked of one participant, via e-mail. Member checking occurred with each participant. After each interview was transcribed the researcher e-mailed the transcript to the appropriate participant within two weeks of their interview and asked for any further clarifications, additions or changes to their statements. All participants approved of their transcript. One participant made minor corrections to the transcript and two clarified names. The researcher explained to those participants that all names and identifying information was changed for the purposes of confidentiality.

Data Storage

The research data is kept in a secure location and the researcher is the only one who has access to the data. All identifying information of the participants was removed. The signed consent forms and printed data are stored in a locked, fireproof storage box in the researcher’s home and the researcher is the only person who has the key. The electronic data is kept on the
researcher’s password-protected computer and a password protected cloud storage account. The electronic audio files of the interviews have been deleted. There is a risk of loss of privacy. However, no names or identities will be used in any published reports of the research.

**Data Analysis**

Data analysis followed the six steps recommended by Smith et al (2013): reading and re-reading, initial noting, developing emergent themes, searching for connections amongst emergent themes, moving to the next case and looking for patterns across cases. Following these steps assured thoroughness of the data analysis process. This method of analyzing the data encouraged a deep focus on each participant’s story, experience with the phenomenon and an in depth analysis of the similarities and differences amongst the participants, all of which are important aspects of an IPA study.

According to Smith et al. (2013), the first and second steps of the data analysis process can happen consecutively. The first defined step in the data analysis process, as outlined by Smith et al. (2013), was the reading and re-reading of each interview transcript after it had been transcribed verbatim. Smith et al. (2013) recommend that the transcript be read while listening to the audio recording of the interview. The researcher listened to the audio of the interview numerous times, while reading the transcript and took notes in a separate notebook on any initial perceptions or striking observation from the interview. This helped to bracket out any potential preconceived notions (Smith et al., 2013). The researcher reread each transcript numerous times to assure that a true sense of each participant’s story and his or her unique experience with the phenomenon was gained. The second step in the analysis process, initial noting on the transcripts, occurred during the reading and rereading of the transcripts. As the researcher read and reread each transcript, exploratory comments that include an understanding of each
participant’s concerns with the phenomenon were made. As recommended by Smith et al. (2013), the researcher also made descriptive notations, highlighted any important linguistic elements, and noted any conceptual ideas that formed.

Further reading of the transcripts and working with the initial notes and exploratory comments on the transcripts led to the development and mapping of emergent themes, the third step in Smith et al.’s (2013) recommended data analysis process. The researcher then began to identify patterns and connections based on the notes taken and identified chunks of the transcripts that represented these emergent themes. Once this was accomplished, the researcher moved to searching for connections across emergent themes, the fourth step outlined in the data analysis process (Smith et al., 2013). Further following Smith et al.’s (2013) advice, the researcher organized the emergent themes chronologically and began to chart and map how they related to or opposed each other. This level of attention and intimacy occurred with each participant’s transcript. Step five was moving to the next case, while keeping in mind that it is important to bracket out the themes that emerge in each case (Smith et al., 2013). Once each transcript was analyzed individually, common themes and patterns amongst all transcripts were identified, meeting the requirements of step six: looking for patterns across cases (Smith et al., 2013). Lastly, interpretations were made from the analysis of all notes and identifications of patterns, opposing statements and the absence of statements.

**Trustworthiness and Validity**

The researcher followed Yardley’s (2000) four principles for assessing the quality of qualitative research, as outlined in Smith et al. (2013), to assure trustworthiness and validity in the study. Validation strategies were used during data collection, analysis and in the presentation of findings. The four principles adhered to by the researcher are sensitivity to context,
commitment and rigor, transparency and coherence, and impact and importance.

Sensitivity to context highlights that the quality of findings was influenced by the quality of the data collection (Smith et al., 2013). Furthermore, in order to collect quality data participants must feel comfortable and the researcher must show sensitivity to the context (Smith et al., 2013). The researcher built strong rapport with study participants to help them feel at ease. According to Rubin & Rubin (2012), participants are more likely to talk with a researcher if they have a connection and “insiders” are viewed as “less threatening” (p. 76). The mutual connection to NEBHE and the researcher’s experience facilitating PBL curriculum created a bridge of trust with participants and reflected the researcher’s understanding of the context. In addition, the researcher’s support of PBL was disclosed to participants to reveal bias towards the use of PBL pedagogy. Although the researcher revealed this bias, interview questions were open ended to assure that this bias did not influence participants’ responses (Creswell, 2013). To further satisfy the first principle, sensitivity to context, findings also relate to the literature on the use of PBL in ATE community college programs.

Commitment and rigor, the second principle, occurred during data collection and analysis. Smith et al. (2013) advised that the researcher must show commitment to study participants by being attentive. The researcher conducted a practice interview with a non-study participant to assure that the interview schedule and questions provided rich data and to prepare for the participant interviews. Being prepared and comfortable with the interview process and the interview schedule allowed the researcher to be fully present to participants’ stories and to be an active listener. Purposeful homogenous sampling and referrals from NEBHE assured that study participants were selected carefully and best served the research question (Smith et al., 2013). Analysis followed Smith et al.’s (2013) guidelines of six thorough steps and to be
interpretive. In addition, the researcher used numerous verbatim extracts in the presentation of the findings to represent the participants’ voices (Smith et al., 2013).

The third principle that the researcher abided by was transparency and coherence. Transparency and coherence relate to the thoroughness of the study’s write up (Smith et al., 2013). The researcher met the criteria of transparency and coherence by thoroughly describing the chosen sample, the structure of the interviews and how the data was analyzed (Smith et al., 2013). As recommended by Smith et al. (2013), the findings are clearly expressed, coherent and easily readable. The researcher closely followed the tenets of IPA and analyzed the data to express how study participants’ perceived their experience with the phenomenon and how they made meaning of those perceptions (Smith et al., 2013).

Lastly, the study aims to meet the fourth principle, assuring that the study is of impact and importance. Smith et al. (2013) posited that research validity comes from findings that are interesting and useful. The study sought findings on how community college instructors in ATE programs overcome implementation challenges so to share these conclusions with those instructors who want to implement PBL as a way to improve teaching and learning. Furthermore, a goal of the study was to collect data that helps others understand how to improve instruction for all students, thus increasing students’ opportunity for success towards a degree that leads to a viable, advanced technological career.

**Protection of Human Subjects**

The researcher ensured the protection of human subjects, receive informed consent from all study participants and Northeastern University’s Institutional Review Board approved the study. The participants of the study were not be a vulnerable population, however, the researcher maintained ethical conduct and protected study participants in numerous ways. In addition, the
researcher interviewed a diverse population of participants, who each taught a different subject matter, to provide the most valid results relating to the phenomenon. Participation in the study was voluntary and confidential. All participants’ names, names of others mentioned in the interviews, the names of the higher education institutions they teach at and have collaborated with have been replaced with pseudonyms and this was explained to participants.

The researcher conducted open ended, one-on-one interviews in person and in a quiet and confidential area that was chosen by participants. Before interviews began, the purpose of the research was expressed to participants. In addition, the researcher provided the intended length of time for the interviews and explained how results will be used (Creswell, 2013). The researcher recorded and took notes of the interviews and obtained a signed consent form and oral consent before any recording and note taking of the interviews began. The signed consent forms assured that the participants understood the nature of the study and how results will be used, were aware of any risks and were not forced to participate (Rubin & Rubin, 2012). The research questions were open ended, allowing participants the freedom to fully reply (Creswell, 2013). An expedited review process was requested because this study posed “no more risk than participants face in their own normal day” (Rubin & Rubin, 2012, p. 90). The interviews and transcripts are stored electronically on the researcher’s password protected computer and cloud storage account, and hard copies of all data and consent forms are locked in a fireproof lock box. The only foreseeable risk was the risk of confidentiality with the use of e-mail and this was expressed to participants.
Chapter 4: Findings and Analysis

The purpose of this study was to determine how community college instructors within advanced technological education programs describe and overcome implementation challenges with PBL pedagogy. The data analysis yielded three super-ordinate themes and eight nested themes. The super-ordinate and nested themes were: 1) Pedagogical Conviction (1.1 Real World Applicability, 1.2 Deep Learning, 1.3 Enjoyment and Engagement); 2) Support and Guidance (2.1 Support from Administration, 2.2 Instructor as Guide, 2.3 PBL Specific Professional Development); 3) Transformation (3.1 Facilitation Versus Lecturing, 3.2 Time and Experience). Super-ordinate themes and nested themes were identified as those recurring in at least three of the four participants’ interview data. Table 1 provides a listing of the super-ordinate and nested themes that manifested through the analysis process, as well as the recurrence of each theme across participants.

Table 1
Identification of Recurring Themes

<table>
<thead>
<tr>
<th>Super-Ordinate Themes</th>
<th>Matthew</th>
<th>Emily</th>
<th>Maggie</th>
<th>Andrew</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedagogical Conviction</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>1.1 Real World Applicability</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Deep Learning</td>
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<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>1.3 Enjoyment and Engagement</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Support and Guidance</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>2.1 Support from Administration</td>
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<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Instructor as Guide</td>
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<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>2.3 PBL Specific Professional Development</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Transformation</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>3.1 PBL versus traditional teaching methods</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>3.2 Time and Experience</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>
Pedagogical Conviction

Although participants identified and discussed a variety of numerous challenges with the use of PBL, at times making PBL appear more difficult to implement than other teaching methods, participants still felt a pedagogical conviction to use PBL. The first super-ordinate theme that emerged from the data was this pedagogical conviction held by all participants. There were three elements of teaching and learning that participants expressed, which merged to develop this theme of pedagogical conviction. Instructors held strong beliefs that their teaching must motivate students to learn and thoroughly prepare them for their life endeavors, including further academic pursuits and future careers, and that learning must replicate the real world to accomplish this goal. Participants identified PBL as a pedagogical framework that is easily applicable to the use of real world scenarios, best prepares students and that students value PBL. These beliefs created a conviction within participants to use PBL. The three nested themes to be discussed are real world applicability, deep learning and enjoyment and engagement.

Real world applicability. The data reflects that participants were driven by a belief that their job is to prepare students to be successful in the future. They also expressed that this dedication to students’ future achievement has strongly influenced their pedagogical choices, including the adoption and continued use of PBL. Participants expressed pride about their choice to implement PBL and its effectiveness. They communicated a deep belief that teaching through real world scenarios best prepares students for future academic and professional aspirations and that PBL provides the ideal platform to model the real world.

All participants communicated that PBL provides the skills that students need to be successful in their future academic and professional pursuits, compared to other educational practices that have not. Matthew, Emily and Andrew, who all teach major specific courses,
discussed the need to use pedagogical practices that will prepare students for their future careers. Maggie, who teaches more general education courses, talked about the need to prepare students for future courses and current employment. Participants expressed a confidence in their curriculum choices, as experienced educators and subject matter experts, who have taught for many years and are informed about their pedagogical options.

Matthew shared that he has been teaching engineering for almost 30 years and has used PBL for the past eight years. Matthew explained that he is knowledgeable about what employers are seeking from college graduates and that he sought to find pedagogical methods that successfully prepare students to meet their requirements:

One of the things that you hear all the time, not only from the employers who are hiring my grads but from engineering employers in general, across the country, not just around here, is that students come out of school with very – they have good technical knowledge, but they’re lacking in problem-solving skills, critical-thinking skills, the ability to think on their feet, the ability to work in teams. So I started researching different methodologies you know that could possibly help develop those problem-solving and critical-thinking skills and the teamwork skills.

Matthew also urged that in his experience students don’t develop the technical and non-technical skills needed for industry through a “traditional didactic format” of teaching and learning. Matthew’s responses reflect a belief that instructors are responsible for finding methods of teaching and learning that best prepare students for employment and future education, for teaching more than core subject content, and that traditional models of teaching and learning are limited in their impact on students’ workplace futures.
Emily, whose entire teaching career was at the community college, has recently retired as a full time instructor, though will remain as a part time instructor. She began using PBL seven years ago. Similar to Matthew, Emily shared that employers were dissatisfied with graduates from her program, though they have not complained since she began using PBL. Furthermore, when describing what influenced her decision to use PBL, she explained that she was looking to implement pedagogy that would be applicable to what employers were requiring of them:

The feedback I got was “your students don’t know how to document a process. They don't know how to write a report. They're scattered. You know, they need to be told what to do.” So anything I could try to improve that I did and this worked beautifully.

