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Improving Math Performance in Adult Female Community College Students: An Evaluation of Project Independence

Robin Tim Frodsham
Walden University

Walden University

COLLEGE OF EDUCATION

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Tim Frodsham

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Eric Riedel, Ph.D.

Walden University
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MS, Brigham Young University, 1980

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Abstract

Project Independence (PI) is a community college immersion program dedicated to assisting women returning to college. The focus of this study and associated summative evaluation was to understand how the PI program addresses anxiety and other learning deficiencies associated with math. Knowle's andragogical models portray adults as motivated and self-directed, and the American college campus fosters a culture of independence. This culture is foreign to many minority, first-generation, and working class adults who learn through interdependence. This qualitative instrumental case study and evaluation is the first to examine the efficacy of PI. The guiding questions of this study concern early math learning experiences, PI interventions on study, coping and math-learning skills, and how participants utilize these skills in subsequent math classes. Three faculty members and 8 graduates of the program who had completed at least 2 math classes participated in individual interviews. Inductive analysis of these interviews showed the cohort and long term counseling as pivotal to developing a sense of belonging, self-esteem, and an attitude of self-worth. With cohort support, students learn to find campus resources, explore career options, and overcome personal obstacles to their education. Improved math learning for adult minority and first generation students has diverse implications for social change. Math education is requisite for many technical degrees and certificates. Enabling math learning expands options that transcend gender, cultural, and socioeconomic barriers. The cohort experience and culture of interdependence should be expanded to college preparation programs for men, as well as mainstream community college math preparation interventions.

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Dedication

This doctoral study is dedicated to LaNae Emma Darrington, my wife of 37 years. We worked as a team, raising six beautiful, honorable, and conscientious children. She joyfully supported me throughout my careers in education and engineering as well as my pursuit of this doctoral degree and, together, we fought the cancer that took her life. Our goal was to use this degree to further humanitarian service, and that will never change. I also dedicate this study to the faculty and staff of Project Independence who, by their example, showed me what it means to be a dedicated and compassionate teacher and counselor.

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Section 1: The Problem

Introduction

Funds from the Women's Resource Center at a Portland community college are used to sponsor a college credit program to help female students learn the skills necessary for academic success in college. Known as Project Independence (PI), the assigned mission of the program is to "help students with college readiness while examining educational and career goals" (Portland Community College [PCC], 2013, p. 1). The design of the original program introduced in 1992 targeted single parent, displaced homemakers and provided short-term job training, and transition to the job market. In 2001, the focus of PI shifted from job training to college preparation, and academics. Over the years, the staff, faculty, and students of PI have explored innovative program, and curricula ideas. Faculty and staff share ideas through statewide organizations collectively known as the Oregon Transition Coalition (Macias, 2015).

Women are recruited to PI by referral from other students, a family member, or an advisor. Those interested in the program are introduced through an information session where they learn how to apply for financial aid, how to negotiate the college admission process, and aspects of the placement exam. The official duration of the program is one calendar term, with program graduates returning for counseling and support throughout the duration of their college experience.

Definition of the Problem

Poor math performance is a problem at the college level; approximately one third of college freshmen are unprepared for a college math course (Long, Iatarola, & Conger,

2009; McCormick & Lucas, 2011). At the Portland community college participating in this study, failure rates for math classes are higher than for any other academic subject. Many degree programs require college algebra, and foundational math students working up to these algebra classes face a failure rate of nearly 50% for each successive course (PCC, 2012). There are a disproportionate number of students who are women, minorities, and of low socioeconomic status struggling with math (Geist, 2010). At the study-site community college, 55% of the students enrolled are women, and 30% are of an ethnic minority (PCC, 2011).

One of the greatest challenges for women participating in PI is learning how to succeed in math classes. Participants complete existing community college courses for preparation in reading and writing, but the PI staff have developed their own course to address poor math performance. To master math learning, students are taught study and organizational skills while learning to recognize the events and emotions that influence anxiety, as well as strategies that control its debilitating effects (PCC, 2006). These skills are taught in a nonthreatening environment through the assignment of learning tasks that encourage student participation (Vella, 2009b). The emphasis on math-learning skills is considered to be effective; however, PI has insufficient published data on how well students internalize these skills or the extent of benefit the skills provide for learning within subsequent college courses (D. Stone, personal communication, May 16, 2013).

Rationale

Evidence of the Problem at the Local Level

At the Portland community college participating in this study, a grade of A, B, C, or P (i.e., pass) denotes successful class completion. In 2012, of the 43 courses analyzed for passing rates, only one math course was listed in the top 25%; seven of the 12 courses placed within the bottom 25% were math courses. The course with the highest completion rate was Psychology 215, with an average of 84%. College algebra reflected the lowest completion rate, with an average of 57%. For some sections of college algebra, only 23% of the students successfully completed the class (PCC, 2012). Low completion rates are a serious problem. To motivate departments to counter this trend, the participating college plans to include completion rates, as well as student enrollment, in funding calculations. The math departments will be the most affected by this change (M. Marciniak, personal communication, April 29, 2013), and the staff are working toward a clearer understanding of causal factors for the low math-course completion rates to effectuate amelioration.

To qualify for PI participation, students must complete a placement exam for reading and writing and, at a minimum, place within Levels 80. These courses stress basic communication skills, grammar, sentence structure, vocabulary, and dictionary use. There is no requirement to take a math-placement exam. The exam itself is too difficult for many women attempting to return to college, and the goal is not to exclude them, but to prepare them for the college experience. Instructors and the project director attribute program success to the sense of community and belonging fostered by PI, as well as the

customized math-anxiety class developed by math faculty associated with the project. This current study explored the success and efficacy of PI, in terms of helping students overcome math-learning anxiety, acquire long-term learning skills, and improve their math performance.

Evidence of the Problem from the Professional Literature

Adult community college students face many challenges, such as divorce or unemployment, while attempting to complete their college education. To qualify for the math courses required in their degree program, 61% of community college students complete a minimum of one remedial class, and 25% complete two or more. Many of these students do not realize remedial classes do not count toward a degree.

As they leave high school, girls and boys are equally prepared to pursue a college degree in STEM (science, technology, engineering, or math), but fewer girls pursue this path (Hill, Corbett, & Rose, 2010). Math is a significant barrier to college entrance, and completion. Authors of the Oregon 40-40-20 Bill (Kitzhaber, 2011) set a goal of 40% of all adult Oregonians to hold a bachelor's degree, 40% to hold an associate's degree or certified postsecondary certificate, and all adult Oregonians to have earned a high school diploma by the year 2025. As a result, community colleges throughout Oregon are working to improve retention rates and overall student success.

At the time of this current study, community college systems do not calculate department funding by student success, only by the number of students enrolled (Fain, 2013). Colleges throughout Oregon are transitioning to a funding strategy based in part on student success. A Klamath, Oregon community is attempting to increase retention

rates by raising the bar on admissions and excluding less prepared students. These efforts have cut enrollment by 20%; however, the long-term expectation is higher overall retention. Even if the higher standards result in improved retention rates, those excluded by these policies cannot start, let alone complete, a college program.

Definitions

Community support: The peer-to-peer and peer-to-staff support specifically, and deliberately developed within PI. This sense of community revolves around the Women's Resource Center, where women currently participating in the program, as well as graduates, come for counseling and discussion surrounding their education. The support continues via telephone calls, social media, and lasting friendships. The peer-to-peer relationship between students enrolled in a common set of classes creates a synergistic group known as a cohort.

Math anxiety: Worry, anxiety, or other physiological factors causal to students performing lower than their actual math abilities. Math anxiety manifests in many ways. It can be a fear of making mistakes or even taking risks in mathematics. Students frequently fear that math performance is linked to ability—ability the anxious student will believe he or she does not possess (Ashcraft & Moore, 2009). Math-anxious students, when presented with a problem they deem difficult to solve, will quit without even trying. They are easily frustrated with math to the point of unchecked stress, even though they may handle stress well in other aspects of their lives.

Math identity: The manner in which students identify with mathematics, and how they relate to math learning (Nosek, Banaji, & Greenwald, 2002). Those with a strong

math identity are comfortable with math, and their relationship with math learning. Those with a weak math identity are more likely to suffer from math-learning anxiety.

Test anxiety: Fear during evaluation. Those with test anxiety lose their ability to think and strategize during an exam. Those who are test anxious worry about failure and how they compare to others (Eum & Rice, 2010). Failure to perform from one exam to the next exacerbates this fear, fueling the anxiety.

Significance

For many students, acquiring the math skills necessary to succeed in college is difficult. Those who struggle with math, typically have weak problem-solving skills, and little faith in their own intuition. Without proper support, they fail their math classes and modify their choice of college programs to avoid math or drop from college completely. The result is detrimental to individual self-esteem and a significant loss of time and money. A college education can bring an updraft of improved employment and community belonging. Unfortunately, a disproportionate percentage of minorities—those who would benefit the most—are left behind (Belfield & Bailey, 2011; Goldrick-Rab, 2010; Museus, 2010).

Adult learners often "revisit" the math-learning anxiety they experienced during their primary and secondary education, but their adult experience and maturity can be harnessed to overcome this anxiety (Merriam, Caffarella, & Baumgartner, 2007, p. 285). Project Independence addresses mastering math anxiety as part of the program; however, insufficient research has been conducted to determine the efficacy of the curriculum, and associated instructional methods. The math-anxiety class within the PI

program is popular and the curriculum has been shaped over the years by dedicated and talented faculty members, but the college participating in this study has little scholarly data on long-term amelioration of the described anxiety or on how the math performance of math-anxious students can be improved. Those teaching anxiety-reduction courses at the participating community college have little knowledge of how well students are assimilating and applying learned anxiety-mitigation techniques either in the short or long term (A. Davis, personal communication, October 22, 2012).

This current study provides a theoretical perspective for the PI math-anxiety program. Faculty and staff may understand, from a conceptual foundation, why the course work and community support are effective in ameliorating poor math performance. Although the results of this study are limited in scope to the women of PI, the conceptual foundation and enhanced understanding of poor math performance may benefit the math faculty as a whole. The enhanced approach to mitigating poor math performance may be relevant to the larger student body. A scholarly review and analysis of project success in improving math performance could justify continued funding and support for PI from the college administration.

Research Questions

Project Independence participants are referred to mainstream college courses for subjects such as reading and writing; however, mathematics poses a unique problem. Project faculty teach a course on math success, which is tailored for the program. Intended outcomes are women better able to assess their attitudes and emotional reactions toward learning math and demonstrating learned behavior, such as organizational and

study skills, which will enhance both their academic and professional success. They learn to employ strategies to reduce emotional overreaction and prepare for and complete tests in a timely manner. They learn to use college resources such as learning centers and advisement. Most importantly, these women develop a sense of community, which provides significant support. Evidence for the success of PI is anecdotal, the majority in the form of testimonials from current and previous participants relating to how the project has changed their lives. The purpose of this study was to understand causal factors for PI success and the program aspects that enable women to master long-term learning of mathematics. The following research questions guided the study:

1. Why do women participating in PI find mathematics an obstacle to their progress at the Portland community college serving as the study site in this research?
2. How does PI help women acquire study, coping, and learning skills that improve their math performance at the community college serving as the study site in this research?
3. How do the women participating in PI apply the skills, and knowledge they have learned to long-term improvement in math performance?

Review of the Literature

Literature Search

I searched various educational databases for literature related to the topic under study using keywords and keyword combinations such as *math anxiety, test anxiety, learning anxiety, math performance, procrastination, mathematics and gender,*

mathematics and advising, math and culture, math and disabilities, math and foundational, math and motivation, math and coping, math and women, math and minorities, intellect and behavior modification, math problem-solving skills, negative self-talk, and *math fundamentals.* For further articles, relevant citations with recent publication dates were reviewed and followed. I also searched each relevant article in Google Scholar to locate other articles referencing the literature. I organized my search by opening each article or citation list in a new browser page. A browser session manager facilitated the organization and saving of the search status as I followed citation chains in a tree-like format.

History of Math Anxiety

For telescope builders, the moment their instrument is pointed to the heavens to gather the light of distant stars is termed *first light.* Dreger and Aiken (1957) published a seminal article on *number anxiety* and shedding first light on the notion of math anxiety. These researchers added three math-related sections to the Taylor Manifest Anxiety Scale to explore the following three hypotheses:

1. Number anxiety is a unique learning anxiety.
2. Number anxiety is unrelated to intelligence and, in fact, has a negative correlation to IQ scores.
3. Those with number anxiety score lower on mathematics evaluations compared to those with equal intelligence. (Dreger & Aiken, 1957, p. 345)

Dreger and Aiken (1957) concluded that number anxiety is a separate factor from general anxiety, and unrelated to general intelligence. Those with significant number

anxiety tend to earn lower grades. For decades, this seminal study guided research on math anxiety. Tobias (1978) developed the term *math anxiety.* Her humanistic approach to math performance was inspired by a study conducted by Sells (1973) who reported that 57% of the male students participating in his study had completed 4 years of math in high school, while only 8% of the female students had received similar preparation. The lack of math background precluded these women from participation in the majority of the math curriculum, and hence many fields of study.

Conceptual Framework

The conceptual bases for this current study were the andragogical learning models of Knowles (1998), Hilgard and Bower (1966), and Mezirow (1991). The Knowles theories address adults who are problem centered, internally motivated, self-directing, and able to draw upon their growing inventory of life experiences (Knowles, Holton, & Swanson, 2011, p. 299). Many adult learners, particularly those struggling with mathematics, have yet to find that maturity. A goal of PI is to lead students to this self-directed, internally motivated state. Knowles et al. (2011) theorized that adults respond to what is real to them, and need to know why they need to know (p. 363). Without a conviction that what they are learning is important and worthwhile, adults have less incentive to study, particularly when the subject is mathematics.

The Hilgard and Bower (1966) 20 principles of learning are relevant to many aspects of adult learning of mathematics (p. 562). Such learning builds from the simple to the complex in a meaningful way. The presentation of a problem must be performed in a manner that allows the learner to recognize and relate to the various facets of the problem

and apply previous experience to finding a solution. In the case of the current study, adults can best apply previous experience when math is presented in a way that is relevant to their culture. For an adult learner, setting goals is important not only to facilitate success, but also to recover from failure. Lastly, individual adult learners respond differently to coaching and motivation, and how teachers successfully encourage their students depends, in part, upon the anxiety status of the students.

Learning is more than a cognitive activity; it is a multidimensional process. One must make meaning through reflection and dialog, concurrently applying past experience (Merriam, 2008). The adult learners of PI face multiple challenges in their approach to mathematics. They must acquire and apply problem-solving techniques while refreshing or learning anew the foundation and supporting tools required to address a math problem. These may be as simple as the multiplication tables or the rules of algebraic manipulation. While attempting to master the tools and techniques of mathematical problem solving, these students may also be plagued with math-learning anxiety. This threefold challenge to mastering mathematics can be a disorienting dilemma (Mezirow, 1991). This dilemma triggers reflection (Malkki, 2012). Confronted with math learning, the women of PI reevaluate earlier accepted assumptions surrounding their inability to learn and engage in transformative learning. They can connect to their own experience, as well as recognize that others have had similar disorienting experiences. Hence, resources and relationships exist that can assist them on their journey.

Learning mathematics is difficult because the required problem-solving skills can be demonstrated but cannot be taught. In his groundbreaking work, Gagné (1965)

described problem solving as the apex of learning types, requiring prerequisites of many other forms of learning, from stimulus response to conceptual learning. Teachers can demonstrate problem-solving skills, but adult learners must hone these skills. Gardner (2004) defined intelligence as the ability to create products or solve problems, and this includes mathematical skills in the form of logical intelligence. Mastering the valuable skills of problem solving, whether in mathematics or the lived experience, is a difficult but achievable process. Teachers can show students multiple routes to solving a problem, allowing them to leverage the stronger of their intelligences (Gardner, 1993, p. 33); however, the will and stamina required for this exploration must come from within. Theorists have focused on cognitive and rational dimensions for dealing with a disorienting dilemma (e.g., learning math), but there are also social and emotional facets. Neglecting these may be causal to the minimal progress in confronting math-learning anxiety (Malkki, 2010), as well as why the staff and faculty of PI attribute so much of their success to the social connectedness and sense of community fostered by the program.

Math Performance

Through effort, both ability and intelligence can be improved (Bednall & Kehoe, 2011; Jaušovec & Jaušovec, 2012; Tarchi, 2010; Willingham, 2009). Existing related research is by no means definitive, with investigators claiming, for example, that practice does not result in improvement to working memory (Chooi & Thompson, 2012). The controversy may lie in the definitions applied. Willingham (2009) supported the notion that practice will not improve the size of working memory; this aspect of intelligence is

fixed. Practice, however, improves how existing working memory is applied (p. 34). Mathematical skills and problem-solving prowess are developed through practice focused on the fundamentals. This does not mean that students behind in mathematics can easily catch up, only that it is possible.

Teachers must praise effort, not ability. The challenge is to convince students that they are capable of improvement. For students to become skilled, they must first acquire knowledge on the respective topic. To improve math problem-solving skills, students must first master the basic facts of mathematics (Ediger, 2012; Miller, Stringfellow, Kaffar, Ferreira, & Mancl, 2011). They can subsequently focus on solving the problem, rather than becoming mired in the mechanics. To master those basics requires practice. New information is understood only from within the context of past experience and knowledge. To acquire deep knowledge on a subject—knowledge allowing an understanding of the context and patterns of a problem—the shallow knowledge enabling comprehension of the context must first be mastered.

Conscientious people are defined as highly responsible, achievement-oriented, and industrious learners. Openness to experience and conscientiousness are factors in academic performance (Hazrati-Viari, Rad, & Torabi, 2012). Such characteristics generate a determination and resolve to reach high academic attainment. Thus, it follows that conscientiousness significantly contributes to academic achievement (Hakimi, Hejazi, & Masout, 2011) and is a five times stronger predictor of grade point average (GPA) than is intelligence (Kappe & Van der Flier, 2012). Student approaches to learning are related to college performance. It is the approach to studying and the quality of the

resulting study time, rather than the overall time and effort, that most improves student performance in the form of grades. To develop a good study approach, some students need extra support in the form of counseling, and advisement (Diseth, Pallesen, Brunborg, & Larsen, 2010).

To overcome poor math performance, students must overcome a past history of poor learning techniques and their own self-perceptions related to their ability to master mathematical concepts. A positive attitude toward mathematics and science can be developed at an early age after practical experimentation (Rukavina, Zuvic-Butorac, Ledic, Milotic, Jurdana-Sepic, 2012); however, the women of PI do not have this beneficial training. Regardless, it is important to foster the idea that all students can learn math, and they can master the subject to the point of positive performance in class. Not only is the converse untrue, it is demotivating (Rattan, Good, & Dweck, 2012).

In all math-learning situations, self-efficacy and problem-solving ability improve with success (Hoffman, 2010). Self-efficacy and perceptions of math anxiety change depending upon the complexity of the mathematics studied (Wadlington, 2008); consequently, it is important to begin at a level that challenges the student, but does not overwhelm. Past academic achievement is related to self-efficacy, and subsequent achievement. To overcome a history of academic struggle, and the resultant lack of momentum requires extra effort. Motivation and learning strategies are strongly linked. Students with poor math performance use avoidance techniques related to surface learning strategies (Diseth, 2011). It takes effort to develop deep learning strategies such as the use of evidence to process and internalize ideas. The teacher is important, and

specially designed programs and counseling can significantly increase student self-efficacy (Habel, 2012), but it is ultimately up to the students to achieve success in their formal education.

Math learning anxiety. Sources of math and testing anxiety are manifold and include negative learning experiences during childhood or adolescence; gender approaches to assessment; adverse reactions to timed exams; high-stakes testing (Geist, 2010); weak problem-solving skills; fear of ridicule; and learning disabilities and phobias. Students struggling with mathematics must change fundamental assumptions surrounding their ability to learn and develop faith in their learning styles. A common symptom of math-learning anxiety is negative self-talk (Ashcraft & Moore, 2009; Jain & Dowson, 2009); consequently, a good technique for overcoming such anxiety and improving math performance is a shift to positive self-evaluation or self-talk. Similar to poor study techniques, negative self-talk is a habit that can only be changed through long-term behavior modification, replacing the negative self-talk with a positive flow of thought toward problem resolution. Academic optimism is a predictor of retention and GPA (Solberg, Evans, & Segerstrom, 2009), and student motivation is the most important factor in achievement. Motivated students view school as valuable and the information they learn as relevant to their academic, professional, and personal success (Saeed & Zyngier, 2012).

The majority of test-anxiety studies focus on how such anxiety impacts performance, and on the nature of the anxiety itself. How students perceive their abilities is a strong factor in the detrimental impact of learning anxiety (Bonaccio & Reeve, 2010).

Students with learning disabilities are more susceptible to test and math anxiety, eroding their self-confidence and exacerbating their learning difficulties (Whitaker, Lowe, & Lee, 2007). Those with low self-efficacy believe intelligence is innate while students with high self-efficacy persist in the face of difficulty (Komarraju & Nadler, 2013). The learning infrastructure can support students in many ways; however, it is ultimately up to the students to improve their overall math performance.

Problem-solving skills. Mathematics is considered a language, and numerical calculation skills are considered an aspect of literacy. Adult learners increase their self-efficacy and problem-solving skills through success in their math classes (Hoffman, 2010). Similar to literacy, enhanced reasoning and problem-solving skills help adults assemble facts, participate in critical discourse, and make their voices heard within a democratic society (Merriam, Courtenay, & Cervero, 2006, p. 82). With these skills, adults are more likely to complete their study programs, thus acquiring skills relevant to employment, and a positive societal contribution. Developing intuition and visualization in mathematical problem solving requires three types of mathematical knowledge (Giardino, 2010). The first is a conceptual understanding of mathematical operations or the connections between operations. The second is a procedural knowledge or the ability to generate processes to solve problems. The third type of mathematical knowledge is declarative knowledge, or the memorization of math facts such as the ability to recall the multiplication tables (Miller et al., 2011).

Problem solving cannot be taught; it must be practiced to develop relevant skills. It is a praxis, an action followed by reflection, followed by new action (Vella, 2009a).

During this process, teachers have the right to ask students to think critically (Galbraith, 2004, p. 344). It is the responsibility of the student to observe the various examples of problem-solving techniques, listen to feedback, and take action toward developing a personal problem-solving style (Caffarella & Vella, 2010, p. 341). Students should reflect and consider how they will integrate their newly acquired strategies and techniques into their unique problem-solving repertoire (Caffarella & Vella, 2010, p. 90). The focus of developing problem-solving skills is more than finding correct answers. Student should explore the problem-solving process and incorporate techniques that work for them within the perimeters of their personal learning styles. Active participation is the optimal way to learn problem-solving skills (Merriam et al., 2006, p. 178), and mastering the problem-solving process is a significant factor in mitigating math-learning anxiety and poor math performance.

Linking mathematics to the sciences contributes to addressing student lack of interest, and improving overall math performance (Arnett & Van Horn, 2009). Demonstrating the practical nature of mathematics and its close connection to problem solving satisfies the adult desire to understand the relevance of mathematics. Intuition plays a large role in mastering math learning, and that intuition is best developed through practical problems of relevance to the student. Merriam (2010) has shown that, when math problems are presented in context, such as price calculation or comparison at a grocery store, students are able to solve the same problems that baffled them on a math test. Developing and trusting personal intuition plays a significant role in learning to solve math problems.

Math-Testing anxiety. Timed testing and high-stakes assessment are the bane of foundational math students, particularly those with learning anxiety (Putwain, 2008b). Test anxiety impacts test performance and, as a result, many students are assessed below their actual knowledge and potential. Increased used of standardized testing and testing at younger ages has concurrently increased the symptoms of test anxiety in children (Putwain, 2008a), and these anxieties follow students into adulthood. The correlation between the stakes of an examination and the level of test anxiety is complex, and even counterintuitive. Putwain (2008b) demonstrated that it was mid-stakes, rather than high-stakes, exams that induced the most anxiety. Placement exams can be detrimental to foundational math students if not interpreted properly (Jacobson, 2006, p. 155). Students may be unchallenged and bored simply because unused math skills placed them too low in the math sequence. To compound the frustration, many of these students are unable to demonstrate their true knowledge and ability due to test anxiety, falsely demonstrating poor math performance.

Math-testing anxiety can be eased by pretask rehearsal, administering practice tests, recognizing effort, and using alternative forms of assessment that emphasize success rather than failure (Huberty, 2010). A nonthreatening approach to math requires honest self-assessment from both teachers, and students (Galbraith & Jones, 2008). Students can implement many different coping activities and behaviors to deal with stress (Hughes, Gourley, Madson, & Blanc, 2011), and these anxiety-reduction techniques and assessment skills are best woven into the foundational math curricula to effectuate change in behavior, and attitudes. Internalizing these behaviors, however, is a long-term process.

In some cases, math testing and learning anxiety are best diagnosed as phobias (Young, Wi, & Menon, 2012), and the same techniques used to conquer other phobias can result in overcoming these anxieties. Within the United States, 80 to 90 million adults are plagued with learning disabilities (Gregg, 2012). These adult learners are more likely to suffer from learning anxiety (Whitaker et al., 2007). Students with high levels of test anxiety are likely to be women who avoid goal setting, and are overly perfectionistic (Eum & Rice, 2010).

Students with poor math performance often understand the mathematical concepts but cannot demonstrate their math proficiency. Problems for these students begin at admissions and placement (Jain & Dowson, 2009), before the first class even begins. Adults who cannot demonstrate their true ability on placement exams are positioned in classes below their actual capability (Ashcraft & Moore, 2009). Because they are unchallenged and cannot demonstrate their true abilities, they tend to be bored and disconnected from the curriculum, exacerbating other learning problems such as procrastination (Klassen, Krawchuk, Lynch, & Rajani, 2008). These students are required to complete additional math classes to graduate from their programs, and the extra classes place an additional burden on time and finances.

Female math-learning anxiety. The hard sciences are commonly considered physics, engineering, and computer science, and only 20% of the graduates from these disciplines are women (Hill et al., 2010). In a landmark study, Belenky, Clinchy, Goldberger, and Tarule documented five major categories or levels to the female "way of knowing" (as cited in Merriam et al., 2007, p. 335). These ranged from the silent,

mindless, and voiceless to an empathetic understanding of knowledge as contextual in nature, and that can be created. These ways of knowing for the women of PI are shaped by the additional stressors they confront such as the aftereffects of domestic violence (Merriam et al., 2006, p. 250). Other factors shaping their way of knowing are the responsibilities of a single mother or the journey of recovery from drug or alcohol use. Such history can reduce women to the silent and voiceless minority. With the proper tools, a community of support and female role models who excel in mathematics, these women can perform at the same levels as their male counterparts (Thilmany, 2010).

Even the use of humor in preparation for exams presents gender differences. Presenting humorous cartoons before an exam reduced anxiety in both genders, but in men significantly more than in women. Pretesting humor buffered women against stereotypical threats they commonly sense before an exam such as the fear of performing poorly in front of peers (Ford, Ford, Boxer, & Armstrong, 2012). Humor works, but only for the uninterested or those with low motivation (Matarazzo, Durik, & Delaney, 2010). Much of the related literature places an emphasis on the female way of knowing and the need to tailor educational practices to gender or cultural minorities; however, other researchers have hypothesized that too much weight is placed on stereotypes (Stoet & Geary, 2012) and that teaching to a stereotype can stifle student performance, and potential (Schmader & Croft, 2011).

Math at the Community College Level

Simple statistics have highlighted poor math performance at the community college level. Only one third of the students enrolled in community college complete a

degree or program 6 years after starting college (Goldrick-Rab, 2010). Fifty-eight percent of African American undergraduates and 66% of Hispanic undergrads are enrolled in these educational institutions. Women constitute a disproportionately high percentage of the adult students, and all demographics indicate high attrition rates.

First-generation students struggle with the culture of independence fostered in contemporary universities, a culture that clashes with their working class, interdependent backgrounds (Stephens, Fryberg, Markus, Johnson, & Covarrubias, 2012). There are links between lower socioeconomic background, financial concerns, and procrastination (Chow, 2011). Many first-generation students have not heard of financial aid, nor are they familiar with the application process. To foster the success of minority students, colleges must attract a minimum critical mass and provide opportunities for intergroup relations and support services (Park, 2009). Common elements that promote success among students of color are addressed in a humanized, multifaceted approach to advising and reaching out to students in a proactive manner (Museus & Ravello, 2010).

Seven factors that contribute to community college success are advising, social connectedness, involvement, approachability of faculty, business procedures, meaningful learning experiences, and student-support services (Roberts & Styron, 2010). To combat higher attrition rates, community colleges are working to provide more humanized advising, expanding their discourse to life experiences. Problems are multidimensional, and require multifaceted approaches. Adult learners are more likely to succeed when closely connected to support networks that maintain connections between advisors and counselors. These counselors should be proactive and track how students are progressing,

assisting with scholarships, and other student needs. To be perceived by students as genuine, they should avoid being overly empathetic or completely disengaged (Museus, 2010). Community colleges should provide training for humanized, multifaceted, and proactive academic advising (Museus & Ravello, 2010). Assisted by a properly trained support structure, previous destructive student behavior can be modified by establishing goals and planning strategies that include honest and ongoing self-evaluation (Jain & Dowson, 2009). Based upon the experience of the PI director, students needing extra support the most are those least likely to seek out these resources (D. Stone, personal communication, May 16, 2013).

Mutual respect is an essential factor in learning (Caffarella & Vella, 2010, p. 455), and how counselors and teachers give and receive feedback will define that respect. Honest, well-meaning, and well-thought-out feedback will leave students feeling as though their counselors and teachers are truly working for their best interest. Advisors can help students set reasonable goals that are realistically challenging. Counselors can help students develop academic relationships with their peers, and the school staff. Low achievers will attribute success to someone or something else, rather than their own efforts. Counselors can help students understand the efficacy of their own efforts (Rowell & Hong, 2013).

Targeted programs facilitate student access to social networks, and the development of social capital (Museus, 2010). Summer learning communities significantly contribute to academic performance, and persistence. These bridge programs foster motivational attitudes that students bring to the college learning

experience (Allen & Bir, 2012). It is not just a matter of study time, but the activities in which students participate that develop volition and the ability to maintain success even in the face of adversity (Kuh, Cruce, Shoup, Kinzie, & Gonyea, 2008).

Student study time can be increased by simply improving the learning environment. Course assignments should be in line with expected learning activities (Doumen, Broeckmans, & Masui, 2013). Course characteristics are a strong predictor of study time. One way to improve study time is to assign specific tasks and match math-learning assignments with student experience (Masui, Broeckmans, Doumen, Groenen, & Molenberghs, 2012). More knowledgeable students may not need the extra study time but can still use it as an opportunity to gain mastery of an academic subject. Study time and academic achievement are strongly connected to academic conscientiousness (Komarraju, Karau, Schmeck, & Avdic, 2011). Conscientious students are motivated and disciplined, setting learning goals and changing their behavior to accomplish those goals (Berger & Karabenick, 2011). The best predictors of study time are gender and study delay. Women are more committed, spend less time on hobbies, and hold fewer part-time jobs. Off-campus work is strongly associated with lower GPA. Colleges need to find ways to separate male students from their computer games and help minority students find work on campus (Brint & Cantwell, 2010).

Implications

Project Independence is a college-readiness program one term in duration. Participants complete classes in career and life planning, values clarification, assertiveness, college survival, fitness, and overcoming math anxiety. Math learning is

the only academic subject addressed during the program. One possible outcome of this project is to provide an evaluation of the math-learning aspects of PI. Answers to the research questions will guide the evaluation of how PI impacts the long-term improvement of student math performance.

Education theorists have concluded that learning must be relevant to the respective culture, and students learn best when they understand why they need to learn the material. This current project evaluation examined the culturally relevant and practical curricula of PI that help women develop problem-solving, and study skills. Even practical problems, relevant to the culture, are insufficient if not presented within a setting familiar to the students. Such settings include the department or grocery store, the gas pump, and travel by car or on mass transit. The evaluation performed for the current study drew from the answers to the research questions.