Additionally, she posited that students’ skills and their ability to apply those skills to their work in industry improved after she implemented PBL and that “the employers are happy with that which is what matters.” Similar to Matthew, Emily also described a belief that the instructor is responsible for designing curriculum that meets employers’ needs and if students are not meeting employers’ needs, then it is at fault of the teaching methods. She also expressed that she abandoned traditional models and sought new teaching methods, which led her to PBL.

Andrew’s entire teaching career of 13 years, thus far, has also been at a community college and he has been using PBL since he began teaching. Similar to Matthew and Maggie, Andrew was also extremely concerned with providing students an education that prepares them for future employment and he believes that PBL accomplishes this. During Andrew’s interview he stated the word “industry” 17 times and the word “job,” in relation to employment, 13 times. He stated that he has three main responsibilities: to recruit high quality students, prepare them for industry and to help them find a job. Andrew explained that he teaches through PBL because his
higher education did not fully prepare him for employment and his goal is to provide students with skills that are directly applicable to what they need to be successful in industry. He shared:

Because of my background in industry and knowing how I was prepared and knowing how goals and programs were preparing people for industry, when I started teaching I taught from what we might call a PBL perspective because I wanted to – when I left school I didn’t feel confident that I could do the work. I wasn’t prepared.

Andrew had a full career in industry before teaching at a community college and due to this experience he knows what skills are applicable to their future careers. Andrew’s experience of not being fully prepared by his education for his work in industry was so powerful that it has influenced his teaching for the past 13 years. This led him to reject traditional methods of teaching and learning and to practice PBL.

Maggie has been using PBL for 19 years and was introduced to PBL when she was teaching high school math. She has been teaching at a community college for the past seven years. She also held passionate ideals about her role as an educator, and about teaching students skills that they can use in the future and in settings outside of her classroom. When discussing positive aspects of PBL she expressed:

I see students begin to connect things and they begin to see the world through Math eyes, or instead of rose-colored glasses like Math colored glasses. And that's one of my goals too, so that they can understand the world like through equations and symbols and patterns. That would be good. I would also like them to be able to go to their Science classes or any other class and say, “Oh, I could use Math to help solve this problem or make this argument.”
Maggie also talked enthusiastically about experiencing the applicability of the math that students are learning to their current work. For example, she explained that many of her students are stationed at a local navy base and that she and the students get excited when they make the connections on their own between the math that they are learning to tools that they use at the naval base. Maggie expressed that what also moti"vates her to use PBL is that it helps students learn in ways that other pedagogical methods do not accomplish. She emphasized, “I want to give them the courage to think for themselves and I think unless they experience problems that they [have] to solve they don't learn how to think for themselves.” Similar to all participants, Maggie is driven by a belief that her role as an educator is to impart both core subject matter, as well as problem solving, to best prepare students for the future.

In addition to holding convictions that their work is to prepare students to be successful in future academic and professional endeavors, participants reflected a belief that they need to purposely teach through real world scenarios and that PBL lends itself to teaching and learning in this way. Furthermore, all participants were eager and proud to share that their curriculum models the real world.

According to Matthew and Emily, industry is an ideal source for finding real world problems. Explaining his educational philosophy, Mathew stated, “I'm a firm believer in experiential learning and laboratory work and projects.” Furthermore, Matthew expressed numerous times that the problems that he presents to students come directly from industry, including those companies who hire his graduates. He advocated, “It gives them a really good chance, opportunity to get some experience on what they’re going to be doing.” Emily also presents real problems from industry to her students. She explained, “What I'll do is I'll look in a trade journal and find some interesting problems solved and have them try that.” In addition,
Emily also spoke of how an industrial advisory board of engineers, scientists and technicians was created to learn how they solve problems in industry and that what was learned from them was used to design PBL curriculum. Emily and Matthew’s responses illustrate a conviction that instructors need to look outside of textbooks, away from traditional teaching methods and to contemporary workplace issues and models to design curriculum that prepares students for their future careers.

Andrew also stated a belief that students should be introduced to real world scenarios and that a learning environment should model the workplace. He discussed relying on his experience in the engineering field to accomplish this. He described:

I try to create an atmosphere of industry in my classroom. I treat my students not as students. I treat them as employees. I set expectations for them like I did - 15 years of my 30 years was in management - having engineers and technicians working for me.

Andrew’s description presents an instructor’s industry knowledge and experience as invaluable to students’ preparation for the workplace. It also delineates from more traditional teaching methods that include a distinction of students being any different or to be treated any differently than employees during a learning process.

Maggie also discussed a value for teaching through real world problems to help students fully understand math concepts and that because she sees Math everywhere she can find real world problems anywhere. Maggie gave an example of her teaching style:

I'll say, “Okay, today I want you to understand why factoring is important.” … And then we do the activity and I'll try to have a hook for them that relates to their life but I don't hold that out as a secret what Math concept they're trying to do. And then at the end say, “Okay, now we see why somebody might want to be able to factor a polynomial.”
Maggie’s description of her teaching style insinuates that it is the “hook” to their life that helps students truly understand new math concepts.

All of the participants advocated for teaching and learning through PBL because of their experiences with its ability to connect to and model the real world, which they expressed is the way to best prepare students for their future. They shared stories of how they felt compelled to move away from traditional teaching methods and to teach through the use of problems. In addition to PBL’s real world applicability, participants favored PBL because they believe that it provides a platform for deep learning to occur.

**Deep learning.** Influencing participants’ pedagogical conviction to teach with PBL was their belief that PBL provides deep learning, much more so than other teaching methods. Participants felt that PBL helps students develop confidence, and the technical and non-technical skills necessary for the workplace. Though participants were not asked about soft skills, all participants expressed that a benefit of PBL is that it helps develop soft skills. In addition, participants noted that PBL teaches students to be more critical in their thinking, to think for themselves and that they have a higher retention for what they learn.

All of the participants described that a benefit of PBL is a higher level of retained learning and an ability to use that learning. Matthew admitted that lecturing and multiple-choice tests are easier than PBL, but claimed that by those methods “at the end of the day students aren’t going to learn anything.” He cheerfully described students’ reactions to PBL:

Even after it’s done they’ll keep thinking about it and go think, “I wish I could’ve have done it differently. How else would I have figured that? What’s the better approach to doing that?” So it kind of sticks with them. When you talk about deep learning, this is
my interpretation of deep learning. It stimulates curiosity in them; they become intellectually more curious. That to me as a teacher … that’s the best that I can do.

Maggie also compared lecturing and PBL. She expressed that she does still lecture and that sometimes she explains something to students and feels that even when she gave a brilliant explanation, students are still left feeling confused. Maggie explained:

Like I can tell a student find the slope between these two points. And they could subtract the Ys divided by the difference in the access and they'll get the slope. But then when I ask those same students what is slope or ask them a practical application of slope, they're clueless, you know. It's like wow, they really don't get it. They just learned to move the symbols on the page. They don't have a feeling in their bones about what slope is and what rates of change are.

Additionally, Maggie expressed that if students get to higher level math classes after only learning through this skills based approach then they are not able to think for themselves and they expect to be told how to solve problems. Andrew explained a similar experience. He posited, “I knew it didn’t work showing people how to solve a Math problem and then here's some more numbers, now you solve it. That does not work.” Similarly, Emily compared her students’ learning through PBL to a study that she read. She explained that the study’s findings revealed “people who were not in PBL had better recall of facts, but six months out it was the people who were in PBL who did better. And I think that's what I’m seeing.” Participants’ focus on the longevity of students’ learning and development of the ability to think critically and for themselves through PBL, suggests that an over-reliance on initial indicators of student success with other teaching methods might misinterpret long-term student learning gains.
Participants also praised PBL because it helps develop additional soft skills, beyond critical thinking. Emily expressed that PBL also helped her students improve their writing skills. Andrew expressed similar thoughts. He stated, “so every student of mine - not only are they prepared technically, not only do they have confidence in solving problems but they know how to communicate and how to write well.” Andrew used the word “confident” nine times during his interview and the word “confidence” twice. Andrew’s own experience of not gaining confidence to solve problems in the workplace, from his education, has driven him to assure that his students gain confidence and he credits PBL as a teaching method that builds confidence.

Matthew conveyed satisfaction with how PBL helps connect multiple aspects of learning. He explained, “One of the big complaints about education in general is that courses are always taught in silos. So it gives them an opportunity to connect all the silos together and see how everything is interrelated.” Participants’ focus on the development of soft skills through PBL indicates a pedagogical conviction and feeling of responsibility to inspire whole student development in their classrooms. It also reflects that they believe that every class should teach students all of the skills necessary for industry, technical and non-technical. Another aspect of learning that participants expressed as significant to their work is the ability to provide education that motivates students to learn, which in turn has motivated them as instructors.

**Enjoyment and engagement.** Participants’ motivation to continue using PBL was commonly fueled by positive student responses. It was clearly evident that all participants want students to find teaching and learning enjoyable and engaging. In addition, some participants reported that students found PBL to be preferable to other teaching methods. Participants also expressed an understanding that PBL would most likely be a new teaching method to students and a willingness to risk initial appreciation for PBL.
In response to what has motivated Matthew to continue using PBL he reported:

In terms of the students, I guess trying something new with them and seeing their reactions, seeing them respond positively to it because you don’t know how they’re going to react, you know, when you first start doing it. But having them come to you and say, “I wish all my classes were done like this.” And so it just gives you further motivation to keep doing it.

Matthew represents willingness to a take a risk with his teaching due to his pedagogical conviction that PBL best serves students. Maggie also discussed taking such a risk. She explained that promotion is tied to student evaluations and that teaching students in ways that seem non-traditional and that push them to be independent in their thinking, in comparison to other teaching methods used at the college, could inspire students to evaluate her poorly. Even so, Maggie did express student enjoyment through the use of PBL. Similar to Matthew, Maggie voiced that “positive feedback” from students has motivated her continued use of PBL. Although she described that student resistance can be a part of the PBL process, she did express confidence in her pedagogical conviction. She stated, “I know I do okay because my students come to me and they ask me questions and we work together and they get excited about it.” Numerous times Andrew also clearly reflected pride that his students have enjoyed and valued his teaching and their learning. He told many stories about receiving positive student e-mails and phone calls from students after they have graduated. Andrew also articulated that although he challenges students through the use of PBL, students never want to leave his classes. These responses from Matthew, Maggie and Andrew suggest that the implementation of PBL requires confidence in one’s teaching ability and the potential of PBL, in addition to awareness that this method will most likely be a new experience for students.
Participants also discussed being motivated by student responses that PBL is engaging, preferable to other teaching methods and useful. Describing students in his classes, Andrew stated, “They can’t wait to get in the second year with me and get prepared to go into industry.” Quoting his students, Matthew stated: “You know, we like doing it this way. We like learning this way because we’re totally engaged.” In addition, he posited that his students do not want to return to traditional, didactic teaching methods once they experience PBL because “they realize the usefulness, the utility of the approach and it motivates them even further.” Emily described student responses similar to Matthew’s. She posited:

I know they enjoy it because the first time I did PBL, when it was over we went back to the book and one student raised his hand. He said, “You’re not going to make us do those phony back of the chapter problems now are you?”

Maggie also discussed student engagement and credited students’ increased engagement to the “exploratory nature” of PBL. Participants’ common discussion of student engagement as motivational for their teaching reflects a personal desire for teaching methods that are more active and a true appreciation for students being involved in directing their learning.

Participants shared a pedagogical conviction that student learning must have real world applicability, provide deep learning and be enjoyable and engaging to their students, and they described PBL as a teaching method that inspires such. In addition, participants all expressed a need to find the most effective teaching methods and believed that PBL prepares students for life endeavors, more so than traditional teaching methods. Participants also held a common belief that preparing students for successful endeavors includes teaching them core subject content, in addition to soft skills. Some participants owned that the newness of PBL might cause initial student resistance but their confidence in themselves and the teaching method has motivated
them to continue using PBL. Participants’ concern with student satisfaction and finding their learning useful represents a desire for students to have a voice in how they are taught. Furthermore, student praise directly correlated with increased pride, enjoyment, confidence and motivation for these instructors.

Support and Guidance

Participants expressed that the adoption and continued use of PBL requires support and guidance for students and instructors. The second super-ordinate theme that emerged from the data was this need for support and guidance, including the sub themes of support from administration, instructor as guide and professional development. A majority of participants discussed how support from administration affected their ability to successfully implement PBL. All participants expressed that they must guide their students through the transition into PBL because it differs from their experiences with more traditional teaching and learning. Additionally, all participants looked upon their PBL specific professional development quite favorably and recommended it for those ATE community college instructors looking to implement the teaching method. The three nested themes discussed are support from administration, instructor as guide and PBL specific professional development.