Summary

For many adults, mathematics is a stumbling block to a college education, particularly for those who had negative experiences with math during their primary or secondary education. Within the United States, women, minorities, and students of poor socioeconomic status are more likely to struggle with math. Math anxiety can be overcome, especially with a support structure and a curriculum grounded in the relevant culture. The manner in which math-learning skills are taught at PI was evaluated in the current study. Student self-perceptions of the improvement in their attitudes toward mathematics were weighed along with their study skills, and overall math performance.

This qualitative evaluation provided insight into the efficacy of the PI program for faculty, staff, and college administration (see Appendix A).

Section 2: The Methodology

Introduction

Teachers, counselors, advisors, and friends can demonstrate math learning and encourage appropriate learning behavior, but the desire, drive, will, and effort to learn mathematics, or more accurately, to learn how to learn mathematics, must be ultimately extended by the individual student. For example, while waiting in the common room of the Women's Resource Center of the study site for an interview with the program director, I overheard several participants discussing their college aspirations. A common theme was the hatred of mathematics. Women in PI have shown the desire and the initiative to enroll in this college-preparation program. For most, learning math was not why they began this quest. Based upon end-of-semester surveys and informal feedback from graduates of the program, collected by the faculty, PI is successful in helping these women improve their math performance at the community college.

The purpose of this study was to understand causal factors for PI success and the program aspects that enable women to master long-term learning of mathematics. Instrumental case study was selected to best answer the research questions, evaluate the PI program, and provide the details of the research. The student and faculty participants are described along with the criteria for participation, and the sample-selection methodology. The methods used to assure ethical protection for the study sample are described and the interview and transcription process of data collection is detailed. Following discussion of the data-collection process, the code and theme development used for organization, and analysis of the data are detailed. The assumptions, limitations,

and scope of this project study are provided. Through a reflective journal, I discuss the themes that emerged during the coding and analysis of the interview data. The research questions are subsequently explored from the perceptions of the student and faculty participants and their insight is linked to existing literature. A discussion of quality and validity, as well as the outcomes of the study, are provided.

Instrumental Case Study

An instrumental case study is tailored to explore a specific issue (Creswell, 2012, p. 465). It is a heuristic form of study and was used in the current research to evaluate the long-term outcomes, both overt and subtle, of math learning at PI. The design is intended to answer how and why questions (Merriam, 2009, p. 44) and is well suited for a qualitative program evaluation. PI leaders attribute program success to the sense of community developed among program participants who mutually support, counsel, and encourage each other. Many in the program are of ethnic minorities with rich oral traditions, which the project leverages for student bonding, and exploration of the college experience.

An instrumental case study is not focused on the case itself, but rather, on understanding a particular phenomenon. The focus of the current study was placed on exploring how to overcome fears sourced in learning mathematics and develop the study, coping, and organizational skills necessary for academic success in a math class. The purpose of an instrumental case study is typically known in advance, and is rooted in established theory (Mills, 2010). The case itself plays a secondary or supportive role in pursuing in-depth understanding of the phenomenon of interest. The case may not, and

need not, be typical. The resulting evaluation of the current study specifically addressed PI. The findings may be generalizable to other populations; however, this was not the goal of the study.

The guiding research questions of this study were focused on how PI helps women acquire, assimilate, and subsequently apply long-term study, coping, and learning skills to improve their math performance. Adult learners need to understand why they need to learn mathematics. Knowles et al. (2011) hypothesized that adults are self-directed and self-motivated; however, the struggling adult learners in PI may not yet have reached that level of maturity. As described in the literature review, the disorienting dilemma and learning from within the context of past experience are integral aspects of adult learning theory. The instrumental case study of PI is based upon this theory and builds understanding of the program and its achievement through the fundamental concepts of the construct.

A goal behind the current study was to provide an in-depth understanding of the processes and results of PI through qualitative research. Descriptive statistics were used only to define the problem and view the PI efforts toward teaching how to learn math from within the context of math learning as a whole. This is a qualitative study; hence, no effort was made to statistically quantify the success of the project. Sample statistics drawn from responses to the demographic survey are included in Appendix B and will be used to provide background on the study group. Table 1 lists the major study types and their suitability to the goals and research questions of this study (Baxter & Jack, 2008).

Table 1

Research Formats not Selected for This Study

Type of study	Definition	Suitability
Quantitative	The use of numerical and statistical methods to answer questions such as how well or how much	A quantitative study is not suitable for answering how and why questions
Mixed method	A combination of qualitative and quantitative approaches	Mixed-method studies are complex, and the quantitative portion of the study would distract from the main focus of how PI helps students improve math performance
Phenomenology and ethnography	Focus on essence and experience	Although PI targets women for college preparation, and much of the study will focus on the female experience in learning mathematics, the goal is to understand how and why
Grounded theory	Derive theory grounded in the data	Closest to an instrumental case study and suitability for this research; the goal here is not to derive theory, but to use theory to clarify and substantiate practice
Narrative or descriptive analysis	Analysis of stories and relationships	Stories and relationships will constitute a significant portion of the data collected, but it is not the prime focus of this study
Explanatory case study	Outcomes are linked to the intervention	Too mechanical for this research
Exploratory case study	Outcomes of the program or intervention are not definitive	The desired outcome—learning how to learn and be successful at math—is known
Intrinsic case study	The intervention is best understood in the specific case	Improving math learning is a universal goal and not limited to the women of PI

Note. PI = Project Independence.

Program Evaluation

This project study is an evaluation of the math-learning aspects of an ongoing college-preparation program that will play a critical role into the foreseeable future of the community college that participated in this study. Key stakeholders and contacts for this evaluation were the program director and the math faculty involved in the program. The program evaluation is summative, focusing on student perspectives of what worked for them in overcoming a fear of math, and developing learning skills. Summative evaluations are best for determining if the program has met intended outcomes, while process and formative evaluations focus on short-term objectives.

This study and the resulting goal-based evaluation were focused on the long-term effectiveness of the PI educational interventions targeting changed attitudes and behaviors toward improved math learning (Spaulding, 2008, p. 18). The participatory-oriented evaluation considers the success of the program from the vantage point of the program participants (p. 12). The details and direction of the program evaluation were guided by the research questions. The logic model of PI consists of the program resources and activities used in the mathematics intervention and the long-term outcomes of this intervention. In addition to a program-evaluation white paper, an oral and media presentation of the evaluation will be presented to the PI faculty and staff, as well as math faculty from other campuses, and interested community college administrators.

Setting and Sample

The setting for this study is a college-introduction program known as PI, which is designed for women and sponsored with funds generated by the Women's Resource

Center at the community college that participated in this study. Forty percent of the students enrolled in PI at the time of the study were African American, compared to 30% of the overall enrollment of the college. This is partially attributable to the campus location, which is within an urban area. A significant percentage of PI students reside within locations that are much closer to other major campuses. A majority of the women are mature adults, well past their high-school years. Many are first-generation college students with a significant history of spousal abuse, drug abuse, and abuse or belittlement as children.

The official duration of PI is one term; however, graduates return for counseling or advisement not only during their subsequent formal college experience, but also after they have completed college. The program begins with a learning-disability inventory that is not used to diagnose, but rather, to identify the characteristics of the participants and potentially point to a need for further testing. Students participating in the program are members of weekly focus groups, which could be observed as a potential source of data. However, the guiding research questions of this study were formulated with a focus on the long-term improvement of math-learning skills and, for this reason, the study sample is composed of program graduates. The participants have progressed in their formal education and have had time to use and develop the math-learning skills developed during PI. The criteria for participation in the study are listed in Table 2.

Each term, approximately 20 to 25 students (i.e., 70 students per year) graduate from PI; consequently, an ample population existed from which to draw a sample. A brief study description was provided to previous graduates of the program through notices

Table 2

Criteria for Student Participation in the Study

Criteria	Reason
A successful graduate from PI	Why students do not complete the PI program is beyond the focus of this study; simple statistics were gathered to highlight overall program success, but only to delineate the limitations and scope of the study
Completion of a minimum of 1 year of community college education; completion of at least 2 terms of mathematics subsequent to PI; still in school or graduated within the preceding year	The guiding research questions revolve around retention of math-learning skills; 1 year is sufficient time for students to comprehend how well they have retained math-learning skills; two math classes provide sufficient opportunity to demonstrate math-learning skills and give participants in the study ample experience from which to draw during their interviews; the majority of the participants completed two or more additional math classes; after several years, details of the college experience begin to fade; participant memories of their college-math experiences should be fresh and vivid
Willing to participate in an interview 45–60 minutes in duration and review the interview data and researcher conclusions	Following the interviews, participants were asked to review their respective interview transcription and subsequent coding; the requirements asked of them were carefully explained prior to the onset of data collection and all were willing to follow through with their commitments to the study

Note. PI = Project Independence.

posted in the Women's Resource Center and through recruitment e-mail. To ensure all members of the participant pool had the opportunity to participate in the study, previous program graduates were sent an e-mail requesting their participation through the Women's Resource Center. Participants were selected based upon the participation criteria, as well as the availability and willingness of the students to participate. A purposeful sampling strategy was employed (Creswell, 2012, p. 206), selecting students

who excelled in math and who struggled with this academic subject. The goal was to select a diverse sample who demonstrated both the strengths of PI and needed improvements of the project.

The ideal sample size for a qualitative study is somewhat controversial. Creswell (2012) recommended from 12 to 20 participants. Merriam (2009, p. 80), as well as Bogdan and Biklen (2007, p. 69), made no recommendations as to sample size, but suggested terminating the sampling when no new information is forthcoming (i.e., when data saturation had been reached). In general, the fewer the participants, the more in depth the researcher can probe. I limited the sample size in this current study to eight to 12 participants, which resulted in an interview pool of eight former students of PI.

Both past and present participants of PI are an intimate community, which is characterized by frequent interaction between students and staff. Participant recruitment for this study was effectuated through flyers placed within the Women's Resource Center and e-mail distributed to former participants. The content of the flyers and e-mail invitations is provided in Appendix C. As noted earlier, the participants were selected through purposeful sampling based upon brief conversations conducted prior to the study interviews to establish the criteria in Table 2. One half of the study participants are African American, which approximates the 40% overall participation of African Americans in PI. One half of the study participants would be considered low income, with three participants not reporting their income. The number of math classes completed prior to PI varies from no classes at all through algebra, and grades ranged from "A" to

failing. All of the study participants reported passing their subsequent math classes with a grade of "C" or better.

For program evaluation, as well as to establish a context for student responses related to the efficacy of the PI math-learning program, two of the math faculty in the program were interviewed for information on the curriculum, the approach to teaching math learning at PI, the interaction between math learning, and the sense of community. The director of the project was also interviewed with the same questions and intent. The interview protocol used for the staff interviews is provided in Appendix D.

Ethical Considerations

Data collection did not begin until after approval by the Institutional Review Board (IRB) of both Walden University and the study-site community college. The IRB of the college reviewed and approved this study after they received notice of the Walden IRB approval. Relationships were first established between myself and the program director and staff through an initial meeting to outline the scope and purpose of the study. I am not affiliated with the Women's Resource Center or any of the staff members of PI. I taught mathematics at another campus as an adjunct professor, but not during the 5 years prior to the study. As such, I had no conflict of interest or other ethical issues with the site or the participants.

The study participants signed an informed-consent form that explained the processes in place to ensure confidentiality and other participant protection. The forms were executed at the beginning of the interviews prior to any questioning. Through member checking, participants had the opportunity to review their interview responses

and the transcription coding. A print version of the coded transcription was either mailed directly to the participants or forwarded through the Women's Resource Center. I treated all information as confidential. For the peer review, data were coded and all identifying information was removed.

Data Collection

While interviewing program graduates, I also interviewed two PI math instructors and the program director to collect curricula and teaching techniques, as well as information on the counseling and community infrastructure. This established the context for the student interviews, delineated both the formal and informal organizational and social structures of the program, and provided a basis for the program schematic. I interviewed graduates of the program to elicit their perspectives on the content of the guiding research questions. This included why mathematics was an obstacle to their college education, how PI helped them acquire the skills to improve their math performance, and how they applied those skills in the long term.

The study interviews were structured around the perceptions and attitudes of the participating students toward their math studies, as well as how these perceptions and attitudes changed during the course of the program and how the students implemented this learning in subsequent math classes. Stories are important in qualitative data collection and are an important aspect of the collected interview data. There are many facets to PI, and the temptation existed to explore other traits of the project; however, structured questions were used to maintain the focus of the interviews on improvements in math performance. Follow-on and probing questions were incorporated to explore

each question in depth. Appendix D provides the interview protocol used for students, and that used for staff.

The student participants completed a simple survey as part of the interview process to effectuate collection of demographic data (see Appendix B). Along with the information, the survey collected a summary of their previous math experience, the math classes required for their major, and their grades in those classes. The bulk of the demographic information was used to establish study context. This is not a mixed-method study, so statistics were also used solely for this purpose.

The interview questions were formulated with a focus on why the participants found math to be an obstacle to their college education, how PI helped them to acquire the skills needed to improve their math performance, and how they subsequently applied these skills to their college math classes. The interviews consumed from 40 minutes to 1 hour and allowed full exploration of the research questions. The sessions were conducted within one of the offices of the Women's Resource Center that was sufficiently private for comfortable interviews. The participants were familiar with the Center and felt more comfortable in that environment. Some of the interviewees had endured abuse as a spouses or children. These topics were off-limits because studying the effects of such abuse was not the primary focus of the study. It was important to maintain a comfortable, nonthreatening atmosphere for these participants. Recording the interviews left me free to focus on participant responses during the sessions, as well as on their nonverbal communication, while developing probing questions. I interviewed each participant once for their insight into the content of the research questions. The interview

transcripts were forwarded to the respective participants with an invitation to contact me with any corrections, misconceptions, or additional insight. No new questions or probes were introduced during follow-up discussion.

All interview data were recorded and transcribed. Prior to each interview, I checked the condition of the batteries in the recording equipment and the presence of note-taking materials. I practiced extensively with the equipment prior to the actual interviews to gain familiarity, and avoid mechanical failure. I transcribed each interview soon after each session and reviewed, and coded the transcripts. For qualitative studies, coding is performed in parallel with data collection, and the codes are somewhat fluid and adapted to the ongoing learning of the data-collection process. As noted earlier, for member checking, I provided each participant with a copy of their respective interview transcript along with my coding. This assured each participant of the accuracy of the data collected and verified my understanding of their responses.

Data Analysis

I transcribed the interview transcriptions, updated my notes, and performed the first coding following each interview. Computer-assisted, qualitative data-analysis software does not analyze data for a qualitative research study; this can only be done by the researcher. Computer software can facilitate the organization and categorization of data, relieving the researcher of some of the mechanics of data organization. Computer programs render data analysis more versatile, allowing better visibility and access to the data (Bogdan & Biklen, 2007). There are several types of computer software available for assisting in qualitative data analysis. Many of these are tailored for manipulating audio or

video files and are not applicable to this study. Text retrieving packages are designed for large databases. The genre of programs most suited to this study are the code and retrieval packages, or theory-building software, that layers over the code and retrieval algorithms to provide more involved search capability and diagram generation. Although the goal of this study was not theory development, the research is closely aligned to learning theory and theory building; hence, qualitative data-analysis software was the most useful for data analysis.

Table 3 lists the codes used in the data analysis of this study. These codes changed as insight was gained from the data. Several tables are presented in this study, giving the research a quantitative appearance. This was not a phenomenological study, but an instrumental case study carefully guided by adult learning theory. As such, the interviews and data-analysis procedures were more formal than for a study with rich description and the lived experience as ultimate goals.

Assumptions, Limitations, and Scope

The Knowles adult-learning theories support the premise that adult learners can be self-motivating and self-directed (Knowles et al., 2011). For the adult learners of PI, this journey is hastened when students have a support structure to overcome the dilemma posed by the requirement to learn mathematics (Museus, 2010, p. 26). To encourage the participants of this study to openly discuss their failures and successes in learning mathematics, I approached each interview in a nonjudgmental fashion to put each participant at ease with the interview process.