Support from administration. Three of the four participants directly discussed the influence of college administrators on their ability to successfully implement PBL. Matthew, Emily and Maggie each described the role of academic freedom in their implementation of PBL. These participants also expressed that the implementation of PBL calls for certain types of scheduling and in some cases rescheduling, which requires administrative support. Matthew and Emily felt fully supported by administration in their implementation of PBL, while Maggie did not. Andrew’s lack of inference to his college’s administration, amongst his confident
statements about what he implements in his classes, lends to the assumption that he also has the academic freedom to design and implement curriculum of his choice.

Scheduling was another area in which instructors needed support from administrators. Matthew and Emily expressed that they needed to change how courses were scheduled to properly implement PBL and that administration supported these changes. In discussing a scheduling problem related to PBL that is now resolved, Matthew explained:

I teach at a college so we have academic freedom. We’re pretty free to do, teach whatever way we want. The problem that I had initially, had nothing to do with the challenges, only with the scheduling of classes. So it took me little bit of time but I was able to rearrange the schedule for my program so that I have block schedule.

Academic freedom was also significant to participants’ concerns. Matthew’s response assumes that academic freedom is always in tandem with higher education and due to his belief he does not discuss the content of his curriculum with administration. However, it also reveals that the implementation of PBL might require courses to be scheduled differently than those not using PBL and this aspect relies upon the support of administration. Furthermore, this insinuates that administration needs to value the curriculum method if it is going to rework academic schedules to meet the needs of PBL.

Emily also expressed a feeling of academic freedom, similar to Matthew. Emily explained that she did not have expectations of PBL when she initially began using the teaching method because she did not have expectations to meet. She shared, “we're not ABET accredited. We don't have standards like K12. The only requirement I have is that I turn out really good technicians. And so I can do whatever I want.” Also similar to Matthew, Emily expressed that she has had no issues with support because administration does not know or seek to know what
she does inside the classroom. She stated, “As long as my classes are filled and my students are getting hired, they are fine with whatever I do.” This statement from Emily reflects that administrators assume that students are fully prepared for industry if they are hired by industry. Another example of Emily’s academic freedom was revealed in her discussion of how she overcame a problem with assessment. She explained that she eliminated a traditionally accepted assessment model for a different type of assessment:

   The other thing that I've done, we have so many students now who have, who need accommodation. They need extra time or they need to be alone, so I say you know, “let's do away with tests.” That's the easy way of doing it. So now the assessments are more written. They're take home challenges.

To further exemplify faith in her teaching methods, Emily said that her Dean and Chair are looking to implement PBL throughout her department. Although Emily posited that administration is unaware of her pedagogy, it is evident that they are aware of her use of PBL and that they also value PBL.

Maggie repeatedly discussed the need for support from administration when implementing PBL in the classroom, though the experience that she shared was contrary to Matthew and Emily’s. In discussing her lack of academic freedom as an implementation challenge, Maggie shared:

   People say, “Well, you get to do what you want in your classroom.” Well, I could but I’m not sure I want to take a stand. I’m supposed to teach from a certain book, and do I really want to defy my department and say, “I’m not going to teach from that book? Would that be worth the unrest? I’m not so sure.”
Maggie’s quote reveals that there is often an assumption of academic freedom for higher education instructors, similar to what Matthew expressed, but that in reality not all instructors within community colleges are provided academic freedom. In addition, this quote reveals that a lack of academic freedom limits Maggie’s ability to use the teaching methods of her choice. Additionally, Maggie is not optimistic that she will be granted academic freedom anytime soon, which is noteworthy. Although she reveals her frustration by classifying this problem as unresolved, the lack of support from her administration does not prevent her from implementing PBL. However, when asked what advice she would give a community college instructor within an ATE program who wants to implement PBL, Maggie encouraged:

The main concern is that you have the support of administration when it comes to the faculty evaluation process. And that they know you’re doing something different and you tell them why and you justify it with research, which is easy to do because everybody has lots of great research that says that PBL is better than straight lecture. So I would say make sure you clue your administrator in so you get support when a parent or student complains about what you’re doing.

This quote reveals that although Maggie has been able to implement PBL without administrative support, she still believes that implementation would be easier and less stressful if administration did support her. Due to this, she encourages ATE community college instructors seeking to implement PBL to try and gain support from administration.

Andrew did not directly discuss administration as being involved in decisions about how and what he teaches and it can be assumed that he has academic freedom. The absence of him mentioning administration when speaking directly about implementation challenges presumes that administration has not posed any challenges and supports his curriculum choices. In
addition, Andrew talked with confidence about when he chooses to implement PBL and how he implements PBL, which portrays the notion that he influences the design of his program. For example, in reference to the students in his program he explained, “Now the total time during first semester, I watch, watch them and talking to the electronics instructor and find out how they’re doing, who’s doing their homework, and who’s not doing, because I recruited all of them.” Andrew explained that students do not take his courses until second semester, though he follows their academic progress before they begin in his classes. Andrew’s statements reflect that he has academic freedom to work with students inside and outside of his classes and that he is able to decide what and how he teaches.

Matthew, Emily and Maggie discussed how support from administration plays an integral role in their ability to implement PBL. Matthew and Emily happily expressed positive experiences with administration, as well as academic freedom and this made the implementation of PBL easier for them. Matthew and Emily assumed their academic freedom, while Maggie did not. Maggie expressed a sense of stressfulness associated with a lack of academic freedom that limited her ability to implement PBL and fear to challenge administration. However, Maggie advised that community college ATE instructors advocate for the use of PBL to administrators and to seek their support. Even amongst the continued challenges, Maggie finds a way to implement PBL. This reflects that the motivation to teach PBL is not necessarily driven by administrative support, even though she recommends trying to develop administrative support. Andrew portrayed that he is able to design his own curriculum and did not mention administration as a challenge. It can be assumed that administration supports Andrew’s implementation of PBL through providing him academic freedom. This notion also supports the
finding related to Maggie, in that PBL does not need to be initiated by administrators, though academic freedom is crucial for PBL implementation.

**Instructor as guide.** All participants described serving as guides to students, while teaching through PBL, a learning process that is usually foreign to students. Participants expressed a need to understand students’ hesitance towards PBL, because PBL requires students to be more autonomous than traditional teaching methods. Participants advised that students need scaffolding into PBL, involving a more watchful eye and assistance from instructors at first introduction. In addition, participants expressed that their role as guide involves being explicit with students about their expectations and what PBL involves, before implementing PBL.

Participants described students’ initial insecurities with PBL and a need to guide them through the initial transition into the new learning method. Matthew explained, “It’s so different from what they’re used to. They’re used to having been – they’re used to being instructed on exactly what they need to do, the odd problems at the end of the chapter.” In addition, Matthew expressed that giving students “ill structured” problems “puts them outside of their comfort zone.” To help students’ immersion into PBL Matthew guides them by modeling the type of questioning that they need to use. He stated that his doing this “usually helps and eliminates a lot of the stress.” Emily also advised that students need guidance while they first learn PBL and that “they need some scaffolding. You have to start off slow.” In addition, Emily advised that being a PBL instructor requires listening skills, in particular listening to students’ needs so to best guide them. Emily also posited:

You have to be there for them to ask them, “But what did you see? Tell me what you saw? What were you looking at? Did you look at this?” ‘Ah, no, I didn’t.’ So you have to be there, you can’t just let them lose.”
Andrew expressed similar teaching styles to Matthew and Emily. He also recognized PBL as a teaching method that requires a scaffolding of students’ ability to perform independently.

Andrew described how he introduces PBL to students:

I watch them very closely. I just don’t turn them loose. I watch them very closely and if I see they're starting to get frustrated then I'll step in, maybe tell them a little bit, and maybe give them a little bit of advice and to help bring them on. But I try not to bottle feed them too long and I try to back away.

Andrew’s repeating of “I try” suggests that it is not necessarily easy for the instructor to initially teach students independence in their learning and that there is a balance of how much support to give and not give when students are first experiencing PBL. Maggie directly expressed this challenge. She portrayed:

I had students complaining about what I did – that I wasn’t doing my job. That they had questions and I wasn’t answering them and wasn’t that my job to answer their questions? And I said, “No, my job is to make you think. And so I pose the question and you think and I'll never pose a question harder than you can answer if you just think a little bit, right?” [laughter] So it was hard for people to get used to that.

Maggie shared that she believes that students’ initial resistance to “thinking for themselves” relates to a lack of courage. This classification of students’ hesitance potentially explains what all participants expressed about their need to guide students into PBL. It also suggests that teaching PBL requires compassion for the immersion that students will go through, in their transition from traditional teaching methods. Additionally, Andrew explained that he does not teach first semester students and suggests that students are more apt for PBL if they have gained maturity though some experience in college.
Another aspect of serving as a guide that participants postulated is the need to be explicit with students about what the teaching method entails and the required expectations, before teaching with PBL. Matthew shared his experience with preparing students for PBL:

“I try to explain to them, “This is how you’re going to feel. You’re going to be angry with me, because I’m not giving you all the information that you need to solve this problem. But it’s okay. You’ll be fine.”

Matthew’s discussion of what he explains to students represents a potential need to build trust with students to help them get engaged with PBL and that honesty about the challenges of PBL helps to develop this trust. Maggie also discussed that she gives a disclaimer to students at the start of each class, as a way to alleviate student resistance. She explained that she tells students:

“This is not your usual - this may not be the same type of Math class you always had before. These are the things I expect. These are based on research and good pedagogy. So, you know, I’m just telling you right now that these are the things I require.”

In addition to an initial disclaimer, Maggie explained that she has learned to also be explicit about her expectations of students throughout the PBL process. She gave an example of what she says to students to help guide them through PBL and to know what to accomplish:

“I’m going to be listening for this and this is what I’m going to be grading you on. I’m looking for you know, questions, who is able to come up with good questions to ask their colleagues. You know, are you talking to each other, are you double checking with each other? So that's what I’m looking for today and I’m going to give you five points towards your next quiz.”

What Maggie expressed portrays a belief that students do not initially know how to navigate through PBL, but that explicit directions help them to be successful. Quite similarly, Andrew
expressed that he explains his PBL teaching methods to students before they are in his classes. He shared:

And now I’ll tell them how I teach and then they talk to the second year students that whole year and they’re prepared for me. “Oh, he don’t do this and he don’t show you how to do this. You have to do it on your own.” And so now it's just a natural thing. It's that they know what to expect.

Andrew, Maggie and Mathew’s presentation of disclaimers about PBL and their expectations reveals an acceptance that PBL is more challenging for students, but also a belief that students will be successful with levels of support that guide them through the learning process. In addition, their encouragement of being explicit with students represents that some finesse is needed when implementing PBL.

All participants encouraged that instructors should serve as a guide through the immersion into PBL from traditional teaching methods. This includes being explicit about student expectations and providing students with a disclaimer about what PBL involves and how it differs from traditional teaching methods. Participants reflected an understanding for the challenges that PBL presents to students, and in accordance do what is necessary to help students succeed through PBL by scaffolding them into independence. Participants’ willingness to adjust their teaching styles and expectations to meet students’ needs reflects their belief that PBL is the best teaching methods for students and that students can be successful in PBL, with some guidance.

**PBL specific professional development.** All participants reported that the PBL specific professional development that they experienced was beneficial. Participants reported that they gained others’ perspectives, gained tools to help with implementation challenges and learned
how to develop their own curriculum through PBL specific professional development work. In addition, participants advised ATE community college instructors wanting to teach through PBL to engage in professional development training and to use pre-developed curriculum.

Participants expressed that learning from others helped them with their teaching of PBL. In reference to PBL, Matthew shared, “seeing what other people had done … and then adopting it to my own specific needs is how I’ve learned it.” Matthew explained that he did a great deal of research on PBL practices and curriculum models and that the curriculum that he developed is a compilation of best practices. When discussing ways of overcoming PBL implementation challenges he described:

I’ve worked with a bunch of faculty members who do PBL as well. And it’s always interesting and valuable for me to be able to talk to other teachers about what they’re doing. They may have a different twist on one of the problems that a lab uses, a different twist on how they implement it or how they assess it. So probably just having some people to bounce ideas off, of how to improve, get some feedback is always valuable.

Matthew’s statement reflects that although he has developed PBL curriculum that he and others use, he still needs guidance, support and inspiration from others who have experience teaching PBL. This also insinuates that growth and development as a PBL practitioner is never ending.

Emily, Maggie and Andrew also expressed that they were influenced in positive ways by their PBL specific professional development training. Andrew described his PBL professional development as an opportunity to see “people's different perspective of presenting the problem and ways of teaching that did influence me.” Emily and Maggie both learned techniques for improving teamwork amongst their students and tools for assessment. Emily shared that she struggled with assessment until she implemented what she was taught at the PBL specific
training that she attended. Maggie shared that the value of teamwork was more profound to her after she experienced it in a PBL specific training. She stated, “I was like, wow, I really get what's going on because other people were explaining it to me in a conversation as opposed to a lecture way. So I experienced firsthand how group work was useful.” In addition, Maggie’s comment also reveals that she preferred to teach in the same way that she preferred to learn.

Similar to Matthew, Emily, Maggie and Andrew also discussed how the use of PBL curriculum that was developed by others has been beneficial and inspiring. Emily expressed confidence in her ability to design PBL curriculum, but her challenge was that she did not have the time to do so. She posited:

There's an issue with unlimited number of packaged curriculum and I know how to create my own and I could do that. I just haven’t – maybe I have time now. But I never had time to do that in the past. So you run out of things to do.

Similar to Emily, Maggie expressed that she appreciates the use of predesigned PBL curriculum because designing her own has been challenging. Maggie explained:

I find that I’m getting better at creating my own because I'll see an idea from a book or at a workshop and I'll begin to implement it and I'll want to fix it. And I think that's a process that can work – that you don't have to create things from scratch. You just start using other people's stuff and then you start developing.

Similar to Andrew and Matthew, this quote from Maggie describes how the confidence to design curriculum came after adopting premade curriculum to work with their courses.

Andrew described how he felt after implementing curriculum that he learned about at a PBL specific professional development training. He told himself, “Boy this works right in with what I’m doing already’ and I implemented them in lab times.” When asked what he thought of
his PBL specific professional development experience he shared, “I think it was very helpful. It definitely influenced my teaching because I came back and used the scenarios and everything. Now I've actually created some of my own scenarios since.” Explanations of how Matthew, Maggie and Andrew described their use of predesigned PBL curriculum suggests that novices to PBL, who want to design their own curriculum, go through a three-step process when first implementing PBL: 1.) Find existing curriculum models, 2.) Redesign the curriculum models to serve your course, 3.) Design your own curriculum after gaining some experience from teaching with the adapted models.

Most likely due to their own positive experiences with PBL specific professional development, when asked what advice to give community college ATE instructors seeking to implement PBL, participants encouraged that they seek support and guidance from others. Emily claimed that what was most valuable for her in the PBL specific training was experiencing PBL and sitting in her students’ shoes. “I think you have to try it,” she encouraged. Matthew gave similar advice. He professed:

The best advice I can give them is to actually do some yourself. Take a course in PBL, or go to a workshop in PBL. But actually do the problems and live the life of your student a couple of times to really feel – see what it feels like to be in their shoes. I think to me that’s the most valuable thing that they could do.

Similar to Maggie, Matthew and Emily also expressed a real value in learning through more nontraditional methods. They expressed that experiential learning, doing the PBL scenarios that they teach to their students, has helped them in their teaching of PBL. Andrew further expressed his support of predesigned curriculum and advised, “I would encourage them to use any resources as far as written scenarios that someone has or develop scenarios like them that come
out of a PBL project.” Maggie shared, “I think for me professional development is essential and the deep immersion ones with follow-up help was also essential.” Participants’ advice for fellow practitioners reflects that they view PBL professional development as inspiration for further growth and development in their work with the pedagogical method. In addition, it reveals that continued support and guidance helps practitioners continue implementing PBL, by learning new curriculum ideas and ways of overcoming implementation challenges. Their support of professional development also paints the teaching of PBL as an ever-evolving process, one that practitioners can continue to grow from.

Participants expressed that support and guidance helps to sustain PBL for students and instructors. A majority of participants discussed support from their administration and revealed that administrators can assist with the facilitation of PBL or make it more challenging, though they did not identify administration’s support as a motivating factor for why they implement PBL. Participants described PBL as a foreign concept to students and due to this understanding they serve as guides when first introducing PBL to students. PBL specific professional development helped participants to gain inspiration and confidence to overcome implementation challenges and they recommend that ATE community instructors wanting to implement PBL seek support and guidance from others.

**Transformation**

PBL encourages students and instructors to evolve from previous expectations of how teaching and learning should occur. The third super-ordinate theme that emerged from the data was transformation. Participants described PBL as a pedagogical method that is contrary to how they were taught and how many of their colleagues teach. Participants stated that they prefer to facilitate PBL than to lecture, even though PBL can be more challenging than lecturing, although
they do still lecture. Participants also expressed that the acclimation to teaching and learning with PBL is a process for instructors and students. In addition, participants posited that students and instructors become more comfortable and confident with the teaching method after experiencing PBL. The two nested themes that emerged from the data are *PBL versus traditional teaching methods and time and experience.*

**PBL versus traditional teaching methods.** All participants discussed various aspects about the facilitation of PBL verses more traditional teaching methods. Participants all posited that PBL is dissimilar to how they, or other instructors, have been educated. Participants also expressed a preference for serving as a facilitator versus a lecturer, though they all discussed that they do still lecture. Some participants discussed that the facilitation of PBL can be more challenging than traditional teaching methods for students and instructor, but that they all optimistically embraced the method after experiencing it and seeing its benefits.

Participants advanced that the facilitation of PBL was either unlike how they were taught or that it is disparate from those with who they teach. For example, Matthew expressed: “Faculty members are like everybody else. They were taught using probably nine times out of ten traditional didactic methods. Somebody lectured to them, wrote on the board, they took notes and took tests and that’s usually the way they teach.” In this statement Matthew connects himself to his fellow faculty members and all learners of the past, and he does not blame instructors for teaching how they were taught. Though he later posited that “didactic” methods are “flawed” and he distinguished himself as an educator who teaches differently. He described:

> A lot of faculty have – if you ask them a question, either they won’t answer it, if they don’t know it, or they say, “I’ll get back to you.” I turn it into a learning opportunity and it’s like, “Geez, I don’t know that. Let’s figure that out together.”
Matthew’s sharing of how he responds to questions for which he does not have the answer classifies PBL as a teaching method that places the instructor in the role of a facilitator. It defines the instructor as one who helps students find answers, but not necessarily as one who instructs the answer or is a suppository of all knowledge. It also suggests that the facilitation of PBL takes a certain amount of courage and confidence.

Emily expressed beliefs that were quite similar to Matthew. In describing how the courses that she taught were structured before she began using PBL, she pronounced, “It was totally disorganized. I was very unhappy with it. But it's the way we learned so it's the way we taught.” Also analogous to Matthew, Emily expressed dissatisfaction with the use of traditional teaching methods without any judgment, and also as if there weren’t other known options. When describing the facilitation of PBL, Emily mirrored what Matthew described. She shared, “I learned long ago that it's okay to say, “I don't know. Why don't you look it up [laugh] and tell me?” Emily states that she puts investigation back on students, this is a significant aspect of PBL and that the teaching method is transformational for students.

Andrew explained that his choice to become a PBL facilitator was due to his belief that traditional teaching methods did not fully prepare him for industry and that was a transformative experience for him. He expounded:

When I left school I didn’t feel confident that I could do the work. I wasn’t prepared. All I had done was – this is how you do a problem now you repeat it type thing. And so I didn’t learn. I mean I had all the basics but I didn’t learn what I needed to know to be confident until months into industry, when I was faced with some problems that I had to solve on my own. And so that's when I became a problem solver.
During his interview, Andrew talked at length about numerous success stories of former graduates now in industry, including their levels of increased confidence and ability to problem solve. He attributed much of their success to PBL over more traditional teaching methods. When explaining the challenges that she has faced with PBL, Maggie shared that student resistance is more challenging amongst a culture that supports more traditional methods:

I knew that there was going to be resistance. So I think the hardest thing is to break the culture that's out there that this is what Math teachers do. And in my particular school setting my bosses here and the department chair and people who have been past department chairs are lecturers and proud of it and they will never change and they said they'll never change.

Maggie values instructors who move beyond lecturing and she believes that student resistance to PBL would be less predominant if other Math instructors used nontraditional teaching methods, including PBL.

Similar to Maggie, Matthew and Emily explained that the facilitation of PBL can be more challenging than lecturing for instructors, but that it is still beneficial and highly valued. Emily and Matthew described PBL as a teaching method that requires more energy than traditional teaching methods. When asked if she enjoys PBL Emily responded, “I do, I really do. Yeah, it’s more difficult I think. You might think it's easier because I don't have to stand there and lecture. But it's harder because you have no idea where the questions are coming from.” Emily’s response reflects that she appreciates the challenge of PBL, in comparison to a traditional teaching method that is easier. She expressed that another reason for her preference of PBL was because she would “rather have them [students] work and we walk around and find out what
they're learning.” This presents PBL as a teaching method that takes more physical energy.

Matthew described the facilitation of PBL quite similarly. He explained:

You’re floating around the whole day. It’s interesting. I look at that by the end of the day I’m tired [laughter]. It is exhausting for a faculty member because you’re constantly being asked questions that are just not out of the textbook, real world questions and you’re trying to help them in – how can I explain this to them without really explaining it to them because I want them to learn it and figure it out. So it’s a little bit draining on the faculty member, but the rewards are worth it.

Similar to Emily, what Matthew suggests is that he prefers more physical and mental exertion when teaching and he is willing to give more to his students for increased student success. His classifying of his own experience as “interesting” suggests a transformation in Matthew, from what he thought teaching was supposed to be to what he now believes is the ideal method.

Maggie also expressed PBL as a preferred teaching method, even though she acknowledged challenges with the implementation of PBL. She insisted, “It's just a lot more fun to teach this way. It's not boring” and “once you begin to teach that way you'll never go back.”

Participants stated a preference for PBL over lecturing, but explained that they do still lecture. Emily expressed that she would prefer to be only a facilitator of learning but she cannot be that all of the time. She explained:

There were some things in what I teach that really can’t be inquiry problem project based learning. If you talk about quantum mechanics, there are some things you just have to explain and there's no way around that. If you’re talking about special relativity, I mean we can’t slow down the speed of light to see what it's like to ride a bike near the speed of
light. So there are some things that need to be explained, but other than that I would prefer to let students just go on their own.

Emily’s explanation suggests that there is a limit to the use of PBL, even if there is preference to use it all of the time. Maggie portrayed a struggle of wanting to be more of a facilitator because she enjoys lecturing but believes that her students learn best through facilitation. She explained:

When I lecture I feel good about myself because I did my job and I can say, “good job.” I know how I did that day, you know, and then at the end I can give them a test based on what I said and they can all spit it back. So I can delude myself into thinking I did a good job but I know down deep that's a delusion. So I would prefer to be a facilitator because I know real growth only happens internally. The person can only grow intellectually if they do the work, not if they're a passive listener to what I do.

Maggie’s story represents an internal struggle as she pushes herself to transform from lecturing to PBL and that she tries to change so to best serve her students. Andrew shared that he also enjoys lecturing and that he incorporates principles of PBL into his lecturing. He explained, “I love lecturing but when I lecture now, students, it’s more students centered lecturing because they have to talk and they have to listen.” Andrew’s teaching style represents a merging of more traditional teaching methods with the facilitation of learning and problem solving. Contrary to Maggie, Andrew did not express distress over his use of lecturing, nor did Matthew. In response to whether he views himself as more instructor centered or learner centered, Mathew explained:

I would say it depends on the class. Some courses, introductory type of courses, I mean there’s nothing wrong with instructor - led courses especially if you have students who are brand new and they’re just trying to get their feet wet in, they need a lot of guidance.
So a lot of times, I will, I do still lecture. I haven’t thrown that away completely. But I also try to integrate, to wean them – I try to wean them off of lecturing.

Similar to Andrew, Matthew also discussed integrating lecturing and facilitating, though he does this as a way to help students transform their learning styles. Andrew and Matthew’s comments about incorporating PBL into lecturing suggest that there are levels to the implementation of PBL in teaching and learning.