Table 3

Transcription Codes

Code	Description
Early experiences	How PI helped participants overcome early negative experiences in learning mathematics
Disorienting dilemmas	How fearful participants were of taking math classes and how PI helped them with cultural and personal barriers to learning math
Self-efficacy	How participants perceived themselves as learners and how PI helped them improve that perception
Math attitudes	Attitudes toward math, before and after PI
Learning behaviors	Learning behaviors participants brought to their college education (e.g., negative self-talk and procrastination) and how PI helped them improve these behaviors
Learning anxiety	How severe do participants perceive their learning anxiety and how PI helped ameliorate this anxiety
Impact of PI	How PI changed the academic direction of participants with a focus on math; how school would be different without PI
Math teaching methods	The most effective PI teaching methods and how they improved math learning and performance for participants
Cultural relevance	How PI helped students seek cultural relevance in learning mathematics and use their experience and intuition in solving and checking their math work
Community support	How participants use the sense of community in PI to change their perceptions of themselves and their ability to learn
Math-testing skills	Skills taught at PI to mentally, emotionally, and academically prepare participants for a test and overcome test anxiety

(*table continues*)

Code	Description
Problem-solving skills	How participants perceive their problem-solving skills and how PI helped them to improve those skills
Classroom skills	Skills taught at PI specifically targeting the classroom experience including note taking and the ability to ask questions
Coping skills	Skills for coping with math-learning anxiety and life events
Study skills	How participants perceive the efficiency of their study time and how PI helped them improve study skills
Organizational skills	Ability to organize study time into daily events, the effectiveness of these skills, and how PI helped to improve them.

Note. PI = Project Independence.

In the interest of the study, I needed to gain the confidence and trust of the participants in order to collect truthful and relevant data. This was partially accomplished by interviewing the students in a familiar, nonthreatening environment; familiarizing myself with the recording equipment so that process was as unobtrusive as possible; practicing skills related to follow-on questioning; and maintaining adherence to the interview protocol. The staff and faculty of PI were enthused about the study and committed to assisting with overcoming any barriers.

This was a qualitative study of a small group of female, community college adult learners enrolled within a college-preparation program. The applicability of the resulting program evaluation to a broad spectrum of students is limited; however, some concepts, such as developing a sense of community and encouraging the use of advisors and counselors, could generalize to other settings. The evaluation does not provide a quantitative measure of program success in terms of facilitating student mastery over the

skills and attitudes necessary to learn mathematics, but approaches program success from the perspective of student participants. This was a study and evaluation of a specific aspect of an ongoing community college program that targets the improvement of math-learning performance. The research does not intend to provide a comprehensive evaluation of the program from formation through implementation.

Reflective Journal

During the course of data collection and coding, the following three themes emerged: (a) education and lived experiences prior to PI, (b) the PI experience, and (c) the transformation of education and life goals following PI participation. As a testament to the strength of the research questions, these themes directly related to the questions themselves and provided context for the investigation of math learning at PI. Rather than relegate relevant participant quotations and other data extracted for the study to an appendix, the rich descriptions they provided are included in the reflective journal.

Theme 1: The Student Prior to Project Independence

The early educational experiences of the study participants were as varied as the participants themselves. A few excelled in math at one time or another during their primary and secondary education experience and many struggled with math as a major obstacle to their education. Two participants enjoyed at least some segment of their early math learning; however, the majority were intimidated by math and avoided math classes, if at all possible. For most, it was life experiences that complicated their education and career pursuits. Prior to PI, these students experienced a spectrum of drug addictions, incarceration, rehabilitation, dysfunctional family life, and abuse.

Teachers and the classroom. Classroom conflict experienced by the study participants as primary and secondary students included struggles with teachers, difficulty with maintaining focus, and difficulty with asking questions. Many had problems asking questions in class and readily perceived a negative attitude from their teachers when they did take the time to answer questions. Personal attitudes and fears diminished the classroom experience. With regard to asking questions in class, one student commented,

> They [the teachers] didn't want to take the time to answer my questions. They looked at me like I was stupid when I asked the question. They wouldn't show me a different way. . . . I had one teacher who gave me a little bit more headway. He took a little more time to break things down a little bit more and how to get the correct answer, how to show my work.

Another student confided, "Lots of instructors tell you no question is dumb, but the answer they come back with makes you feel dumb. They can tell me no question is dumb, but the way they reply is another story." According to one student interviewee, questions in class was not the only difficulty participants had with instructors. She stated,

> I had a really good teacher who was a terrible teacher for me. He was the opposite of the kind of teacher that I had previously. He didn't engage anybody, he was highly performative, very shy, and had no sense of what was happening with the students in the class.

Humiliation in front of the class was another common theme. As young students, the participants were asked to demonstrate their math skills in front of the class, which was not always successful, as illustrated in the following interview excerpt:

> The second week of class, my teacher made me do math problems in the front of the class. It was humiliating; a horrible experience. It was the first time I ever did math in school. . . . I was out of context. I was very shy and had to go to the front of the classroom to do this thing on the board that I didn't understand. . . . From then on, I avoided math. I avoided math at all cost and I have almost no memory of doing math after that. I avoided it in junior high and I dropped out of high school at the end of my sophomore year.

Some of these early math experiences were positive learning moments that caused a connection within the classroom, especially when teachers provided quality one-on-one time with the students as early math learners. One interviewee explained,

> I don't [know] what happened there, but I heard the right things from the teachers and it was like an "aha moment." I started tutoring math; it was like night and day. I don't know where it came from, or how it hit me, but I loved math from then on. . . . In general, I liked all my teachers. I don't remember any negative school experiences.

Another student commented on the accelerated class she attended before moving and returning to public schools, stating,

> What was great about accelerated math was it was a small class, so I had more challenging work, but I also had more one-on-one interaction with my instructor. I

> would not have had nearly as much of this in a normal math setting. I was able to really thrive.

Another student described the following positive experiences early in her education:

> I need one-on-one attention. I was able to get that one-on-one attention in the alternative school that I went to. I only went once a week and I took the packet home. I got one-on-one attention when I went [there] once a week. I was able to focus and I got a "B" in math. That was good.

However, later in the interview, this student described difficulties with math as she approached high school that seemed to cancel out her earlier positive experiences and placed her back on a path of fearing and avoiding math.

It was evident by the data collected in the study interviews that math held special significance as a barrier to education progression. Lack of success in math "bled into other academic endeavors and jeopardized the overall education pursuits of the students. The participants did not know how to ask for help with overcoming their math-learning deficits. They felt they could and should overcome them on their own and frequently dropped from their academic programs rather than solve their math-learning dilemma. As one student revealed, "With that conflict [with my teachers], I just shut down regarding math. I was a nervous wreck." Another interviewee described the unique problems she was having with math learning in the following manner:

> In elementary school, I was always in the TAG program and [in] accelerated math [courses]. During my sophomore year of high school, math was very hard. My instructor and I didn't "click." I was used to not having to put a great deal of

> effort into school and doing really well, but here, I was . . . at a point where [I] was putting a great deal of effort and not doing that well in math. So basically, I took the minimum required for graduation [and] I went above and beyond in every other subject.

For one study participant, the problem was finding help with math. She explained,

> I couldn't get through the math classes I needed to become an RN so, basically, I took a break from school. I've got to figure out something else. It was math that tripped me up. . . . I had the mind of a very stubborn 18 or 19-year-old girl. I didn't really know anything about tutoring, getting extra help. I wasn't going to engage with anything like that because I felt that I can't do it and I should be a leader on my own.

Life experiences. The life experiences of the students participating in this study are "peppered" with abuse, drug addiction, incarceration, and dysfunctional family lives. Although not directly related to math learning, these experiences affected and delayed their overall education pursuits. For one study participant, it was drugs and alcohol. She described her experience in the following manner:

> When I went to treatment for drug and alcohol, I was broken, completely broken. I wanted to give up on everything in life. I was there for 7 months; I was out in the real world about a year before [I] decided to go back to school.

For another student, it was the loss of a job. She succinctly revealed the impact in the following interview excerpt: "It was a huge, huge life shift. I lost my job; it was one thing after another. I went to a very dark place. Life was really bad for years after that."

Another study participant described multiple issues before even starting school. She recounted,

> Twenty years of not going to school, taking any kind of classes. A big part of the 20 years was drug addiction, on the streets, stuff like that. Literally, it was the farthest thing away from school that you can get. I was really intimidated. . . . I'm so different. I'm a lesbian, I'm a woman of color, I was homeless, I was on drugs. I felt that I didn't belong anywhere, let alone in an academic setting.

According to the PI program director, in addition to drugs and alcohol, incarceration and violence also darkened the past of many program participants. She reported,

> On average, at least four to five of our students have been incarcerated previously. At least four, and sometimes eight, are in recovery from drugs and alcohol. Close to 90%—and we've done years of anonymous surveys—90% have experienced domestic violence at some time in their life as an adult.

First-generation college students. According to the data collected by anonymous surveys conducted by PI, most of the students participating in the program are first-generation college students dealing with the unfamiliar culture and language of academic life and with little or no family support. One participant spoke to the lack of help when running into problems at school and not knowing where to turn to ask for help. She stated, "No one close to you was talking about college at the dinner table night after night. No one knew what a PhD was, or had even heard of it." Another student described supportive parents, but they could not offer any help. She explained,

> Nobody in my family graduated from high school. My mom had me at 16 when my dad was 17. School was important to them but they did know how to help me and they didn't know anything about the math I was doing, it was just a foreign language to them. So I didn't feel like I had help at home or outside of the classroom, and I think that's a lot of what I struggled [with] because I would be lost on a problem and just give up because nobody could help me with it.

Extended family relationships. The families of first-generation students typically have no knowledge of how to extend support, even when willing to help. As one participant described, "I had no rules at home, so I went from [a] straight-'A' student to 'I don't care about school anymore.' I got a job and stopped going to school." Some family relationships were negative and abusive. In the following interview excerpt, the PI project director described the expectations placed on these students by relatives who are suspicious of a family member attending college rather than working:

> So many of our students are the ones in their family that everyone relies on. When their aunt . . . has to go to work and their kids are sick, they will call them—"Well, I have a job." They expect them not to go to class and take care of their kids, and they have their own kids to worry about when they're sick.

Some family members pressured the students to do well in their early years, but that pressure was, at best, misplaced and, at times, abusive. One student commented,

> I had a lot of pressure to get straight "A's." The pressure came from my stepfather who was very abusive and controlling. Since I was a baby I was considered really

> super smart and so the pressure got put on me from a very young age to do really well in school.

Summary. The PI study participants had endured a wide variety of negative experiences both at home and at school. Those at school extended beyond the mathematics classroom. They dealt with classroom issues such feeling "dumb" when asking questions and the humiliation of being asked to work math problems they did not understand in front of the class. Outside the classroom, they dealt with broken homes, drug addiction, alcohol abuse, and depression. Some had attempted college prior to PI, but as first-generation college students, they lacked family support and a working knowledge of the postsecondary education system. As a result, they modified their education goals or completely dropped from school.

Theme 2: The Project Independence Experience

The study sample of women participating in this research came from disparate and varied backgrounds, but all had one common experience—they found their way to PI. Once enrolled in the program, they worked not only on academic prowess, but also healing and nurturing the whole person, as well as finding the self-esteem and renewed motivation to further their education and life goals.

Discovering interests and receiving direction. As described in the following interview excerpt, considerable effort was extended in PI on career and life guidance, helping this student explore her interests, capabilities, and education and career options:

> Project Independence carved out my personality even more. It finds out what you're made of. It got down to the core of our personalities and all of the stuff that

> holds us back, the stuff that causes us to move forward. . . . Project Independence had a way of digging deep into our personality, our subconscious mind, and all this stuff. It let us know whether we were ready to move forward or we need to take a step back and reexamine what we really wanted to do.

Motivation and self-esteem. Building motivation and self-esteem is critical for PI students who have been demeaned and abused as children and adults. Several of the study participants cited graduation as one of the best moments of their PI experience. One interviewee described the experience in the following manner:

> Graduation! Graduation! That day was so much fun. . . . We were celebrating each other that we had done it. . . . We had speakers that were alumni. We had speakers from our class go up and read poetry that they had written about Project Independence. It was sad, but just knowing that we got through it made us believe that we can go further in our education. It was definitely a foundation for me.

Another participant described the support of her family at the program graduation. She recounted,

> I sang at the graduation. My family came. I haven't had a graduation ever, since '92 when I got my GED. It was just a graduation from the program, but it felt like it was a piece of something that I want. I want to go to get my master's degree, I'll get my associates degree, my bachelor's degree, and . . . my master's degree. I had my family there to support me. It was amazing to be able to get the certificate and a feeling of completion. I have not completed anything like that in a long time.

Over one half of the interviewees spoke of a math teacher who came to their math-anxiety class to tell about her story. She came from a similar ethnic and economic background and described her journey from math anxiety and the lowest level math class in community college to a math professor. For three of the study participants, it was one of the highlights of the PI math-anxiety program and a singularly motivating experience. The following interview excerpt described the visit:

> Another professor came to speak to us about math. . . . She came from a very working class background; neither of her parents went to college; she got married quite young, and again, this is something that many of us in Project Independence can identify with. She was a nontraditional student. . . . She explained to us that she hated math. She felt like she would never be able to succeed in school because of math. . . . Of course, now, she is a math professor. Having our instructor bring in somebody who is so relatable really resonated with so many of us that, if somebody else can do this, coming from the same place that I am, I can do this too.

Another study participant commented that the guest speaker gave her hope. She stated, "One of the teachers here said she started in math 20, which is the lowest math class. Here she is teaching. She found a love for math. It helped a lot, actually, and gave me some hope." Another student revealed that the experience transformed math into something within her reach. She explained,

> It was important to us to have somebody come in in a similar situation and tell us what she did to succeed, especially in a field that is so threatening to many of us such as math. They gave us a belief that we could do it, it was within our reach.

The entire PI program is rooted in motivating and supporting each participant as they learn to understand and navigate the community college system. As one participant described, they have not only the PI staff, but the Women's Resource Center, the learning center, and their instructors. She stated,

> The wonderful thing about Project Independence is that they supported me as a person. They helped my confidence as an individual. They made me feel capable of learning. The Women's Resource Center and Project Independence, as a whole, let you know that you are not alone, that you are supported. You can overcome any fears.

One of the PI math instructors acknowledged that the sense of self-worth and a desire to change manifests from more than simply the math-anxiety class. She commented,

> I don't know how they do such a good job at this, but the students really develop a sense of self-worth, a sense of core orientation. They really want to do some change in their life. That does not all come from my [math] class; it comes from Project Independence.

Addressing the needs of the whole person. The staff at PI understand that, before participating women can succeed at college, they need to overcome a plethora of negative behaviors and experiences, both past and present. This involves helping and

healing the whole person. One participant described the link between physical exercise and mental health in the following interview excerpt:

> I came out of physical education, I went to math. People forget the correlation between physical health and mental health. Project Independence recognizes that. There a lot of these women who have never been in a gym their entire lives. Project Independence tied all of this together. Especially being older, we are talking to older women. I always went to the gym, but lots of women did not always go to the gym. We would watch them struggle [at the gym] and watch . . . how good they felt later. I thought that was a real big plus.

For another student, the physical-exercise interventions of PI kept her centered. She explained,

> One of the things that we talk a lot about was lots of physical activity. It helped. When you are physically healthy, you are rested and breathing, letting your mind get real still. I don't know what to say. Relying on what you can learn and know to keep yourself centered.

Physical exercise is one area easily neglected were it not a part of the program, as the following study participant described:

> And then there's the health piece. We actually had a physical, adult-education, aerobics-type class. If you have a really busy life, that's something you would put off. It was actually helpful to help get the physical body in line, as well as going back to school and doing the note taking and study skills.

College survival skills and career choices. The women of PI face the same dilemma as many first-generation college students as they chart their education and career paths. This includes navigating the community college institution and conventions while defining education goals that match interests and career choices, financial aid, and finding and registering for the right classes. Housing and balancing family demands with school, particularly for the single mothers, is a major focus of PI, as well as the informal counseling and casual conversation between the staff and students. One student described the frustration of financial-aid forms, which brought her to PI. She recounted,

> I didn't fill out the financial-aid forms right; I messed up because I didn't know how to do it. I was talking to the people in financial aid and I got really upset. I don't like to cry in front of people so I immediately ran over here [The Women's Resource Center]. This door was opened, and I came in this door and they saw how upset I was and they told me about Project Independence. That's how it all came to be for me. I happened to be at the right place at the right time. From that day on, from the day that I started Project Independence, it built me up more and more to believe in myself and to follow my dreams.

Supporting students through decisions related to college and career is just one of many positive outcomes of PI. One interviewee commented,

> They certainly gave me a lot of structure to help me get back on track. Studying, basically making up my mind as to what I wanted to do, career choices. There was a whole array of things Project Independence did.

For another participant, the PI offices were a place to socialize. She stated, "I can go back to the PI program and ask about anything—housing, food, just the simplest questions or a casual conversation." Another interviewee acknowledged PI as the reason for her decision to enroll in college. She recalled,

> I was actually at a place where I was trying to come out of a depression—mental-health depression—and it was a real lifeline and refresher for me. I had no idea or no thoughts previous to Project Independence about returning to college. They help[ed] me to get registered; they helped to get financial aid. They opened up that whole door and gave me the confidence that I needed, as well as the navigation skills. I had thought before, if I signed up for college, I needed to be ready and willing to do this full time, and I still had underaged children at home; one was not even old enough for preschool the time. I couldn't quite see how [it] was going to work. They helped me walk through all of that; it was great.

The staff at PI work with the unique problems of each student. Several study participants struggled with conflict-management issues and, with the help of the staff, learned to properly handle anger and differing views and approaches. One participant described the difficulty she had with learning how to listen in the following interview excerpt: "Maybe you should hear what they have to say. Even if you don't agree with everything, just listen a little bit. That has really helped me a lot in my classes, and it helps me from going mad." Another interviewee learned

> not to "fly of the handle," not overwork myself and work myself up to a point that I'm not thinking, to be more considerate about what I say. . . . I don't get upset as

> quickly, think things out. If it happens, it happens. Don't let it stress you out, sit back. . . . I would've been kicked out. I would've slapped somebody a long time ago. I would just get up and walk away. Right now, I can handle the situation. I may not talk to you immediately, but I will talk to you later. I would've been kicked out of school, suspended, or expelled.

The majority of the participants attributed their success and even college attendance to PI. One interviewee commented,

> Without Project Independence, I don't think I would be in school anymore. I really do. . . . How does anybody succeed in school if they haven't done Project Independence? It gives you a "map"; it's really a map. It is a map people can internalize. It doesn't leave you. Everyone's going to have slipups and mistakes, places where you lose the map. "Oh, I've got to go find that map again," but it's still there.

Another participant stated,

> I have no idea; I have no idea. I am so grateful that I was able to go to Project Independence. I am grateful I heard about it. I would've been really lost without having all the information and skills, the resources, and the way the college works.

Another interviewee would not have taken noncredit classes on her own, but in the long run, found them beneficial. She explained,

> The classes that they cover are noncredit. I wouldn't have paid for them, but I also wouldn't have had the information I needed to make better choices, that it could be done, basically. It would've cost me more in the long run.

A PI faculty member described the advantage of the cohort system in which the students are together with a small group of faculty members the entire term. The faculty come to know each individual, deeply probing for the skills and limitations related to their education pursuits. He explained,

> When in a cohort like Project Independence, the faculty and teachers have time to watch the students and learn how they learn. Over time, they learn to recognize those students who are struggling with learning disabilities. This would not happen in a regular-class environment.

Although they do not diagnose or treat learning disabilities directly, the staff directs students to the proper resources on campus.

Finding a safe place. All of the participants in this study perceived the PI offices as a place of safety and refuge. Each requested the Women's Resource Center for the study interview, which was in proximity to the staff they had grown to know and trust. One participant described the PI offices in the following manner: "When we would sit down and speak with the director and go over our situation, tell her our feelings about the week, what was going on, it felt good. Sit down, let it out, and let it go." Another study participant visited the offices multiple times each week and commented,

> Project Independence gives people a safe place to get rid of their fears and to tackle math a little bit at a time, no matter where they are or their style of

> learning. I come to the Women's Resource Center two or three times a week. This is my safe place."

One interviewee described the confidence it gave her, "knowing that the Women's Resource Center is always here. We can come in and have coffee [and] speak with the people that are here who have been through Project Independence at some time or another."

The cohort and a sense of community. Central to the PI experience is the cohort. In the words of the project director, "The cohort is everything." The sense of community developed during the term is a crucial aspect of the healing and helping process. The ability to help a fellow student is integral to that process, as is exemplified in the following interview excerpt:

> We all help each other, even outside the course, and we still do. Two years later, I still talk to quite a few of the women who were in my group. Not all of us are still here, but a large majority of us are, and I see them all around. We still check in with each other.

The sense of community and belonging fostered by the PI cohort is multigenerational. Participants in the program receive support not only from other members of the cohort, but from graduates of the program as well, as described in the following interview comments:

> We ran into them while we were in Project Independence. We walk around campus a lot and instructors would notice somebody that was in a previous class. We would hear their conversation: "I'm going full-time now; you ladies stick to

> it," just encouragement from alumni. I try to do the same thing for the new classes now. For next term and the end [of] the term after that, I am going to try to do that too. These are women starting from very different backgrounds, but all starting with a fear of college and doubts of their own self-worth and their right to attend college.

One study participant realized that many within the cohort were starting from a similar position. She stated, "Maybe the difference with taking it with the Project Independence people was the fact everyone is starting out at a place in life where most of them had not been to school for a very long time." It was clear the cohort was not a competition. All of the participants worked to help others reach success, as described in the following interview excerpt:

> The faculty of Project Independence [and] my fellow students were so supportive. We were all working on the same goals together. It wasn't like classes where we were in competition; we all want to do the best. There, it was more of a situation where we want everybody to succeed; it was important that we all do well and all graduate from this program, that we all go on in school and do whatever our goal is. There was a great willingness to communicate our feelings and our needs, and there was also a great willingness to help each other to work through these issues together.

For one student, the motivation to attend the next day of class was spurred by a desire to not let their fellow "sisters" down. While each student depended on the others

for support, each realized that the others depended on them as well. This interviewee stated,

> If I'm [in] the cohort with a girl and I know she has four kids [and] is really struggling, or I'm in a cohort and I know someone is in a domestic-violence relationship or somebody doesn't have transportation to get to school, we can come together and we can support each other. . . . We can catch each other when we're down, when we see each other messing up or missing classes. We can call each other up and say, "How can I support you, because I want you to succeed? It's important for you to be here because you help me too."

For another student, it was a readymade network of support. She explained,

> We were already "plug[ged]-in" to this idea that we were a network with each other. We were forming some kind of cohesive body. One of the strengths of being in the program is that you had this horizontal interdependence that could be experienced with the other students.

One of the faculty members described how each of the program participants relied upon the moral support of the group to surmount the hurdles they faced in their education and career pursuits. They were facing and surmounting problems together. He recounted,

> The other thing I hear every single class is "I wasn't going to come today, but I thought of all of you. I thought how much I worry about you when you don't come, how it is really important to me that you are here when I come, and so I came." At some point, usually by the second or third week, they will do a *phone*

> *tree* with those who want to, and they begin to call each other. "Where are you? Are you coming today?" Sometimes they give each other rides.

A student participant commented that PI made school less intimidating. She explained,

> There was camaraderie. There was even food, believe it or not, something sweet or even something healthy like a fruit tray or a granola bar. . . . There was always something positive. We are going to tackle this tough thing together and we can win together. It wasn't as intimidating.

For another student, the cohort was a safe place to exchange ideas, as she described in the following excerpt:

> There was also a time period where we could come together as a group. It was very orderly and very respectful of one another. We would share a question [or] a challenge that we were facing that day. That could include math, but it could be any other thing as well. It was a safe place to talk and to share, and sometimes outside of that group, someone may have the same challenges [and] we could "bounce back" ideas in problem solving.

The PI faculty is firmly committed to the cohort. They encourage bonding between faculty and, just as important, between faculty and staff. The cohort encourages student participation, as one member of the math faculty explained, stating, "The cohort plays in tons. If I just pictured me randomly having students from PCC and try[ing] to do this class, I don't think there would be that same cohort buyin." Another faculty member observed that students are more comfortable and at ease in the math-anxiety class. He stated,

> Some people just don't want to talk in front of the group, but I don't see that as much in this class because there are only 20 of them and they get to know each other pretty well. They are comfortable talking in front of each other.

The faculty must act professionally and work within certain bounds, according to the following faculty participant:

> I totally believe [in] learning communities when they are authentic and there is caring and getting to know people. With reliability of the professionals, meaning they're [there] all [the] time, they don't step over the boundaries; I think that is transformative for all of us.

In order for the cohort to be a life-changing experience, one faculty member commented that it must be an immersion. The trust, camaraderie, and mutual support cannot be developed in one or two class periods. The participants must have time to develop rapport and trust, with each other and with the staff. He explained,

> For that first-year student, a cohort cannot be 2 hours a week. . . . It's not going to get the life-changing experience. . . . I don't internalize something that I do 3 hours a week, or that experience 3 hours a week, the way I am going to internalize something 15 hours a week, or even 6 hours a week in two classes.

Summary. PI supports participants as they discover their personal and professional interests through career guidance and life coaching. Various aspects of the program, such as the graduation, classes, and counseling, help to motivate students to begin or continue their postsecondary education and develop the necessary self-esteem and confidence. They become aware of their rightful place within the education system

and the knowledge and resources to successfully complete their education goals. The most poignant experiences were centered in the role models who spoke in their classes, describing lives and education experiences similar to their own.

PI participants have multiple resources at their disposal to help them "kick-start" their education pursuits. The PI staff and the Women's Resource Center are always available for counseling, life coaching, or casual conversation. The physical-education portion of the program teaches participants to care for themselves and to value physical health and stamina as necessities for completing their education. PI helps students learn how to apply for financial aid, navigate campus life, develop effective conflict management, and receive career guidance, as well as how to optimally react to life issues. Without PI, all but one of the study participants claimed they would not have survived the college experience and would have dropped from school. The cohort provided a base of peers from whom support could be drawn and to whom support could be provided. An awareness that others were depending on them was just as important as the strength and support received.

PI and the cohort are safe places, with a sense of community that allows each participant to overcome self-doubt and any lack of self-worth. A feeling of belonging and the right to attend school and achieve goals are perpetuated. However, as pointed out in an earlier interview quote, this sense of community and belonging within the cohort cannot be developed over one or two classes. It takes immersion for an entire term to develop a feeling of rapport and trust.

Theme 3: The Impact of Project Independence

Although this study was focused on the changes students made in their math learning over the long term, the improvements in math learning cannot be isolated from the overall impact of PI. This third theme was focused on how the participating students internalized and applied the concepts learned in their lives, their careers, and their education.

Academic future. Students of PI realize that their dreams can become reality. One study interviewee stated, "I can follow my dreams and accomplish them. Project Independence was definitely the key to my education." The students learn they have a right to, and a place within, the education setting. They have the ability to work and, if not to thrive, at least to succeed within the academic environment. Another interviewee stated, "In my core, I believed that I would never have a chance to do anything academically again. . . . It was Project Independence that turned me around." PI made the future real for another study participant who commented,

> That was one thing that helped me realize that I could do it, seeing other people that had been in Project Independence doing what I wanted to do, even though it seemed so far away in the future. I recommend it to everybody.

For another study participant, PI was a way to come back to school. She explained,

> Being older and not having been in school for a long time, there was a wide gap there for me, new ways of doing things. I didn't know about anything. I came on this scene here and Project Independence was a good idea because there were a lot of things that I was unaware of.

The participants in this study developed a belief in themselves and their ability to succeed. They developed a confidence and an understanding that they belonged in an academic environment and that their studies had purpose. For several, it was the first time they thought about their own dreams, their own goals, and their own success. These were not selfish desires, but dreams in context with their families and their community. One student commented, "Going through the Project Independence class made me feel more confident." Seeing others in a similar situation gave the following study participant hope:

> I think this gave me more of a belief in myself and my ability to do it. Looking around and hav[ing] more self-value and not see myself as "Oh, I'm this older person who has no hope." It helped me open my eyes and look around. There a lot of poor people in community college who are successful and it's possible.

Through PI, the following interviewee found school to be one way to better her life:

> It is way different than high school. You are here because you want to be here. You're not doing it because you have to be here or the truancy policeman will be after you and your family. It is a completely different experience; it's more of wanting to better your life rather than having a job your whole life [that you] don't really want but you have to have it to support your family.

PI taught another study participant the importance of perseverance and investigation. She explained, "First, that it is doable. Just like everything else: How do you eat an elephant? One bite at a time. . . . Project Independence opened my eyes to the importance of and the ability to investigate."

A faculty member opined that the PI program develops a sense of belonging. She stated,

> The other goal of the program—and this is something that I hear all the time each term—is to help students come to feel that they belong in college, if they choose to be, and on this campus. I hear all the time "I feel like I don't belong here."

For another faculty member, the program develops purpose, as she described in her following interview comments:

> Through the [current life-planning] class and that instructor, [a student] learned how to go to school with purpose. She did not say a purpose, she said *with* purpose. It was really important to see advisors. She said . . . in a way . . . it wasn't just "Yes, go see advisors, but each week, I go to school with purpose. I think about what I need to do."

Another faculty member summarized the PI experience as a chance for adult women to think about and further themselves. He stated,

> The other thing that women say over and over again is that this is the first time that I have really had a chance to just think about *me*; my life; and what I want to do, what I can do, and what I deserve to do.

Summary. Throughout the interview process, participants reiterated again and again that PI was the key to their education. All are adult students who had completed their formal education decades earlier. They had developed a belief in themselves and their ability to successfully participate within an education setting. They used the tools and resources they learned in PI to navigate the community college experience. They

developed a sense of belonging and self-esteem that carried them through. Although the study, classroom, testing, and coping skills they learned in PI were important, it was the life skills, confidence, self-esteem, and sense of belonging they most valued.

Findings

Exploring the experiences and attitudes of the students participating in this study, before, during, and after PI, allowed the research questions to be answered. The questions were formulated around the specifics of math-learning ability and how PI influenced positive change within this realm of learning.

Research Question 1

Research Question 1 asked, "Why do women participating in PI find mathematics to be an obstacle to their progression at the Portland community college serving as the study site in this research? The following transcript codes are related to this research question: early experiences, attitudes, disorienting dilemmas, self-efficacy, learning behaviors, and learning anxiety. Learning anxiety experienced by the study participants may or may not have been real. The majority of math anxiety is due to a lack of preparedness, as the following faculty member described:

> Most students have anxiety on the exam because they are not prepared. We have one day where we talk about anxiety, in particular, related to math. In my experience, there are few students [who] have anxiety just because of the math; it's really because they aren't prepared, so we do a lot of the talking about study skills, and the best way to overcome anxieties is to be really prepared for the

> exam, and then we talk about what you can do in terms of when you do get anxious.

For most students, negative self-talk plays a significant role in fostering anxiety and sabotaging the ability to learn math, as exemplified in the following excerpt from a student interview:

> My self-talk was that I was retarded. This tape played in my head over and over. A large number of us were really concerned about our ability to do math. We thought we were incapable of doing math, even those of us who felt somewhat confident in our academic ability. I didn't feel confident in any area, especially math.

Some of the study participants expressed an aversion to a specific aspect of math learning. One student stated, "I had come to feel that math is a very exclusionary process. . . . I had developed an idea that there was a narrow sort of channel that I had to fit in in order to do well." For another interviewee, fractions represented the barrier. She recalled, "Early on, I think it was pretty scary for me, especially fractions, which is pretty common." For others, it was testing. Another participant described this fear in the following manner:

> I came to PCC and took the entrance exam. I was so terrified. I had a major breakdown at one point and that memory is so "crystal clear" to me. I went to take an IQ test online, but I felt like I was so stupid, I was freaking out. I was terrified to take it and I didn't, but I ended up having a breakdown thinking about the fact that I'm stupid.