Participants expressed that PBL is a more active and mentally rigorous teaching and learning experience compared to how they were taught and to how other instructors teach. Participants did not express judgment over those instructors who use more traditional teaching methods but did insinuate that a more wide spread shift away from more traditional models would lend support to the teaching of PBL. Participants shared stories about the challenges with student reluctance and their own hesitance with PBL that later transformed into confidence, as well as appreciation and preference for the teaching method. Although participants preferred to spend more time facilitating the learning process, they also stated that PBL can be limited and at times there is still a need for lecturing. In addition, analysis of the data suggests that there are levels of PBL implementation that can occur and that participants in this study found that the blending of lecturing and PBL was a successful method for introducing PBL to students.

**Time and experience.** The data of this study reflects that learning through PBL is a process for students and instructors and that time and experience help them become acclimated to PBL. Participants expressed that initial reluctance and stress from students is common when first learning through PBL but fades, especially after going through the process more than once. In addition, participants described the teaching of PBL as a learning process for themselves and that they learn to improve their facilitation as they continue to teach it.
All participants expressed that students evolve out of their reluctance to PBL. In discussion about the challenges with PBL Andrew shared, “[The] only problem is once in a while you have students that are reluctant to do it but they'll come around.” Andrew also expressed his belief that reluctance comes from a lack of experience with problem solving and that students will initially have different levels of comfort with PBL. Andrew’s ease about student reluctance portrays it as a natural part of the PBL process and that it should be expected but not stressed over. Matthew described his students’ initial response to their experience with PBL in a similar way. He described:

It was very transformational for them. They – at first were a little reluctant because they didn’t know what to expect. But once they first started getting into it and using the tools that we have developed and provided for problem-solving, problem-solving whiteboards, they found them extremely valuable, not only in my class but other classes.

Matthew’s statement reflects that once students move past their reluctance they transform as students and begin to request the teaching methods that they were first hesitant to try. Maggie also expressed the initial challenge of student reluctance, which later turned into positive feedback. She shared:

In the end I saved letters like “I didn’t like what you were making us do in the beginning but by the end of the class I could see where things are going and I really liked it and I hope I have you again next year.” [laughter]

Maggie’s portrayal of students’ initial disapproval of PBL, which later turned into preference for the teaching method, also reflects a transformation of values by students for how they are taught. Additionally, Maggie’s saving of student letters suggests that they represent a reward for her perseverance through students’ initial hesitancy. Emily shared that she “expected them to get it
on the first try” but she learned that the acclimation to PBL “really is a process” that requires
time and experience, however “once they [students] get involved there's no stopping them. So
you don’t have to worry about that.” Emily’s description of the student experience suggests that
instructors who are new to PBL might feel uncomfortable with the time that it takes for students
to acclimate to PBL, but to allow them their process and to know they will eventually embrace it.
Matthew also described students’ adoption of PBL as a process and that instructors should expect
some initial struggle from students. He advised:

When you first start out with them, it’s going to stress them out so you just have to be
patient and accept the fact that in three weeks from now, they’re going to love you more
[laughter]. But it’s like tough love.

Again, Matthew’s statement suggests that instructors of PBL need to feel confident in the
teaching method to navigate through students’ initial struggles and uncertainties with it. His
statement also encourages that although the adoption of PBL by students takes some time, it does
not take a long time.

Participants also described how the teaching of PBL has been a process of adoption and
has required adjustments to their teaching methods. Emily explained that she teaches PBL
differently now, compared to when since she first began. She described:

In the beginning I would say, “You can go anywhere.” You know. “You want to go to
the cafeteria? You can go anywhere you want, but here's your deadline.” And I still do
that at the end of the semester, but at the beginning of a semester they need to be there
under my watchful eye, so I can make sure that they're actually functioning like a team.

Emily’s candidness about changing her teaching approach with PBL suggests that growth and
development occurs for instructors, as well as students, through the process of teaching and
learning through PBL. Matthew shared that he did initially stress about students’ acclimation process with PBL but that he has learned to not stress and to “keep an open mind.” He advised: Don’t think that you are supposed to have all the answers because you’re not, you don’t, you can’t. So the earlier – the sooner you learn to accept that – one of our colleagues likened it to teaching without a net, that was his motto. It’s like teaching without a net. So you have to be able to accept that – give up – be willing to relinquish some of the control of your class and have faith that the process is going to work.

Matthew’s statement reflects the need for a transformation in teaching methods for instructors who feel that they need to have control over the learning process. His statement also highlights that a solid belief in PBL, as a successful pedagogical model, helps with the transformation process. Emily’s description of how she felt when she began teaching PBL provides a similar portrayal of how Matthew describes the transformation process into PBL teaching. She shared:

I was initially a little hesitant. Um, I had the same reservations that our participants have. “How can they possibly do this without me telling them how?” But I was very quickly converted [laughter] … when you actually try it and it works so beautifully and the students were so excited about it, ah I could see that this was what I was going to do from now on.

Emily expresses that student support of the method helped her to embrace the method. Maggie poignantly described her process of transition into teaching PBL:

I’m not really good at facilitating because I want to help and so the biggest problem I have is not telling the students how to solve the problem because I’m so good at figuring things out, you know. [laughter] But I have to enjoy their process, so I have to be
disciplined not to answer too much of their questions and not to get drawn into that. So that's a hard thing. But I'm getting better at it and so I guess it just takes practice.

Similar to Emily, Maggie reported finding strength through her students while she was navigating through her own uncertainty with the teaching method. Her statement also reflects that the transition to PBL is a learning process for students and the instructor and that her teaching of PBL improves through time and experience. Maggie also expressed this when she described how she has overcome the implementation challenge of student reluctance. She reported, “I think that I’m more confident and I listen less to their complaints. I try to distinguish between whining and legitimate concerns.” Andrew also described the teaching of PBL as an evolutionary process. “It’s evolved and evolved more and more and more and more, I mean, every year I’m sure it's refined and I adjust and change,” said Andrew. In answering if he continues to use PBL, since he began using the teaching method, he replied:

I definitely use PBL and I use it more and more and more. I use them in lectures now. I use it in some labs that students have to do, which has some PBL problems. I use them, they have homework assignments, PBL problems. So I’m using it all the time. And it's working.

Participants in this study expressed that the more an instructor implements PBL the more it becomes a pedagogical philosophy of how to teach, instead of just a pedagogical model. He encourages that PBL can easily be implemented into many different types of assignments.

A transformation of values and expectations of what teaching and learning is occurred for participants and their students through time and experience with PBL, instead of traditional learning methods. Participants described that initial instructor and student reluctance to PBL occurs at various levels, but does turn into appreciation and confidence with PBL after having
enough time and experience with the teaching method. The data suggests that student reluctance is a normal part of the acclimation to PBL and that instructors need not worry about initial hesitance with PBL. Additionally, participants reflected that the teaching of PBL has been a learning process for them as well and that their teaching methods continue to evolve the more they teach PBL. All participants expressed a preference for facilitating learning versus more traditional lecture style learning, though they also recognized a limit to PBL and that lecturing is still useful. The data suggests that a blending of lecturing and PBL served as an effective introduction of PBL to students.

**Conclusion**

This study sought to answer: How do community college instructors in advanced technological education programs describe implementation challenges with problem and project based learning and how have they overcome those challenges? Analysis of the data reveals that the ATE community college instructors who served as study participants identified implementation challenges that include: a lack of academic freedom and administrative support, difficulties with curriculum design, student reluctance and self assuredness. Participants explained that they overcome implementation challenges in various ways. Participants’ pedagogical conviction for the use of PBL inspired them to sustain the use of PBL, even during times when they felt unsure. Time and experience also increased instructors’ and students’ confidence with the pedagogical method. Participants reported that they developed students’ trust by providing students clear expectations and by gently acclimating them to the PBL process. Additionally, administrative support to design and schedule courses as instructors felt best assisted in the implementation of PBL. Lastly, participants expressed that professional
development and perspectives from peer implementers helped them to overcome implementation challenges related to curriculum design.
Chapter Five: Discussion and Implications for Practice

The purpose of this study was to examine how community college instructors in advanced technical education programs identify and overcome implementation challenges with problem and project based learning (PBL) pedagogy. A qualitative approach of phenomenological analysis was employed, which allowed the researcher to deeply explore the participants’ sense making of their experience with the phenomenon. Given the numerous factors that influence the implementation of education reform in the classroom, McLaughlin’s Theory of Implementation (1987) provided a useful lens to study the participants’ experience with the phenomenon. The three superordinate themes that emerged through a close analysis of the data were 1.) pedagogical conviction, 2.) support and guidance and 3.) transformation. This chapter begins with a discussion of the findings related to each superordinate theme and how they are situated within current literature. Then this chapter discusses the implications of the findings for the practice setting and how these findings can be used in the practice settings. Recommendations for practice focus on how ATE community college instructors and administrators can overcome implementation challenges with PBL to help enhance teaching and learning through the sustained use of PBL. Finally, this chapter concludes with recommendations for future research on how to evaluate the outcomes of PBL within ATE community college programs, a deeper understanding of implementation challenges in general education courses, and the role of administration in the implementation of PBL.

Pedagogical Conviction

For the four community college instructor participants in this study the phenomenon of overcoming implementation challenges with PBL was driven by a self-motivated pedagogical conviction to teach through PBL. Participants expressed an innate belief that their role as
educators is to prepare students for further learning, as well as current and future employment, through the use of real world scenarios and that PBL is the ideal pedagogical framework to accomplish these goals. Participants also discussed their experiences with PBL providing deeper learning, in comparison to other learning models. In addition, participants conveyed that students valuing and enjoying the learning process was significant to their pedagogical choices.

Participants in this study described that providing real world applicability is an essential aspect of how they teach and a driving force in their choice to implement PBL. Participants’ teaching standards and choice to implement PBL were always presented as self-motivated, though they did often talk about aligning their teaching to employment standards. This finding supports McLaughlin’s (1987) claim that “motivation and commitment (or will) reflect an implementer’s assessment of the value of the policy or the appropriateness of the strategy” (p. 172). In addition, these findings support what McLaughlin (1987) theorized that the implementation of education reform is inspired by personal and professional motivations. Furthermore, participants felt compelled to use PBL, even during implementation challenges, because they found PBL to be a valuable pedagogy. This lends to the question of whether or not participants’ outcome expectancies and pedagogical choices (micro world) have internalized the national call (macro world) to use PBL as a way to successfully increase the number of those who are prepared for advanced technological careers.

Participants’ noted PBL as a teaching methodology that best prepares students for the future, which aligns with the notion of seminal scholars (Blumenfeld et al., 1991; Hmelo-Silver, 2004) who posit that a goal of PBL is to teach students how to solve real world problems. Hanson (2008) argued that community colleges should develop curriculum that teaches students to solve the problems within their communities. Participants unanimously expressed that the use
of PBL has proven to effectively prepare students with the technical and non-technical skills needed for future learning and employment, including the ability to solve real world problems. This finding also aligns with subsequent research, which evaluated programs that shifted to the use of PBL to better prepare students with 21st century skills, and also found PBL to be effective in this regard (Craft & Mack, 2001; Delale, et al., 2011; Jones, 2008; Massa et al., 2012; Nasr & Ramadan, 2008).

Participants’ described a pedagogical conviction to teach PBL because they experienced it providing deeper learning than other teaching methods, which supports findings within the literature. Citing Pressman & Wildavsky (1973), McLaughlin (1987) posited that “implementation dominates outcomes” (p. 172), suggesting that the pedagogical approach inspires the type of learning that occurs. Chin and Brown (2000) describe a deep approach to learning as one that stimulates intrinsic motivation by making the material personal and meaningful to the learners, allowing them to relate to their own experiences and the real world. In contrast, Chin and Brown (2000) describe a surface approach to learning as one that encourages the learner to memorize information and to regurgitate facts back to the instructor, without much commitment to connect the knowledge to previous learning or real life. Jones (2008) described deep learning as authentic learning that inspires students to question assumptions and become more analytical, and found PBL to be a pedagogical approach that encourages deep learning. Furthermore, Jones (2008) reported that PBL helped teach application of knowledge, instead of just content. Matthew described a deep approach to learning as one that stimulates curiosity and advanced that PBL is a teaching approach that accomplishes deep learning, similar to what Jones (2008) found. Participants also stated that PBL increases problem solving ability, which supports Novarian’s (2013) findings, and that it increases their critical
thinking skills, as reported by Jones (2008), Massa, et al. (2012) and Woszcyna-Birch (2009). A finding from this study that extends what the literature reports is that PBL increases students’ overall confidence with the problem solving process.

Hmelo-Silver (2004) advocated that one main goal of PBL is to increase students’ intrinsic motivation and this notion coincides with this study’s findings and additional findings within the literature. Participants’ responses were extremely student centered and advanced that students’ appreciation of the learning process influenced their pedagogical choices. Analysis of the data reflects that all participants experienced that students found PBL to be enjoyable and engaging, similar to study findings from Jones (2008), Keller (2002), Nasr & Ramadan (2008) and Noravian (2013). In regards to students who have experienced PBL, Noravian (2013) advanced that they become engaged because the learning process makes sense. In support of what Noravian (2013) postulated, findings from this study revealed that students enjoy the usefulness of PBL and making connections with what they are learning to real life. Keller (2002) reported that students were active participants in their learning through PBL and at times participated more often than with non-PBL assignments and this study presented similar findings. A common aspect of PBL is to have students work in teams and Nasr & Ramadan (2008) found that students enjoyed working in groups more than working individually. Findings from Jones’s (2008) study revealed that students preferred PBL to other teaching methods, similar to what Matthew and Emily expressed. While the findings from most of the literature focused on students’ enjoyment and engagement in the learning process, Keller (2002) did express that PBL allows for more creativity in what and how instructors teach. This study extends that finding, as all participants in this study expressed that they also greatly enjoy and prefer teaching PBL. A finding from this study that is also situated within the literature is the
importance of support and guidance for students and instructors when implementing and learning through PBL.

Support and Guidance

Participants identified various types of support and guidance as a way to overcome implementation challenges with PBL. For example, participants described how they needed to coach students through their initial hesitance with PBL, because PBL was usually a new experience for them. Additionally, three participants directly discussed the relevancy of support from their college’s administration to their implementation of PBL. Lastly, all participants praised their experiences with PBL specific professional development and recommended it to those ATE community college instructors who want to implement PBL.

McLaughlin (1987) postulated that pressure helps to create a focused attention on reform efforts and that support is essential. Study participants did not directly speak of feeling pressured when they implemented PBL, however “pressure” can be assumed through their discussion of implementation challenges and their convictions to prepare students to meet future academic and professional expectations. All participants did directly discuss support as a way to help students and instructors overcome implementation challenges. Analogous to recommendations in the literature (Barron et al., 1998; Hmelo-silver, 2004; Keller, 2002; Noravian, 2013), participants explained that students need to get acclimated to PBL and that the instructor’s role is to provide support and guidance through this process.

McLaughlin (1987) postulated that the implementation of education reform should happen slowly and responses from all participants in this study aligned with this belief. Similar to Craft & Mack’s (2011) portrayal of the instructor’s role in teaching PBL, participants described themselves as coaches to their students when teaching them through PBL. Hmelo-silver
(2004) also defined the instructor’s role in PBL as one that facilitates collaborative learning and guides students learning through open ended questioning. Similar to Hmelo-silver’s (2004) claim, Matthew compared his PBL teaching style to the Socratic method. Analysis of the data also revealed that study participants overcome implementation challenges with PBL by scaffolding the process, as previously found by Barron et al. (1998), Keller (2002) and Noravian (2013). Similarly, Keller (2002) found that instructors should make the problems more challenging as students gain more experience with PBL and aim to present problems that do not have concrete answers. An additional finding related to supporting students through scaffolding that this study’s data present and is not represented in the literature is the need to ease students into the autonomy that PBL provides. Another finding of this study that does validate conclusions stated in the literature is the call for administrative support.

Findings from English’s (2013) study on the implementation of PBL in K-12 classrooms advanced that support is compulsory to the successful implementation of PBL, even for the most motivated instructors, and an absence of support will deter its use. As stated in the literature, three participants of this study found administrative support, or lack there of, as having a significant effect on their ability to implement PBL. Barron et al. (1998) classified administrative issues as a common implementation challenge and one Maggie’s discussion of how the absence of support by her college’s administration has made the implementation of PBL more challenging further validates this finding. This story also provides an example of McLaughlin’s (1987) implementation framework. As Maggie described, once she was able to understand the first phase of implementation challenges (external policy) - the expectations of her college’s administration that she teach certain competencies in a certain way, she was able to move into the second phase of implementation (internal factors) relating to the quality of her
implementation of PBL. Furthermore, McLaughlin (1987) expressed that implementation challenges never fully resolve but instead evolve. The portrayal of this experience exemplifies this notion because Maggie was able to work around the existing implementation challenges put forth by her administration and still implement PBL. Although the Maggie expressed being able to move into the second phase of implementation, her repeated mentioning of the lack of support from administration and her offering of advice to other ATE community college instructors to try and gain administrative support questions whether or not this issue lessened in importance. Maggie’s experience with the implementation of education reform was contrary to one aspect of McLaughlin’s framework, which professes that all external implementation issues (first phase) recede in importance once the implementer moves into the quality of implementation (second phase). Contrary to Maggie’s experience, Matthew and Emily discussed receiving support from their administration and that this support helped to resolve scheduling issues. Although their experiences align with previous research findings, their experiences do not support McLaughlin’s (1987) notion that implementation issues never resolve.

Analysis of this study’s data substantiates a common finding amongst the literature, which states that additional time is needed in class to implement PBL and that this causes a need for courses to be restructured (Blumenfeld et al., 1991; Keller, 2002; Nasr & Ramadan, 2008). As Matthew and Emily expressed, they gained support from administration to rearrange their PBL courses so to allow more time in each course. Although they described other implementation issues that continue with the implementation of PBL, they felt that the issue of scheduling remained completely solved. This supports McLaughlin’s (1987) framework, which expresses an ability to move on to the quality of implementation after dealing with external forces, but it contradicts McLaughlin’s (1987) notion that implementation issues never resolve. In addition to
a request for administrative support, a main thread throughout the literature and a nested theme in this study was the use of professional development to help instructors overcome implementation challenges with PBL.

Findings within the literature and the analysis of this study’s data reflect that professional development is significant to the internal factors relating to the education reform, which McLaughlin (1987) classified as the instructor’s quality of implementation, commitment, motivation and competence. Craft and Mack (2011) expressed that PBL specific professional development helped create “exemplary faculty,” as part of their efforts to increase retention and graduation rates in ATE programs (p. 427). Recommendations from Keller (2002) and Massa et al. (2012) were that professional development is necessary for those looking to successfully implement PBL. Jones (2008) also discussed the need to receive training on PBL previous to implementing the teaching method for the first time. Validating these previous findings, all participants from this study recommended that community college ATE instructors seek professional development as a way to overcome implementation challenges with PBL. Adding further significance to this finding, study participants described the specific implementation challenges that professional development helped them overcome. Furthermore, participants explained that professional development helped them overcome common challenges associated with the time needed to design curriculum, assessment and group work. Another major finding from this study that aligns with McLaughlin’s (1987) framework, and previous findings in the literature, relates to the adoption of and adaptation to PBL as a process of transformation.

Transformation

Study participants expressed that the implementation of PBL requires a transformation of beliefs for how teaching and learning should occur, often contrary to how students and
instructors were previously taught. Analysis of the data reflects that time and experience with the teaching of and learning through PBL caused an increase in confidence for the teaching method by students and instructors. Additionally, participants also claimed that students’ initial reluctance to PBL transformed into a preference for the teaching method versus more traditional teaching approaches. Participants portrayed this initial reluctance as a natural part of students’ acclimation to PBL and expressed being less concerned with student reluctance after experiencing the repeated benefits of PBL. The implementation of PBL proved to be a learning process for participants and they expressed that their teaching continues to evolve through the use of PBL. Although participants expressed a preference for PBL, they also stated that they value lecturing and continue to use both teaching methods.

The implementation of education reform is a continual process that is transformative for educators and students. McLaughlin (1987) explained that the implementation of new policies, such as new pedagogical methods, is an iterative and evolving process. Within the process the implementer will experience new challenges, must learn how to manage those challenges and develop new ways of viewing the implementation process. The literature expounds that this fluidity with change, while transitioning to the facilitation of learning through the implementation of PBL, creates a sense of insecurity in students and instructors who are new to PBL (Keller, 2002; Lam, Cheng and Ma, 2009; Massa et al., 2012), which findings from this study validated. Keller (2002) found that students asked for more traditional teaching methods and were initially resistant to group and student centered work, but that students’ participation also increased at times with the use of PBL versus more traditional teaching methods. Conclusions from the literature (Nasr & Ramadan, 2008) and this study portray PBL as a process of acceptance for students and that they need time to transition from their comfort with
traditional teaching methods to the expectations of PBL.

Similar to students, instructors have found the implementation of PBL to be an evolving process of transformation. Most participants expressed that PBL is different from how they were taught and Lam et al. (2009) posited that having a dissimilar learning experience creates hesitation in instructors when they first implement PBL. Keller (2002) described having to initially overcome feelings of guilt due to not always being with students during the learning process and one study participant also expressed that she needed to learn how balance student autonomy. Massa et al. (2012) reported that PBL can initially be intimidating for instructors, and three participants from this study expressed similar feelings when describing their early experiences with the implementation of PBL. McLaughlin (1987) asserted, “changes associated with a reform effort take more time than expected but once in place, they are stable” (p. 175). Aligned with this notion, study participants’ portrayed that they feel more comfortable with PBL and implementation challenges after more experience with the method and they now try to use the pedagogy as often as possible. Extending from what McLaughlin (1987) posited about education reform increasing in stability over time, a finding from this study expressed that the more instructors implemented PBL the more it became an overall philosophy for how to approach all aspects of teaching and learning. This finding is significant because it expresses that educators broaden their overall teaching methods after teaching through PBL. This study also came to conclusions relating to transformation that the literature did not discuss. Findings from this study suggest that PBL requires more energy than traditional teaching methods and that those who want to teach PBL value the challenges, especially because they believe that it best serves students. Also unique to this study was participants’ discussion about the continued use of lecturing, even after disclosing a preference for PBL, which suggests that PBL does have
limitations. Additionally, findings from this study insinuate that a mixture of lecturing and PBL would provide a gentle acclimation to the PBL process. Recommendations for practice are made based on this study’s findings.

**Recommendations for Practice**

A goal of this study was to identify how ATE community college instructors identify implementation challenges with PBL and how they overcome these challenges to provide guidance to educators and administrators pursuing the implementation of PBL. Numerous recommendations are made to help instructors and administrators inspire support for this pedagogical method, have realistic expectations of the implementation process, and understand how others have approached and overcome common implementation challenges. These recommendations aim to help community college ATE programs and community colleges implement PBL because this pedagogical method has proven to be successful in serving the national call to attract, retain and graduate students who become advanced technological experts. Students in ATE programs, ATE community college instructors, community college administrators, and industry can directly benefit from these recommendations. Additionally, many of these recommendations are beneficial to any instructor and academic institution seeking guidance about the implementation of PBL.

To be an effective facilitator of PBL and help overcome the implementation challenge of student reluctance, instructors will need to initially guide students through the PBL process. Instructors facilitating PBL must practice patience with students as they adjust to a different learning style. In addition, facilitators should scaffold the difficulty of problems presented and resist giving students answers. A PBL facilitator must embrace that they are not an answer bank and feel confident in themselves and the teaching method, even though students will ask
questions that they might not know the answer to. Furthermore, an instructor’s role as an implementer of PBL is one that guides students to be analytical and innovative in their approach to solving problems and completing projects. Serving as a guide, instructors must provide more support to students initially, while giving them more and more autonomy to direct their own learning as they become comfortable with the teaching method. To accomplish these goals, PBL practitioners should design curriculum that teaches students a formula for problem solving and provides students tools to practice this formula. The ability to analyze and solve problems on their own will give students the confidence with the pedagogical practice and the ability to work autonomously and in teams, without direct supervision from their instructor. Once students are comfortable with a uniform and expected problem solving process, instructors can begin giving students more difficult problems and provide students more autonomy. Additionally, instructors need to be explicit with students through clear guidelines and provide a thorough explanation of what will be expected of them, before PBL implementation begins.