One student interviewee could not point to any particular aspect of math that she disliked, just that she disliked math altogether and could not see a need for it. She commented,

> I never enjoyed math in particular; I'm not going to sit here and tell you that was my favorite subject. It was never my favorite subject. It was something that I had to do, so I did it. You have a healthy attitude because I was taught to have that kind of attitude. . . . The attitude in every math class I've ever been in is "Why do we need this? When are we going to apply this?"

A "common thread" among the study participants was the early self-perception that they could not do math. As expressed by one interviewee, "I was very intimidated. I had very little confidence and, in my other classes, I excelled, so I was really frustrated with math." Consequently, although students may excel in other academic subjects, they frequently do not know the language of math. Finding it intimidating, female students frequently assume they are not sufficiently intelligent, or succumb to the stereotypical notion that women do not do math. As one study participant expressed,

> For more people than me, there is an emotional component to learning math that is about whether you are intelligent or not. That's how I grew up experiencing it. The really smart people could do math and could find a way to fit into that, and people who weren't smart could not.

Some of the study participants excelled in other subjects, but struggled with math learning. As one interviewee explained, "I've always been a good writer and speaker, but math, I always told myself I don't know the language; I will never be able to do that; I can't do it. My mind doesn't think that way." Another participant stated, "I don't think I

really applied myself [in math] as I could have because I felt like it was beyond my reach." Still another study participant commented,

> Math seemed very complex for me. Words, you can play with them, you can write them to make them sound good. Math is pretty straight forward. You are right or you are wrong, so you have to get it right. You have to know what you're doing because there is no gray area. There is no sliding scale, so to speak. . . . I just remember being really intimidated by math. Math was hard. It was something that I did the very minimum just to get by; it never excited me.

Math learning as "not a girl thing" was another common thread among the study interviews, as addressed in the following transcript excerpt:

> I didn't particularly love math as a kid. English and history were more the subjects that I was interested in. I honestly felt like math wasn't a girl thing to do back in the 70s and 80s. . . . We didn't see a lot of women going into engineering. Even though these programs encouraged me to do so, it didn't seem like the feminine thing to do. . . . If you're going to have a high-paying job, you are going to need to have the ability to go into chemistry or trigonometry, and that just seems so intimidating to me. I don't think I really applied myself as I could have because I felt like it was beyond my reach.

Another participant addressed the same issue in the following manner:

> I don't know where the thought or belief came [from], but I hate math. I'm not good at math; girls are never good at math. That was something that was part of

> my belief system and I'm not exactly sure where it came from. There was no math experience, probably just a bunch of little accumulated stuff over my lifetime.

The student participants in this study had issues and conflicts with their math instructors. One interviewee stated, "With that conflict [with my teachers], I just shut down regarding math. I was a nervous wreck." The math classroom became a time and place for conflict; students had difficulty asking questions, demonstrating learned principles on the classroom board, and following the math instructor. One student participant commented, "I have never been a person that was afraid to ask questions; I've always ask questions all my life. In math, I didn't want to be that person who didn't know the answer. I didn't want to be her."

Some students had good experiences with math early on and received helpful feedback from their instructors, feedback that helped either in their math learning or in their attitudes toward math itself. However, regardless of those positive early experiences, they questioned their ability with college math. The following interview excerpt describes learning math through practical application:

> I was essentially learning math from the time I was talking because I live in very practical environment. My dad was a commercial fisherman; we did everything with our hands. We were always learning math. We were counting things; it was being applied to life. "How many things go there? Take five of these over here and add them to those over there, and how many do have now?"

Another student was concerned about returning to math learning after a long hiatus, stating,

> When I did move to Mexico and had the teacher that helped me and pretty much told me that it was my choice whether or not [whether] I liked math and that I could do it, I knew I was, at one time, good at math and I like numbers, but I was nervous about getting back into the classroom for any class, but especially for math. I already had that background; I was good at it but I forgot it. Would I be able to remember the math, especially the fractions?

Relationship to the literature. Existing literature related to self-talk, testing and math anxiety, and attitudes toward math learning for women and minorities has been reviewed, but answering the research questions brought out additional aspects of math learning for adult female students such as the role of teachers and parents in early attitudes toward mathematics and the propensity to ask questions in math class. There is a distinct variance in the percentage of girls who dislike math compared to boys within the same age-group (Leaper, Farkas, & Brown, 2012). The gap is nonexistent among first-grade students (Harari, Vukovic, & Bailey, 2013); identified in fourth-grade students, and widened by the eighth grade (Bharadwaj, De Giorgi, Hansen, & Neilson, 2012). Attitudes at home, particularly the attitude of the mother, enforce the negative stereotype of math learning in girls (Wang & Degol, 2013). These gender differences extend into higher education and career choices (Shoffner, Newsome, Minton, & Morris, 2014), and the gender gap in terms of interest in science, technology, engineering, or math subjects continues (Vantieghem, Vermeersch, & Van Houtte 2014).

Jackson and Leffingwell (1999) published a seminal article on the role of math teachers in creating math anxiety, with only 11 out of 157 student participants claiming

positive experiences in their math classes. A more recent study indicated that contemporary women generally have a more positive view of their math-class experience while in high school and less anxiety surrounding math learning compared to men; however, they do report higher anxiety with math testing (Taylor, & Fraser, 2013). The results are mixed, with other studies indicating that girls are more likely than boys to have a poor view of their classroom experience (Dowker, Ashcraft, & Krinzinger, 2012; Eden, Heine, & Jacobs, 2013). The negative perceptions of math learning by women are fostered by both parents and teachers (Gunderson, Ramirez, Levine, & Beilock, 2012). The math anxiety levels of female teachers in elementary school have a direct correlation to the anxiety levels in their female students including how these female students perceive their own math abilities (Wu, Barth, Amin, Malcarne, & Menon, 2012).

One of the most important factors in math performance is the relationship between the student and the teacher (Mistele & Louis, 2011). Overall, women are performing better in primary and secondary math classes; however, the gender gap in math performance between men and women persists for those who actually pursue a career requiring mathematics skills (Cheryan, 2012). The bias continues among teachers and parents, attributing male math success to ability and female success to effort. The implication remains that boys are more gifted in math (Espinoza, da Luz Fontes, & Arms-Chavez, 2014).

Asking questions in math class was of particular concern for the participants in this study. Students can go to great lengths to avoid asking a question, skipping problems or giving a random answer rather than asking for help (Ryan & Pintrich, 1997). Asking

for help in the classroom is important to education development, and many students are reluctant to seek that help. Students would rather admit defeat than suffer the embarrassment of asking questions (Karabenick & Dembo, 2011). However, the ability to ask questions in a math class correlates to standardized achievement (Schenke, Chang, Conley, & Karabenick, 2015).

Engaged students are not passive learners, but rather, are actively engaged and perform significantly better in their education pursuits (Dunne, 2013). The practice of completing homework within the classroom and studying new material at home is referred to as *flipping the classroom.* It is a popular method used to humanize the classroom and provide greater opportunity for struggling and otherwise apprehensive students to participate and ask questions (Berrett, 2012). Although this teaching technique has been practiced over several decades, it has become recently popular as one of many methods to increase student engagement.

Summary. The participants in this study described many negative aspects to their early years of math learning such as negative self-talk, math testing and learning anxiety, fear of asking questions, negative experiences in the classroom, and conflict with their math teachers. Volumes of research and related methodologies have been published on the topic of flipped classrooms and engaged learners; however, the subject is beyond the scope of this research. The study participants completed their primary and secondary education before these teaching techniques were popularized. Few of the participants described themselves as engaged learners in primary and secondary school, actively participating in their math classes. Those who were interested and engaged in math

learning in the primary years, lost interest in mathematics through negative experiences at home or within the classroom.

Research Question 2

Research Question 2 asked, "How does PI help women acquire study, coping, and learning skills that improve their math performance at the community college?" The following transcript codes pertained to this research question: PI methods, math-teaching methods, cultural relevance, and community support.

The cohort. The cohort played a vital role to math-learning success. According to the study participants, it provided the motivation to endure and even succeed in the math-anxiety class. Participants were able to freely discuss their anxiety, self-talk, and attitudes surrounding math. Motivation in this class was not an issue. One faculty member explained that, as a cohort, the students were dedicated to the success of all members and, when one member was struggling, others would provide encouragement and motivation just as they had been encouraged and motivated through difficult periods. She also stated,

> Another thing that I rely on is that they are in cohorts and in other classes [together]. They are such a diligent, motivated group, unlike my normal math classes where I have to work on motivation, buyin, and all these things. It's pretty rare that I have to work too much on buy-in in Math 15. They seem to be very motivated. I can't think of anything other than the fact that they are already motivated, probably because of their cohort.

The participating students understood the benefit of the cohort in addressing learning issues in the math-anxiety class. One student interviewee stated,

> Maybe the difference with taking it [the math-anxiety class] with the Project Independence people was the fact [that] everyone is starting out at a place in life where most of them had not been to school for a very long time; another percentile had struggles in other areas. That was the difference. Staff members were also instrumental in encouraging students to take and complete their required math classes. Project Independence and the Women's Resource Center were places to go when these participants felt overwhelmed and directionless.

Even after the math-anxiety class, students benefited from follow-up counseling to maintain pace with their education plans and complete their math-learning sequence. Another student participant described her experience in the following manner:

> The project director brought it up. "Okay, you haven't taken any math yet." We talked about what was going on in my head. She basically said to me, "You have a 4-point GPA; you're doing very well. Even if you don't get an "A" in math class, you're going to be okay. There's no outcome of this that you can't get through." She basically brought up all of the ideals that have been instilled in us during Project Independence. . . . That's a great thing about Project Independence. They don't just push you out at the end of the term. They are not required to engage, but the support is definitely here. If we want advice or help, the director and all the instructors are really great. I've continued relationships with all of them.

When asked about taking the math-anxiety class as a standard college offering rather than with the cohort, all of the interviewees stated emphatically that the cohort

made a difference. One student interviewee commented, “Yes, [the cohort] plays in tons. If I just pictured me randomly having students from PCC and try to do this class, I don’t think there would be that same cohort buyin. It would not have been the same.” For program participants, the academic and attitude changes would not have been as significant without cohort support. One participant stated,

> When I had fear or apprehension about math, I would have all these classmates to talk to and to work through these issues. We were going through the same thing I was. I think that, if I just came in randomly, I would not want to admit [to] anybody how fearful I was; I wouldn’t be comfortable with asking for help. I would be so worried that I would appear stupid. I have a lot of anxiety around it. . . . We were all working on the same goals together. It wasn’t like classes where we were in competition; we all want to do the best. There, it was more of a situation where we want everybody to succeed; it was important that we all do well.

Another participant echoed this viewpoint by stating,

> It did make a difference. It totally made a difference. It was key. . . . We had support from each other. That was intentional. This is an intentional learning community of people. To just go into a class not knowing anybody, people are trained and programmed to stay isolated in that individuated way. You really have to “push on the wall,” and that wall was already dismantled.

The cohort support allowed one student to explore her negative beliefs surrounding math learning. She offered the following interview comments:

> It made me feel less shy to ask questions. I knew the girls that were in the class. I do think that it really helped me because I was able to explore some of my negative beliefs about myself and about math. I was able to talk freely because I knew the women. . . . It made [it] a lot easier to get in there and say, "I think I'm done when it comes to math." It's like a foreign language to me and I'll never understand it. I don't think that I would've been able to say that in another class with people that I didn't know or just met that term.

The cohort support helped participants remain in the math-learning program, even when they were discouraged about their progress. As expressed by another student participant,

> Even if you got a little overwhelmed or off track, there was always going to be someone there on your left and on your right, saying, "No, we are going to this class or that. Did you remember to bring your homework?" The balance was really good.

The math-anxiety class. Three themes drive the PI math-anxiety class. The first was determining the math identities of the students, their attitudes surrounding math, how they relate to math learning, and what makes math fearful. According to one of the math instructors,

> The big picture is trying to work on the students' math identity. If they come in with a weak math identity, that means they feel uncomfortable with their success in math. . . . Surprisingly, some of them come in with a strong math identity, which is good because they can help the weaker ones in class. The main goal of the class is to get people to walk out the door with a strong math identity: "I may

> not like math, but I can take these classes if I need to for my particular goal."
>
> This [was] mostly just the conversation of talking about math and realizing that there are people that are nervous, as well as them, about math, and [there are] people who are less nervous about it. . . . I [can] tell the ones who have weak math identity; we can really talk about math-specific study skills. For those who have a high math identity, the goal is for the class to be broad enough that they will find study skills they can use.

The second theme that drives the math-anxiety class concerns study skills and the need for students to be self-motivated. These skills include organization and note taking, problem solving, classroom skills, and study skills. This theme is covered in depth in the answer to Research Question 3 and discussion of the various study and coping skills taught in the math-anxiety class, as well as the long-term learning strategies adopted by the student participants. The third theme is learning styles. This is not discussed and reviewed at length. As a faculty participant stated, "It's just a daylong theme, not really study-skills related." Learning styles include those auditory, kinesthetic, and visual in nature. As one student learned, "There is always one right answer, but there are many ways that you can learn it. There are many learning styles. There are different formulas, different ways we can break it down." Another program participant commented that learning styles are also pertinent to selecting a math teacher. She explained,

> The way that we examined aspects of learning styles such as auditory learners, kinetic learners, and visual learners, that gave me insight into my own learning process and math became engaging to me again. . . . I've had different teachers

> who were all very different from each other here at PCC. As a teacher, he [the math-anxiety instructor] has a unique ability to be able to be in front of a class and have a unique connection with each student. He was very gifted to be in touch with individual learning styles.

Learning styles are important to the academic success of students. Students cannot always find the ideal teacher who is conversant in their learning style. As explained by one faculty member, the students of PI are taught coping skills for these situations as well. He went on to state,

> We talk about math teachers, learning styles, and teaching styles. Ideally, you want to find a teacher that matches up with how you like to learn, but that's not always possible. Sometimes, the only time that fits for you is this particular time. Everybody has been in that situation; you end up with the teacher who is not the best fit for you and what [do] you do in that situation? Do you just quit? Maybe that is not ideal for getting your degree. There is a chapter in the book that we use that talks about, what if you're in a non-ideal situation? What can you do to make sure you are still getting something out of the course, you are still succeeding?

The instructors of the math-anxiety class use multiple resources and formats for teaching classroom, study, and coping skills. One student participant spoke to this in the following interview excerpt:

> He had us go online; there were short tutorials about study skills and where we can go for help all around the campus. I believe that the woman who does these tutorials is from PCC. She talked about the resource center. That helped a lot.

Student perspectives on the various aspects of math learning are developed through group sessions, interviews involving probing questions, field trips to the various campus resources, videos, tutorials, and other online resources. The math-anxiety class is not about math, but about math learning. As described by one student participant,

> He showed us videos; he basically gave us that information verbatim. We journaled [and] he had open class discussions. He opened up the mystery of it. I always thought that there was a mystery that girls couldn't do math. That was a big belief system. He challenged that. Why not? He asked us those questions. . . . He asked us direct questions. "Why don't you think you can do math? Why do you think it's hard for girls to do math? What [does] this come from? Write about that. Write an assignment about that. Tell me where that comes from." He gave us different information to challenge the way that we thought.

Students are presented with skills and techniques that empower them in the math class. They are encouraged to maintain journals on their math-learning experiences to help them transform bad attitudes and behaviors into positive characteristics. Homework is assigned that entails reading and a simple writing task. While in the math-anxiety class, students are talkative, engaged, and motivated. As described by another student,

> "Let's talk. Let's figure it out together." You feel a part of it. Sometimes, when I go to a class, I feel like a teacher talks at me. He made me a part of the solution. He made me feel more empowered than just, "Okay, I have to sit here and receive everything you have to say." He said, "No, I'm not going to give you all the answers; we are going to plug into each other and [figure] it [out] together."

In the following interview excerpt, a student participant described the support of the cohort as they helped her to talk about her math-learning fears:

> Normal classes are very competitive. "I know the answer; I'm so smart." You don't want to say anything to make yourself sound stupid or sound like you don't know what you're doing. If you open your mouth, it's because you know the answer, but in this class, we were invited to open our mouth[s] when we didn't know, and talk about why we felt we couldn't do it.