Facilitators will also gain students’ trust and help minimize student reluctance by easing them into the implementation of PBL and by being strategic in how they implement. For those instructors who are used to lecturing, they should consider starting with a hybrid approach to PBL. For example, instructors can add in material about unsolved problems from industry in their lectures and then ask students to seek solutions to those problems. This would help the instructor and students become accustomed to PBL versus traditional teaching methods. Additionally, facilitators will need to consider the appropriate audience for PBL. Considerations should include which courses and at what point during a course to implement PBL. Additional considerations should also incorporate students’ experience managing the expectations of college and how much foundational knowledge about the core subject matter is necessary before having
the ability to complete content specific problems and projects. For example, introducing PBL to first term college students in an introductory class, during the first week of classes, might be too much of a shift for students who are also learning to adjust to all of the other new expectations placed upon them. Additionally, seeking and listening to student feedback is a critical part of the PBL process and will help instructors to overcome implementation challenges. Some of students’ feedback will be reluctance that they need to be guided through, however students should be encouraged to help direct their learning. This will develop students’ appreciation, and sometimes preference for PBL, and confidence in those who facilitate the teaching method. Facilitators also need support and guidance to help them overcome implementation challenges and to sustain the use of PBL.

As McLaughlin postulated (1987), education reform, such as PBL, needs to be self-motivated by implementers. Administrators who are seeking to transform teaching and learning on their campus through the use of PBL should provide opportunities for faculty to learn about the teaching method. Ideally, a way to increase the use of PBL on community college campuses is the offering of on site PBL specific trainings. On campus trainings will raise awareness about and an understanding of PBL. Administrators should seek help from their college’s professional development office or committee to arrange on campus PBL specific professional development opportunities. The professional development committee should encourage experienced PBL instructors who are faculty at the college to give a presentation to their peers, including predesigned PBL curriculum models and suggestions for how to overcome implementation challenges. If the college does not have experienced PBL faculty on campus, administrators should use professional development funds to bring expert PBL implementers to their campus.
Once PBL professional development opportunities have been provided on campus, continued support to those who begin to implement PBL will also be necessary.

Experienced PBL instructors should be encouraged to serve as on campus mentors and guides for those instructors who are new to the implementation of PBL. If necessary, release time should be given to those serving in this capacity. Furthermore, those implementing PBL cannot be isolated and will need time to discuss implementation challenges, gain perspectives from their peers, and share resources to help overcome implementation challenges. Faculty will need to gain support from the chairs of their departments and chairs of academic departments will need to garner support from their academic Deans and budget for any necessary course reductions. Course reductions and release time is an additional upfront cost to the implementation of PBL and those colleges seeking to implement PBL should consider applying for a National Science Foundation (NSF) ATE grant. As the literature reflects, the NSF has been a long time supporter of the implementation of PBL in ATE programs. Additionally, sharing success stories from those who are implementing PBL, within department meetings, will encourage a culture of appreciation for the pedagogical method. Some educators interested in adopting PBL will need to introduce PBL to their administration and ask for their support.

Some community colleges will have limited experience with the implementation of PBL, so instructors looking to implement the pedagogy will need to be proactive in gaining the support of administrators. To do so they will need to inform their administrators about the benefits of PBL and how it has successfully served students within advanced technological education programs in community colleges. Additionally, facilitators will need to schedule adequate time for their PBL courses because PBL requires more time than more traditional teaching methods. Support from administrators will be needed if adjustments to course scheduling are necessary for
the implementation of PBL. Instructors new to PBL should begin with a pilot course and carefully track student success, in comparison to non-PBL courses, to help garner administrative support. Those instructors who have limited support on their college campus should also seek PBL specific professional development opportunities through other organizations.

Novice and experienced PBL implementers should reach out to organizations that provide PBL specific curriculum and professional development opportunities as a way to overcome implementation challenges and to help sustain the use of this pedagogical practice. Curriculum design is extremely time consuming, especially when trying to implement a new pedagogical method. PBL facilitators should seek out premade curriculum that has already been implemented and then adapt that curriculum to fit their courses. In addition, PBL facilitators should attend a PBL specific professional development training to help learn perspectives from others implementing PBL and garner ideas for how to overcome common implementation challenges. For example, two organizations that have received funding from the NSF and have been providing in depth PBL specific professional development opportunities are the New England Board of Higher Education and the South Carolina Advanced Technological Education center. PBL facilitators should visit the websites of organizations such as these and seek out predesigned tools and curriculum models to help with their own implementation and to learn about any further professional development opportunities.

A pedagogical conviction for the use of PBL has proven to motivate instructors through implementation challenges with the teaching method. Those seeking to implement PBL need to enjoy student centered teaching, feel responsible for teaching more than subject matter content, and have a mindset that PBL is an ideal learning method. Instructors will need to implement PBL numerous times as way to fully embrace and feel comfortable with the pedagogical
practice. For those new to PBL, the initial implementation might feel precarious at times. Implementers should form a support team of experienced PBL practitioners on their campus, and if necessary, on other campuses. Attending PBL specific professional development trainings will also help implementers learn of others who teach through PBL. Additionally, implementers will need to have faith in what research findings and peer implementers advocate, in regards to how it effectively prepares students with the necessary 21st century skills. Attending professional development trainings will help novice implementers learn about how to integrate skills that extend beyond their expertise into their curriculum, hear PBL success stories and learn about implementation strategies. In addition, the implementation of PBL will most likely be pedagogical method that is different than how implementers were taught in their schooling and they will need to learn how to become a facilitator. Those new to the implementation of PBL must welcome the acclimation process that it takes to transform into a facilitator of learning and seek guidance. Instructors will improve their facilitation skills through frequent implementation of PBL, watching PBL implementation in other courses, discussing PBL challenges with peer implementers and openly discussing the process and expectations of PBL with students.

Implementation of recommendations. The researcher plans to extend these recommendations onto campus through support from the Academic Dean, membership on the College’s professional development committee and on campus PBL implementers. The researcher will first arrange meetings with the College’s Academic Dean and the professional development committee to gain support for increased PBL specific professional development opportunities on campus. The researcher will encourage the College’s Academic Dean and professional development committee to increase PBL specific professional development opportunities as a way to better serve one of the College’s initiatives, which is ‘develop students’ ability to
The researcher suggests the following action plan to the Academic Dean and the Professional Development Committee and will work with them to refine and implement the action plan. The researcher will suggest the following action items:

- The Academic Dean raises attention to the College’s initiative to “develop students’ ability to problem solve” and asks academic chairs to encourage faculty to engage in PBL professional development opportunities.
- Findings from this study will be presented at a department chairs meeting.
- The professional development committee develops and manages a PBL folder on the College’s electronic shared drive. All faculty who implement PBL will be asked to submit curriculum models, teaching tools and links to any off campus PBL specific professional development opportunities. Also in the folder is a list of on campus PBL implementers.
- The professional development committee will host a series of one hour PBL specific trainings focused on the study’s findings and recommendations for practice. For example, topic will include promising practices on assessment, teamwork and curriculum design. Experienced, on-campus implementers will be asked to discuss their work with PBL and lead these trainings.
- The professional development committee works with the College’s development office to apply for a National Science Foundation Advanced Technological Education targeted research grant to help support the spread of PBL on campus through a study aimed at evaluating the effects of increased on-campus, PBL specific professional development training.
Additionally, the researcher will share the study’s findings and recommendations for practice with all faculty in the academic department and will lead a review of all pre-existing PBL curriculum. Faculty will work together to redesign and newly design aspects to the existing curriculum to address the recommendations for practice based on the study’s findings.

**Recommendations for Future Research**

There are a limited number of studies on the use of PBL in ATE community college programs. Additionally, findings in the literature usually focus on students’ experiences with PBL. This study adds to the literature because it investigated the instructor experience with the implementation of PBL. Furthermore, study findings provide guidance for how instructors in ATE community college programs can overcome common implementation issues discussed in the literature. Findings from this study reflected a difference in administrative support for instructors teaching major specific courses versus the one participant who taught a general education course. Future research should explore the required general education courses within an ATE degree program and how those instructors identify and overcome implementation challenges. It is important to understand if those implementing PBL in general education courses, within ATE programs, need additional or different types of support than those teaching PBL in major specific courses.

Additional research should also seek to further understand the deep learning that occurs with the implementation of PBL versus surface learning. This study supports what the literature reports, which is that PBL provides deep learning, however research specifically aimed at investigating any significance related to this is needed. For example, a study that seeks to understand the levels of deep learning that occur in an ATE community college course taught through PBL in comparison to one taught through traditional teaching methods would be
significant. Also, a study that seeks to understand how PBL curriculum that provides deep learning directly relates to performance in industry would provide useful information.

Findings from this study that also align with conclusions in the literature posit that PBL provides students with necessary 21st century skills. Research on performance in industry by students who learned through PBL, versus non-PBL curriculum, would provide a clearer understanding of what aspects of PBL are essential when preparing students for the real world. Additionally, such a study would give facilitators guidance on how to create a classroom environment that best models the workplace.

Lastly, more direct research on the role of administration in the implementation of PBL within ATE community college programs is needed. For example, an understanding of whether or not the implementation of PBL is widely embraced by community college ATE faculty relates to the values put forth by college administration would be helpful to those seeking to spread the use of this pedagogy. Additionally, research on the role of administration would provide guidance about how administration can support the implementation of PBL without hindering academic freedom.

**Conclusion**

This study sought to answer: How do community college instructors in advanced technological education programs describe implementation challenges with problem and project-based learning and how have they overcome those challenges? Findings from this study can help instructors and administrators in community colleges inspire and sustain the implementation of PBL, a pedagogy that has proven to attract, retain and graduate advanced technological experts. Findings from this study reveal that a pedagogical conviction for the use of PBL helps facilitators sustain their use of the pedagogy through implementation challenges. Additionally,
support and guidance for students and facilitators during the implementation process is a critical part of overcoming implementation challenges, such as reluctance to the teaching method. The experience of teaching and learning PBL proved transformative for students and facilitators and created a preference for the teaching method.

This study supports previous findings, which express that those who implement PBL are inspired by a pedagogical conviction to provide real world education that is student-centered and prepares them for future academic and professional experiences. In addition, findings from this study revealed that the student-centered approach leads to the implementation of curriculum that students find gratifying and that this gratification leads to improved enthusiasm for learning, in support of previous findings that the literature presents. Study participants all expressed that PBL does provide deep learning and provides students with 21st century skills, also in alignment with findings from previous studies of community college ATE programs that sought to implement PBL as a way to improve student learning. A unique finding of this study was that all participants reflected a desire to thoroughly enjoy the teaching experience and that PBL stimulates such joy, which builds off of Keller’s (2002) finding that PBL allows instructors to be more innovative.

Further findings from this study that are situated in the literature include a need for various levels of support to help manage the pressure and challenges associated with implementing education reform, such as PBL. Concurrent with the literature, ways of overcoming implementation challenges identified in this study include the instructor serving as a guide for students by scaffolding the learning from less challenging to more challenging problems through open ended questioning. A finding from this study that adds to the literature is that instructors also need to ease students into the autonomy that PBL requires of students, which supports
McLaughlin’s (1987) notion that implementation must happen slowly.

Further findings from this study support and negate additional aspects of McLaughlin’s (1987) theoretical framework. The conclusion that implementation of education reform can still occur, even if implementation issues related to administrative support are not resolved does situate itself with McLaughlin’s (1987) theoretical framework. However, the finding from this study that revealed that the implementation issue relating to course scheduling could be completely solved, with administrative support, contradicts McLaughlin’s (1987) notion that implementation issues are never fully resolved. Study participants discussion of administrative support validates what the literature purports, which is that administrative support is critical to the implementation of PBL. Additionally, participants in this study also aligned with the literature’s portrayal of professional development as essential to the effective implementation of PBL and extended this finding to report that professional development helped them to overcome implementation challenges associated with curriculum design, assessment and group work.

The implementation of education reform brings about numerous new experiences. Findings in the literature and this study report that these experiences can be transformational for instructors and students. Findings from his study also support McLaughlin’s (1987) notion that the implementation of education reform is a process of evolution for instructors and students. This study also supported conclusions in the literature that expound that student resistance is a natural part of education reform, but that this resistance transfers into preference for PBL versus traditional teaching methods. Additionally, participants in this study confirmed previous findings that PBL increases student confidence. A common implementation challenge noted in the literature and validated in this study is that PBL is a different teaching style than how implementers were taught, but that through time and experience instructors overcome their initial
hesitancy. Furthermore, findings from this study extend that the continued use of PBL transforms instructors' view for how teaching and learning should occur in various contexts. A finding from this study that the literature did not express, in regards to transformation, was that an effective introduction to PBL for students is the weaving together of traditional teaching methods, such as lecturing, with PBL.

Based on these findings numerous recommendations for practice are made to ATE community college instructors and administrators. Those implementing PBL and those wanting to inspire the implementation of PBL need to believe in the pedagogy, be patient and accept that implementation takes time. A recommended approach to introducing PBL to a class is a hybrid method that initially introduces problems to students through more traditional teaching methods. The implementation of PBL should not happen in isolation. Support from administration, peer implementers’ feedback and PBL specific professional should be sought to help overcome implementation challenges and sustain this pedagogical practice. In addition, implementers should seek out premade curriculum, as well as tools to help facilitate teamwork and assessment, and if necessary redesign the materials to meet course specific outcomes and objectives. Lastly, administrators and implementers can apply for grant funding, such as through the National Science Foundation to help manage expenses related to overcoming implementation challenges, such as curriculum design, instructor release time and professional development.

These findings add to the literature on the implementation of PBL in ATE community college programs, although additional research can extend an understanding of the role of PBL in student and faculty development. Additional research is needed on the involvement of administration in the implementation of PBL as well as on facilitation challenges within the general education courses with ATE programs. Also, research that evaluates the proposed
findings in this study, such as increased confidence, motivation for learning, deep learning and students’ preparation for industry should occur. A study that examines how former students use what they learned though PBL in the workforce would be ideal.
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Appendices

Appendix A – Recruitment Letter

Date

Dear:

The New England Board of Higher Education (NEBHE) and its National Science Foundation-funded PBL Projects program invites you to participate in a doctoral study conducted by Benjamin Franklin Institute of Technology Associate Professor, Tanya Rogers for her doctoral dissertation at Northeastern University.

Ms. Rogers’ work is focused on examining how community college instructors who teach a STEM discipline and have implemented problem and/or project based learning (PBL) in their classrooms, describe successes as well as challenges and how to overcome the challenges.

The study seeks to learn more about your experience with and reaction to the professional development training on problem and/or project based learning you have received. The purpose of this study is to use its findings to develop a promising “PBL Practices Guide” designed for use by community college instructors who teach in advanced technological programs.

You are an ideal candidate for this study because you teach in a community college, within the [program name] and you participated in NEBHE’s (insert PHOTON or STEM) PBL project.

Participation in this study would involve:

- One in person interview that would be approximately 60 minutes in length. You can choose the location for this interview, ideally somewhere on your college campus. If necessary, the interview may be done via an online platform, such as Google Hangout.
- Follow up questions via the telephone or through an Internet discussion forum.

The total time commitment would be approximately 2.5 hours, including the initial interview, and follow up questions. Ms. Rogers plans to begin interviews in May 2014 and complete interviews by the end of September 2014. Follow up questions will occur in May or June 2014 and a review of findings will occur between June and August 2014.

In appreciation for taking time to participate in this research project, NEBHE will send you a $25 gift card upon completion of your interviews with Ms. Rogers.
We believe that Ms. Rogers’ research will help NEBHE and the PBL Projects assess our professional development trainings and will add much needed literature on PBL in community college advanced technological education programs. Your participation is entirely voluntary. We hope that you will decide to participate in this study.

Although we are asking you to participate in this study, Ms. Rogers will conduct this study and it is not being controlled by NEBHE. In addition, NEBHE will not seek to influence your responses in any way.

Please contact Ms. Rogers directly, via e-mail: rogers.t@husky.neu.edu or phone: 401.965.4771 to respond to this invitation. Please let her know the best method of communication for you to arrange an interview. If you agree to serve as a participant in her study she will contact you via phone or e-mail to arrange a time to conduct the initial interview.

If you have questions, please contact Ms. Rogers.

Sincerely yours,

Fenna Hanes
Senior Director, Professional and Resource Development
New England Board of Higher Education
Appendix B – Consent to Participate

Northeastern University, College of Professional Studies
Name of Investigator(s): Principal Investigator: Dr. Kimberly Nolan, Student Researcher: Tanya Rogers

Title of Project: Overcoming Implementation Challenges with Problem and Project Based Learning in Advanced Technological Education Programs within Community Colleges

Informed Consent to Participate in a Research Study

We are inviting you to take part in a research study. This form will tell you about the study, but the researcher will explain it to you first. You may ask this person any questions that you have. When you are ready to make a decision, you may tell the researcher if you want to participate or not. You do not have to participate if you do not want to. If you decide to participate, the researcher will ask you to sign this statement and will give you a copy to keep.

Why am I being asked to take part in this research study?

You are being asked to participate in this study because you have had experience implementing problem and/or project based learning and have received professional development training on PBL.

Why is this research study being done?

The purpose of this research study is to learn more about how community colleges instructors who teach problem and/or project based learning in advanced technological education programs describe implementation success, challenges and how to overcome challenges.

What will I be asked to do?

If you volunteer to participate in this research study, the following will occur:
- You will be interviewed about your experience teaching the PBL pedagogy and any obstacles related to its implementation.
- The interview will be digitally recorded to ensure accuracy in reporting your statements.
- The researcher may contact you later, via phone or the Internet, to ask other questions and will ask you to review the study’s findings.

Where will this take place and how much of my time will it take?

- The interview will take place at or near your college or via an Internet discussion forum and will take approximately 60 – 90 minutes
- Follow up questions will occur via the telephone or via Internet discussion forum and take approximately 30 minutes
- Review of the study’s findings will occur via the telephone or via Internet discussion forum and take approximately 30 minutes
### Will there be any risk or discomfort to me?

There is a risk of loss of privacy, due to the use of the Internet, however the risk is extremely limited. No names or identities will be used in any published reports of the research. You will incur no harm during this study.

### Will I benefit by being in this research?

There will be no direct benefit to you for taking part in the study. However, your participation might provide you insight into your own teaching practice and help you determine solutions to any challenges with teaching PBL.

### Who will see the information about me?

Your part in this study will be confidential. Only the researchers on this study will see the information about you. No reports or publications will use information that can identify you or where you teach in any way or any individual as being of this project. Pseudonyms will be used for yourself and where you teach. The research data will be kept in a secure location. At the conclusion of the study, all identifying information will be removed and the data will be kept in a locked cabinet, on a password-protected computer, cloud storage and external storage drive. Digital audio files will be destroyed at the end of the study.

### What will happen if I suffer any harm from this research?

It is expected that you will not suffer any harm from this research. No special arrangements will be made for compensation or for payment for treatment solely because of my participation in this research.

### Can I stop my participation in this study?

Your participation in this research is completely voluntary. You do not have to participate if you do not want to and you can refuse to answer any question. Even if you begin the study, you may quit at any time. If you do not participate or if you decide to quit, you will not lose any rights, benefits, or services that you would otherwise have.

### Who can I contact if I have questions or problems?

If you have any questions about the study you can contact myself at 401.965.4771 or rogers.t@husky.neu.edu or the Principal Investigator, Dr. Kimberly Nolan at 617-390-3622 or K.Nolan@neu.edu.

### Who can I contact about my rights as a participant?

If you have any comments or concerns resulting from my participation in this study, you may contact Nan C. Regina, Director Northeastern Univ., Human Subject Research Protection 360 Huntington Avenue, Mailstop: 960 Renaissance Park Boston, MA 02115-5000 Tel: 617.373.4588; Fax: 617.373.4595; n.regina@neu.edu You may call anonymously if you wish.
Will I be paid for my participation?

You will be provided a $25 gift card at the end of the study, which will be provided by the New England Board of Higher Education.

Will it cost me anything to participate?

It will not cost you anything to participate in this study.

Is there anything else I need to know?

This research is being supported by the New England Board of Higher education and the Foundation for California Community Colleges. The New England Board of Higher is paying for the $25 gift card that you will receive. The Foundation for California Community Colleges is paying for any travel and transcription expenses related to the interviews. These organizations will have no influence over the study’s findings and they will not have any access to the interviews or interview transcripts.

Signature of study participant

____________________________________________

Printed name of person above

____________________________________________

Signature of Tanya Rogers - person who explained the study to the participant above and obtained consent

____________________________________________

Printed name of person above

____________________________________________
Appendix C – Semi Structured Interview Protocol and Schedule

Date:
Time:
Name:

Interview Protocol

Good morning/afternoon. My name is Tanya Rogers and I want to thank you for participating in my research. The purpose of the study is to understand the successes and barriers to implementing problem and project based learning, which I will refer to as PBL, and how and if you have overcome any barriers. My hope is that the findings can be used to create a promising practices guide for those instructors who would like to implement PBL and are looking for additional support and guidance.

There will be one initial interview that will last about 60 minutes. In the interview I will ask you questions about your previous experience as an educator using PBL. The purpose is to get your perceptions of the teacher/facilitator experience with the use of PBL, in particular the obstacles that you felt you have faced with the implementation of this teaching method and how and if you were able to overcome such obstacles. There are no right or wrong answers. I would like you to feel comfortable with saying what you really think and how you really feel.

Participation in the interview is entirely voluntary and there are no known or anticipated risks to participation in this study. You may decline to answer any of the questions you do not wish to answer. Further, you may decide to withdraw from this study at any time, without any negative consequences, simply by letting me know your decision.

Before we get started, please take a few minutes to read this consent form. Do you have any questions? (read and sign form).

If it is okay with you, I will be recording our conversation. The purpose of this is so that I can get all the details but at the same time be able to carry on an attentive conversation with you and take notes. I assure you that all of your comments will remain confidential.
Interview Schedule

1.) Please tell me about how you first started using PBL. Possible prompts: What was your initial motivation to use PBL? Which courses and why? What influenced your decision to start using PBL?

2.) Please talk with me about any professional development training that you attended, which involved specific training on PBL. Possible prompts: What did you think about this training? Was the training helpful? Did the training influence your teaching?

3.) Would you tell me what you expected to happen in class when you started using PBL? Possible prompts: What were your expectations? What were your expectations based on/influenced by?

4.) Are you still teaching using PBL? Why or why not? If yes, what has motivated you to continue teaching with PBL? Possible prompts: Compare when you first began teaching with PBL to now. What changes have you made in your teaching style? What has been your students’ reaction to PBL?

5.) Based on your experience, would you tell me about any positive aspects of teaching PBL. Possible prompts: Do you enjoy teaching PBL? Have you received any positive feedback? Have you received any funding, such as grant funding?

6.) What problems if any did you have when you initially began using PBL … did they continue? Possible prompts: curriculum design, internal & external support, students, assessment, role as facilitator?

7.) How have you worked to overcome challenges related to implementing PBL? Possible prompts: Did it require specific skills or strategies? Did you seek support from others?

8.) What challenges related to the implementation of PBL have been resolved and what challenges are ongoing? Possible prompt: Are there any challenges that no longer exist? Can you provide an example from your experience?

9.) On a scale from 1 to 10 (1=instructor-centered; 10=learner-centered), how would you rate your teaching style preference and why? Possible prompts: Has your view changed since you began teaching PBL? Do you prefer being a facilitator of learning versus lecturing?

10.) Based on your experience, what advice would you give to a community college instructor in an advanced technological education program who would like to teach PBL? Possible prompts: curriculum design, internal & external support, students, assessment, role as facilitator.
NOTIFICATION OF IRB ACTION

Date: June 4, 2014  
IRB #: CPS14-05-03

Principal Investigator(s):  
Kimberly Nolan  
Tanya Rogers

Department:  
Doctor of Education Program  
College of Professional Studies

Address:  
20 Belvidere  
Northeastern University

Title of Project:  
Overcoming Implementation Challenges with Problem and Project Based Learning in Advanced Technological Education Programs within Community Colleges

Participating Sites:  
N/A

DHHS Review Category:  
Expedited #6, #7

Informed Consents:  
One (1) signed consent form

Monitoring Interval:  
12 months

APPROVAL EXPIRATION DATE: JUNE 3, 2015

Investigator’s Responsibilities:
1. The informed consent form bearing the IRB approval stamp must be used when recruiting participants into the study.
2. The investigator must notify IRB immediately of unexpected adverse reactions, or new information that may alter our perception of the benefit-risk ratio.
3. Study procedures and files are subject to audit any time.
4. Any modifications of the protocol or the informed consent as the study progresses must be reviewed and approved by this committee prior to being instituted.
5. Continuing Review Approval for the proposal should be requested at least one month prior to the expiration date above.
6. This approval applies to the protection of human subjects only. It does not apply to any other university approvals that may be necessary.

C. Randall Colvin, Ph.D., Chair  
Northeastern University Institutional Review Board

Nan C. Regina, Director  
Human Subject Research Protection

Northeastern University FWA #4630