Although the efficacy of math-anxiety and math-learning classes taught out of context with actual math learning has been questioned, for the students participating in this study, these classes were safe places to develop math-learning skills and attitudes. One student commented,

> It was a class that didn't require tons of homework; it was more about learning skills and techniques that were verbally communicated to us, and we practiced them there in the classroom. We got a handout or sheet to take away to help us to remember it. Actually I was able to show it to my children to help them in their math class. The book was simple enough to introduce the concepts without being overwhelming. It helped me to refresh the brain; it had been many years in my case. It was a very positive, encouraging, and nonthreatening environment to learn in.

This informal and nonthreatening learning environment was also described by one of the math faculty in the following manner:

> I just walk around, making suggestions. I hand back their homework; that takes 5 minutes. I make suggestions. I just chat from group to group. This is totally different than most of my math classes. It's a very talkative class, engaged. They have buyin from the start. . . . By the way, in Project Independence, all the classes are quite informal and there are no rules about talking too much. The rules that exist in a regular math class just don't exist there.

The math instructor. Observing an example of a good math instructor allowed the students participating in this study to set expectations for subsequent math classes. One of the students reported, "He had a perceptive capacity to engage each student, to be aware of us. He could see when someone was distressed. He had the ability to engage that and to help us." The experience of learning under a talented instructor, adept at teaching to different learning styles, gives students the practice to handle a less ideal situation in the future with a teacher to whom they are having difficulty relating. For one study participant, it is important for the instructor to be approachable. Exemplifying a teacher she viewed as highly skilled in this regard, she explained,

> He is so approachable. That is one of the elements that helps people because you have to be approachable, whoever you are. You have to make it inviting. A lot of math instructors are so good at math that they forget that I am not. They love math so much that they forget that some don't. Our instructor understands that everyone doesn't love math. His aim is to try to make you at least like it and not be afraid of it. . . . He was very careful to make sure that he reiterated over and over again, "No question is dumb. You don't need to feel ashamed. You are not

> alone." He made sure that people felt comfortable asking questions. [He would say], "Don't shrink back. It doesn't matter what, raise your hand and I will answer you; no question is dumb."

Another study participant valued the ability to explain a concept in multiple ways. She described one such teacher in the following manner:

> He, as a teacher, had a unique ability to be able to be in front of a class and have a unique connection with each student. He was very gifted to be in touch with individual learning styles. In a lecture, he could explain the concept in the way he would think about it and then it was like he was speaking three or four languages. [He would say], "First, I'm going to translate it this way; then I'm going to translate it that way." His process of inclusion was so developed it didn't leave much room for people to fall outside of that net of understanding.

The math instructors themselves realize the importance of placing good role models in front of students to allow them to become comfortable with a math instructor. One participating faculty member commented,

> They may also be scared of math teachers, so another valuable part is to actually have a math teacher in front of them for 9 weeks who they get to know and realize we are not some "evil monster," and they can get comfortable asking us questions and things like that.

Students are responsible for their learning and, although it is not always possible, they will, ideally, seek instructors who match their learning styles. As one student reported,

> We talk about math teachers, learning styles, and teaching styles. Ideally, you want to find a teacher that matches up with how you like to learn, but that's not always possible. . . . You need to take care of yourself; your learning is your responsibility. I have experience with different math instructors and the typical things they might see, but a lot of it, again, is being a student and learning how to be a student.

Students attending the math-anxiety class take several field trips or "scavenger hunts" on campus to find resources for math success. It is one thing to talk about the resources; it is another to take the students and introduce them to that resource. For example, they visit the learning center and are introduced to the center staff and tutors. They are more likely to use a resource if they have had a firsthand introduction to the people and their physical location. For the majority of the study participants, the scavenger hunt to find campus resources was a productive and enjoyable experience. The experience of one interviewee was described in the following transcript excerpt:

> We went on a scavenger hunt where we went around and tried to find all the resources that could help us. . . . We made posters in groups of what we found around the campus—the underground, the student center, something that somebody who is just coming to school wouldn't know was there. He gave us markers. I felt like I was in elementary school; it was a lot of fun. We had markers and stickers. We were in six groups and we put our posters up on the whiteboard and we discussed what we found.

The instructors show the students firsthand how to use the learning centers, as described by the following faculty member:

> It's a 5-minute rundown of best practices at the learning center. First, I show them how to sign in. Second, I show them how to get a list of tutors, then I tell them what they really should do is keep this list in hand and start circling the tutors that are appropriate for their level because not everybody can tutor [at] the same level.

For nearly 50% of the math-anxiety class sessions, the instructor divides the class into random groups, which is a technique known as the *jigsaw*. If students remain in the same group throughout the term, the stronger personalities may dominate, leaving out voices from the less gregarious members of the group. A faculty-member interviewee explained,

> The main reason I do it [the jigsaw] is because this is what I do in my actual math classes. I use playing cards to put people into groups. If you get an ace, you go to Group 1; if you get a 2, you go to Group 2; if you get a 3, etc. They are just random groups each time. That way, one person doesn't take over a certain group. If you have the same group for a long time, one person can take over the group and just give the answer. It might be important to the learning process, it might not. I've never played around with it too much.

In these group sessions, the instructor encourages stronger students to remain engaged by helping those who are struggling. A student participant described the experience in the following manner:

> We did group work, which is nice. I have since been in classes that do group work, but one thing our instructor explained that I never heard a teacher explain since is that we went into small groups to do small-group activities. He explained the benefits of there being unequal levels of skill. It was important that there were people who were not very confident in the same group with people who were overly confident. Overly competent people really needed that engagement. You can lift some people up, and people who are already skilled, it helped him develop other skills of perception and intuition in teaching and helping, which made their math stronger. He described it as a "win-win" situation for everybody.

The math-anxiety class is designed to give students a "taste" of success. As one student described the class,

> It wasn't so much doing math as [it was] exploring math as a phenomenon and different ways to engage in it. I could totally get into that. It gave me a point of reengagement, I have some control here. That was cool.

The success must be genuine, and the class is set up to help each student make progress in developing their math identity and math-learning skills. For the following study participant, a taste of success at her level of math learning grew to a self-belief that she could succeed at math:

> He would give us work that we were able to do and, if we were not able to do it, he would take it down a level until he would get to our individual ability and then let us build on it by giving us something a little bit more difficult but along the same line. He allowed us to get success. . . . I usually end up getting frustrated, I

> feel stupid, and I shut down. It seems like nothing else is going to "sink in." I have stopped figuring it out. Everything else being thrown at me might as well be in a computer language. This [math-anxiety class] got me to a place where [I] felt like it was something I could tackle. This allowed me to succeed, succeed at my own pace to build a foundation of belief that I could do math and then move forward.

One instructor brought math problems into the class, subsequently working with students until they achieved success. For one participant, being prepared for a math quiz was a positive experience. She recounted,

> We broke the problem down and we were all able to follow through and complete this math question. When it was done, he said, "Well, you're doing algebra right now." Basically, he got us to do a problem that we all felt we could do. . . . He allowed us to have success and do something we were comfortable with, but we were moving forward. . . . He gave us a pop quiz covering basic algebra stuff. It was . . . really stressful in the sense that it was a pop quiz and we were having to do actual math. I felt like I had studied for it. I went ahead and did it and it turned out we had [been] totally prepared for this.

The math-anxiety class was less about learning math as it was learning how to learn math, which involved addressing fears, experiencing success, learning basic math vocabulary, developing learning styles, practicing time management, completing homework, and developing coping strategies. Repetition was an important concept. One student participant explained, "There are certain things that were presented to us that

helped us to redefine what was necessary to do well in math, like repetition—frequent repetition—and managing time around when that experience would happen." Learning and practicing these skills in a nonthreatening environment provides an opportunity to implement the skills that succeed in future math classes. The class gave the following study participant the ability to examine herself and her math-learning anxiety:

> The class that we took was about math anxiety, so it was more of a philosophy class than a math class. This was very helpful. It made me look at the fears that I was having over math, and sometimes we have so much fear over something that we will not complete that something. . . . Project Independence gave us the tools to be able to look at ourselves and get over our math anxiety.

Simple study habits, such as reviewing a lesson and lecture the same day it was delivered, are important skills to the following study participant:

> In study, it's . . . very important to review the lesson and the lecture that same day. We would have quizzes and worksheets about that. It was to ingrain those ideas [in] all of our minds. It was very helpful; I wouldn't have just done that by nature.

For another student, it was learning the basic vocabulary and order of operation within a friendly environment where she learned to ask questions, as described in the following interview excerpt:

> He reviewed the basics—math vocabulary, what an exponent is—but a lot of us have a fear of appearing stupid. He taught us the basic vocabulary in a nonthreatening environment so that we could ask questions and not feel stupid.

> We could take that knowledge forward with this. That was really important to my learning process and I think to the learning process of the other women in the class. We reviewed basics like the order of operations.

Significant portions of the math-anxiety class were dedicated to reducing math and text anxiety. Coping strategies included breathing techniques; test preparation; and accommodations for taking tests, asking questions, taking notes, and being prepared. The math instructors taught the students to identify causal factors for their anxiety. One method was described by the following faculty member :

> You write down lists of why you're scared [and] enumerate them 1 to 5—5 being super scary. Over a few weeks, read them again and try to think of ways to bring the numbers down and make them more rational.

Math instructors are not out to fail students, but are interested in student success. In fact, it is harder to grade the test of a student who is doing poorly than the test of one who is doing well, as is reiterated in the following interview excerpt:

> The instructor is not out to fail you; they are not out to purposefully trick you. A lot of times people think we put trick questions on an exam. It is not about trick questions; in fact, it is a lot harder to give a grade when somebody is not doing well than when they are getting it all right, so we do want people to do well.

For one participant, knowing she was not alone allowed her to move forward in math learning. She offered the following interview comments:

> The teacher showed me that it wasn't just me that had anxiety over tests. I would worry about the time [and] noises. He taught me to sit back and take a breather. If

> you can't take a test in a roomful of people, then talk to your instructor; let them know you need to go somewhere else to take the test. I can't do it with background noises. Our instructor really helped. He made me feel comfortable; don't be afraid to ask questions. Record things, if you don't get it, don't be afraid to raise your [hand] and ask questions. There's no such thing as a dumb question, just ask. If you don't get it, let them know you're not getting it.

To learn that she had the ability to challenge her anxiety and concepts of math learning was a positive and surprising experience for this participant. She went on to say,

> The first part of this class is talking about our anxieties about math, challenging our belief system about math. "What do you think about math? What do you believe? How can you challenge anxiety about math?" I was really surprised at his approach. The things that he taught us about math had nothing to do with numbers at all. It was about changing the way we thought about math. . . . Yes, it was dealing with your anxieties, your negative belief system. Your personal experiences affect why you think that, challenging those beliefs. It's about building up your confidence with math, not being afraid to tell a tutor or teacher or even yourself, "The way that you are teaching, or the way that you are explaining to me, I'm just not getting it."

Test preparation is a particularly important subject; hence, portions of several class periods are used to reinforce test-taking skills. Preparation begins 2 weeks prior to the exam and continues up to and beyond the exam itself. One instructor described the class period intended to prepare students for exams in the following manner:

> Week 6 is exam day. They get another breakout and the idea is we have an exam coming. Group 1 [is to] figure out what we should be doing 2 weeks before the exam. Group 2 [is] what we should do 1 week before the exam, etc., all the way down to what do you do during and after the exam.

The math-anxiety class is centered in empowerment. One student described the class in the following manner: "My best experience was more of an overarching experience. It was coming to understand how I learned. . . . Everything was relevant and supportive, and I'm dealing with it out here in the math world." Students typically approach their education and career pursuits with a "can-do" attitude. They perceive mastering the necessary skills and accomplishing their goals as within their reach. One interviewee reported,

> They had us examine our own fears and our own past experiences with math. They had us look at careers that might be able to change the world. This is a huge drive for women, careers that involve math like civil engineering. It's the desire to do something that drives us to want to use math. Project Independence made math look like practical applications in the world.

The feeling of empowerment and the notion of succeeding in math learning manifested through the math-anxiety class and the overall PI experience. Another student interviewee explained,

> It wasn't the experience, or one particular thing that our instructor said; it was the way he made me feel. I will never forget. He made me feel empowered, he made me feel confident, and he made me feel that I could do it. That is something that I

> will take with me forever. There is not one epiphany, one moment, one exercise that he made us do in class. I can't remember those things, but I remember the way he made me feel.

Relationship to the literature. Community colleges invite and enroll a diverse population of students; however, only 28% of those enrolled graduate with a degree within 4 years (Burrus et al., 2013). Although enrollment percentages have increased for all ethnicities and classes, minority students continue to lag their Caucasian counterparts (Aud & Fox, 2010). To combat these statistics, community colleges are focusing on programs and processes to encourage student retention. Students who are engaged in their community college education are emotionally and cognitively committed to learning and actively participate in the community college process (Rocconi, 2011; Zepke, Leach, & Butler, 2010). One aspect of retention is to encourage student engagement through social relatedness, and one intervention fostering social interaction is the cohort, which enhances the social climate and peer support (Allodi, 2010; Beachboard, Beachboard, Li, & Adkison, 2011).

The academic success and achievement for minority and first-generation students at the PI community college improves as these students develop friendships on campus (Przymus, 2011; Rodriguez & Buczinsky, 2013). Learning communities improve grades and increase overall college retention (Popiolek, Fine, & Eilman, 2013); consequently, schools are using these communities to enhance student involvement and increase student completion rates (Andrade, 2007). PI implements the concept of the cohort to facilitate student engagement by encouraging discourse between students and teachers, motivating

students through peer support, and developing a sense of citizenship and belonging (Chambers & Poock, 2011; Clark, 2012; Zepke & Leach, 2010). Students in PI are immersed in the program for one school term, and this immersion encourages social interaction that results in improved self-esteem and enhanced cooperation (Senior & Howard, 2014).

African Americans and other minorities report a diminished sense of belonging within a college setting (Johnson et al., 2007). Early in their college careers, these students must overcome their misconceptions of the community college and discover and learn to use the available college resources and infrastructure. This will undoubtedly change their personal attitudes with regard to their ability to succeed (Miranda, 2014). Students engaged in their education learn from the experiences of others, integrating those experiences with their own personal experiences. They continuously improve their study habits, note taking, and listening and problem-solving skills. They confront and expand their perceptions of the world, their sense of belonging, and their views regarding their ability to impact the world. They understand the importance of their education, their ability to achieve their education goals, and their right to participate within the community college environment (Marzano, Pickering, & Heflebower, 2011; Pittaway, 2012).

Learning communities work best when they enhance the community experience with counseling and training in academic skills (Wurtz, 2014). Frequent interaction with faculty is also a strong predictor of student success (Lundberg, 2014). Matching students with faculty mentors and counselors early in their education process allows students to

experience improved interaction throughout their college careers (Fuentes, Alvarado, Berdan, & DeAngelo, 2014). Peer-to-peer interaction and engagement is as important as these staff connections (Love, 2012), and cohorts facilitate the creation of both personal and academic support networks (Visher, Schneider, Wathington, & Collado, 2010).

The nontraditional adult student is becoming more commonplace, and optimal methods of encouraging engagement in the community college differ for adult students returning to school (Gibson & Slate, 2010). Designing an efficient course of study and focusing only on the classes required to complete a degree or certification may not be the most desirable path. In addition to social interaction and engagement, perceiving value in their education goals is important to these students (Gilardi & Guglielmetti, 2011). Noncredit courses, such as career guidance, physical education, and other prescriptive courses, can enhance the education experience and improve retention and graduation rates (Cowie & Hamilton, 2014; Johnson, 2013). PI incorporates career guidance and academic advising to help students understand course offerings and to foster career commitments, both of which enhance student learning and college completion rates (Barovich & Reeves, 2014).

Time-management training improves student success in college (Nadinloyi, Hajloo, Garamaleki, & Sadeghi, 2013). These skills are more important for part-time students juggling diverse responsibilities than for full-time students with a more singular focus on their education (MacCann, Fogarty, & Roberts, 2012). This is especially true for college students with their own children who must balance life as a parent, student, and family provider. With this added stress, the development of coping strategies focused on

time management is critical. This could include studying with their children or finding a quiet place, free from distraction, where they can better concentrate on their studies (Peterson, 2014).

More than any other subject, math can pose a significant barrier between students and a community college degree or certificate (Bryk & Treisman, 2010). Of students referred to a remedial math course, 30% never enroll. More students fail to enroll in this course than actually attend the course and subsequently fail or withdraw (Bailey, Jeong, & Cho, 2010). Learning communities have been successfully implemented at the community college level to enhance learning in developmental math and cooperative-learning techniques. Students work toward a shared goal (Hansen, Meshulam, & Parker, 2013; Hodara, 2011; Weissman, Butcher, Schneider, Teres, Collado, & Greenberg, 2011).

Summary. PI is grounded in the cohort as a way to foster peer-to-peer and student-to-faculty support. For the math-anxiety segment of the program, students arrive in their cohorts familiar with each other and motivated to mutually support their success. Many community college students never enroll in the recommended foundational math classes; however, the staff of PI are instrumental in encouraging enrollment and completion of foundational and degree- or certificate-required math courses. In the math-anxiety class, students come to understand their math identity and work to improve that identity. They are not asked to like math, but they are asked to leverage the support they receive to reach a point where they have the confidence to succeed. Students are taught optimal study habits and test-taking and coping skills to facilitate their math success.

They are encouraged to journal and are introduced to the various available campus resources. These include the learning center and center math tutors, the Women's Resource Center, and various other departments and programs on campus.

The PI math-learning class leverages the cohort and uses group sessions to help students interact, participate, and provide mutual support. Another purpose of the math-anxiety class is to expose students to a math teacher who projects a positive role model for student-teacher interaction. By learning to work with a talented, motivated, and approachable instructor, they can subsequently apply learned interactive skills in later math classes. The instructor takes the students on field trips to personally introduce them to the available campus resources. They are more likely to use these resources after physically seeing and interacting with the departments and respective staff. Students "taste" success in this math class, even if it is success in learning how to learn math. They learn the tools necessary to confront their fears.

Research Question 3

Research Question 3 asked, "How do the women participating in PI apply the skills and knowledge they have learned to long-term improvement in math performance?" The following transcript codes pertain to this research question: math testing; problem solving; and classroom, coping, study, and organizational skills.

Test preparation. Test preparation was an important topic in the interviews conducted for this study. Prior to the introduction of PI, many of the participating students did not know how to prepare for an exam, nor what to do once the exam started. One interviewee commented, "In math, it's not just about reading it, it's about doing it,

and so you have to practice and practice and actually physically do problems to get ready for a math test." PI students learn to study in an ongoing manner, devoting time on a daily basis rather than "cramming" for an exam the preceding night. Another student stated,

> A big part [of test preparation] was daily study. I am revisiting that over and over again—consistent study. I have a big test coming up, I will do even more study, but I study all term long. I don't just do the assignment and I'm done; I go over my notes and really study all of the material. I do that continually.

PI students learn to create their own exam study guides by selecting and writing down problems that are particularly difficult for them or that involve an important concept. A student interviewee explained,

> When we see a question is really hard, one that we needed help on, even if we solve it ourselves, it is something that we spend extra time on. We should write that problem down, as well as the answer, in separate places—one page for the problem and a page for the answer. We should do that throughout the term. When you get to midterms, you already have a premade pretest and study guide. On the answer sheet you made, you can put down learnings or tricks. I have used that ever since then and it has been very helpful. I have major test anxiety, especially when it comes to math. I was able to do very well in all my classes.

With each math problem, the students would note helpful things they had learned to solve that and similar problems. It is important to repeatedly work through the problems to reach their solutions. Attending a PI review day is an excellent way to obtain help with

particularly difficult problems. Even when students have confidence in their knowledge of the material, participation in review days is important because the instructor will often provide hints and tips regarding problems that will appear on upcoming exams. The following study participant learned to use the pretests and chapter tests in the book as a way to prepare for a math exam:

> I go over my math notes, the sections that we are doing. If we're doing primes or factoring, I'll open my solution book and have my math book on top and I will do the pretest—the chapter test of the book—to prepare me for that.

How to take a math test was another concept the study participants internalized. Keeping a positive mental attitude through the exam is important. As one student commented,

> Do what is comfortable for you. He gave us a lot of material to show us how to do tests. Don't stress over the first question. If you don't get it, move on to the next question, then come back to what you don't know. If you don't get it, don't even sweat it.

Another student participant implemented the techniques she learned for taking a timed test in the following manner:

> If it was a timed test, in which case you go through [and] answer all the ones you know [then] come back later to the harder ones. If it was a test where a guess is better than no answer, the book covers how to make an educated guess, the best guess.

Sometimes, even an educated guess, where you can eliminate one or two false answers, makes a difference. PI students also learn to check their work, as explained in the following interviewee excerpt: “I check three times to make sure I didn’t make a mistake. I just had an exam yesterday; we had the whole class time to do it. I make sure I took almost the whole class to go over it.”

The participants in this study had little training at home or during their primary and secondary education on study skills. Study time is important, and the mechanics of how to use that time is just a crucial. One interviewee stated, “I do not stay up all night to finish an assignment. I will do it bit by bit before the assignment is due. I don’t work myself to frustration.” Studying for a math exam is different from studying for any other subject. With regard to cramming for an exam, one student learned, “With math, it was made clear that, in order to do well in math, it would be better to prioritize smaller amounts of time every day than to do a 5- or 6-hour study session.” To study math every day during the term is the most effective. As another interviewee commented, “You lose a lot of information if you wait 2 days before you start on the homework.” The study participants learned that repetition helps solidify math concepts and recall of the mechanics of working a problem. Another student stated, “That repetition allows everything to “stick.” What’s great about math is I’ve had some success in math and I have learned. I’ve had success in my math class overall that has carried into problem solving.” One student participant in the study who struggled with math homework described the study techniques she learned in the PI math-anxiety class in the following manner:

> We focused on the idea that studying for math is not like study for any other class. If you study for psychology or sociology or even some of the sciences, you're okay to study three or four times a week. Math is a situation where you need to spend some time on your math every single day. . . . Ideally, after your math class, you should go through that day's lecture. You should go over the homework you were assigned, or at minimum, at least going back over your notes and work out the examples from class. Doing that is super important; you have to build onto your studying. It's something that requires consistency in order to master.

Another student interviewee expressed the importance of homework in the following transcript excerpt:

> I can't just look at the book and . . . go into class and think I will be prepared for the test. It's important to do all my homework. . . . Nine times out of 10, the teacher never really checked the homework in college classes. They assign it and then test you on it. A lot of people, myself included when I get very busy, think the teacher's not going to take the homework so I'm not going to do it. I notice a difference in how well I do on a test. I learned to do my homework. Doing homework is important [and] reading all the paragraphs before I do the work is important.

Study skills. Finding and using available resources when struggling with a concept or specific math problem is another study skill learned by the PI participants. A study interviewee stated, "Study skills. It was a solid refresher on study skills, making sure that we actually accessed the resources that were available such as the math tutoring

and the Web sites." Finding tutoring resources and a tutor that best fits the learning style of the student is also important. Study groups facilitate mastery of difficult math concepts. One student participant commented, "Knowing to go to the learning center and getting that extra help, forming study groups, that was another thing we were taught." Using the examples in the text to learn how to solve the problems relevant to each math section was also expressed as an effective study tool, following the steps in the example and writing them down. As another student explained, "I learned the best by looking at examples already done, breaking it down step-by-step and being able to write those steps down, following and reproducing the problem. That is how I learned early on."

With other academic subjects, learning weakness in one chapter can potentially be ignored; however, math builds upon one concept to another, one chapter to the next. Students must master the concepts of each chapter before progressing forward. As one student participant stated,

> If you're in a sociology class, some concepts you don't get, but you can just move on to the next chapter and that concept will end up being, for the most part, irrelevant because you are focusing on some aspect. But for math, everything builds on the section before it, so he stressed the importance of making sure that you understand.

In a moment of humor, another study participant described the smart people she recruited for her study groups in the following manner:

> I try to get together with study groups if I can. I find somebody that knows a lot more than I do. I think that's a really good idea. Make friends with smart people, people that are smarter than you or at least people that may be struggling as well.

Reading a math book is unlike the textbooks of any other academic subject. Every word is important, and progression to the next concept cannot be initiated until the problem at hand is mastered. This factor is exemplified in the following interviewee comments:

> He also taught us how to read our textbooks. These were different approaches than I'd had in previous school experiences. I would read a problem and do the problem, but he taught us the importance of reading every word in the textbook on whatever chapter we were assigned. There was a lot of good information in the text [that] a lot of people, myself included, would've missed had we not been guided towards it.

Learning math is more than just memorizing information. PI participants learn to master the information and make it a part of them. To do this takes time, careful reading, and repetition, as is evident in the following interview excerpt:

> There are many courses [where] you just try to jam what you can in your head and spit it back out, but for math, [you] really have to be able to retain that stuff. It's not just bringing in information and putting it back out; it's bringing in information and making it a part of you, information that can be of use over and over again.

Learning how to study effectively while preparing for math exams is not enough; it is important to set aside sufficient and organized time for studying. This was addressed by the following student participant:

> The push to get organized and not be so scattered was really helpful. There's your binder; you need dividers. They [are] really structured and laid . . . out so that, if you had never ever been to school before, I would tell you this is a good way to get started. It sounds very basic, but if you had not been in school for 20 years and you're just scatterbrained, that was helpful for me. . . . It was literally walking through the organizational steps. Here's your binder; label it this, set up your pages. They literally said this is how you need to set up your information.

The study participants learned how to use a day planner and organize their notes and assignments into binders, complete with dividers for each subject. As one interviewee explained,

> I also organize all of my work chronologically. . . . I have the notes in the assignments, a quiz, whatever all the stuff that is covering the same specific subject, I keep together. That's how I organize myself. It is functional and easy to use, a tool for studying. When I review that area, I have all the stuff that I need.

Study participants were encouraged to take these organizational skills home, as another interviewee revealed in the following excerpt:

> They showed me how to schedule things. I write things down in a day planner, which I have never done before. Now at home, I have a huge whiteboard in which I put down all my notes: "Do the homework for this class by this date." I have

> four different calendars in my house, throughout the house, so I see them every day.

The students found ways to be accountable. The experience of the PI cohort taught the study participants how to develop peer support, which they implemented in group studies for subsequent math classes, relying upon each other for motivation. One student commented,

> One of my challenges, personally, is procrastination, and there was a lot of emphasis put on that. Accountability—working with a team—really helped. Because you knew you are going to see folks or even just talk to them, they would ask you; folks get this done.

Classroom skills. The study participants also learned and internalized classroom skills, how to make the most of classroom time by asking questions and actively working and reading to understand the concepts of the day. They learned to take notes to ensure they retained the concepts learned in the class. As one student explained, "The note taking is big; I take notes every day. My notes are bigger than my homework folders. I write down everything. Everything that teacher has to say [that] I believe is important in one way or another." Another study participant understood that the note-taking skills for a math class are different. She stated,

> There were some basic techniques such as taking notes in math class. People are usually taking notes in the English class or history class, but actually taking notes in a math class to make sure that we understand what the teacher wants us to answer in a sentence format versus just [putting] your basic things down.

Another student pointed out that, if the teacher repeats something, it must be important. She recalled, "He gave examples; he constantly repeated himself. If the teacher is repeating himself about something, then write it down. It will show up on a test or he will ask you about it later on. Write it down." Another point repeated in the study interviews was to not be afraid of asking questions nor of asking for a different approach to explaining a concept. The majority of math teachers are able to explain what they are teaching in several different ways. The study participants learned how to use their math instructor as a resource for their math learning. One interviewee explained,

> Communicating with the professor. We were very much encouraged in the math class and in Project Independence as a whole to use our instructors—not to be afraid to say I don't understand something because you we don't want to look stupid. The instructor is there because they want to teach. They went to a lot of school to be an instructor. Tell your instructor that you don't understand something.

Asking questions was a theme that emerged repeatedly throughout the study interviews in a manner similar to the following transcript excerpt:

> What did help me was being comfortable asking questions about math. Everyone gets to a point where they feel as though the rest of the class has passed you by. You're the only one who doesn't have the answer. I know everyone else knows the answer to this. . . . The moment you decide that you should not ask that question, is the moment that you end up getting "stuck and spinning" in one area. You can't come out of it. You have to ask those questions.

The study participants learned to get over the stigma and shame of asking questions in class, as is evident in the following interviewee comments:

> I realize that there are no stupid questions; this is a big thing that he taught us. Raising my hand while sitting in front of class, making myself believe that I can do it. It wasn't impossible; I could get it. . . . When I did ask questions, it opened up a box for other people [in] the class. "Yes, that's a good question; I'm struggling with that too. "That made me feel better. . . . I felt really shamed when it came to not understanding. "Okay, I don't understand that, can you explain it to me again?" It became second nature. The teacher actually had another three or four ways to explain it to me. He had some really good examples.

Given a choice, it is optimal to choose a math class that meets as frequently as possible during the week. This will break the material into smaller segments and provide greater opportunity for learning through repetition. As one student participant explained,

> Take a math class with the greatest number of sessions per week. If the class is three times a week versus two, we should take the class with three times. It's more advantageous. That seems counterintuitive to a bunch of women who haven't been in school for a long time and are afraid of math. Taking one math class after another is something that we would naturally not do. You would not take a class with the most number of meetings per week. Most of us would think [taking] a class with one or two meetings [means] less math. He explained all the advantages of that, the repetitive learning.

Coping skills. Balancing the demands of life with the pressures of school can be overwhelming for PI participants. They internalize coping skills to help them through "stretched" periods. They learn to not exceed their strength and take a break when mentally struggling. The related experience of one student was expressed in the following manner:

> He taught us to take breaks when it was beginning to be too much. Don't overexert yourself. When it comes to a final, study, but also get some rest. You will retain more. He taught techniques to help us get through. The rest, study techniques, taking your time, breathing, making sure you communicate your special needs.

Another student recommended time away from a difficult math problem, taking a few minutes away from going over the same concepts again and again. She explained,

> I noticed with math, if I'm doing 40 minutes worth of problems, and it's really a tough algebra for me or something and [I'm] getting stuck, it's important to take a break. Go outside for 20 minutes, take a walk, drink a Coke, talk to a friend on the phone. . . . If I just try to cram enough for 3 hours, I'm going over the same problem and still not getting it. If I take a break and go back to it, I get better if I do that.

The study participants learned the importance of balance and self-reflection, as expressed by the following interviewee:

> Leaving time for self-reflection. Particularly as a female, we tend to be caretakers of others and we tend to get lost in that. To have a safe place to just talk or a place to think, to gather yourself, reorganize if need be.

Coping skills were an important aspect of the PI math-anxiety curriculum, which the study participants learned and internalized. One student commented,

> I don't study the night before a test; I get a good night sleep, I eat dinner. . . . What has made me successful would be to apply that regular, consistent process to my math. Before a test, the night before, if I'm not ready by then, it's not going to happen. . . . When I've tried to really study the night before a test, what it has really done is produce high levels of anxiety in me. It was a killer.

Coping skills for math learning are applicable to other academic subjects, according to the following study participant:

> The ways that we learned to look at things to be successful in math, you could apply to the overall experience in school—time management; staying rested, balanced, and healthy; [and] not going overboard and doing this all-or-nothing kind of thing.

Another study participant commented on coping skills such as sleep and proper test preparation. She stated,

> I always got a good night sleep. I always had something to eat, I always had my cup of coffee, and I always got up early so that I would be in class at least 5 or 10 minutes early and be prepared and have everything that I needed. I shut my phone off [to] be mentally prepared for the test.

Proper attitudes are also important for test preparation, as expressed by the following study participant:

> I take a big breath [laughter]. If I go in with an attitude that I can pass it, I can do good; it tends to turn out that way. Think positive. If you go in with a bad outlook, you're going to screw up the test. When you have those bad thoughts in your head, you won't answer the questions correctly.

The study participants learned to journal about their experiences. As one interviewee commented, "Journaling about it, checking in with myself about how I feel before a test." This led to self-reflection and a positive change in attitudes and habits. The students also learned to take the math classes in sequence. One study participate stated, "It really helped when I broke it down into sections. Don't be in a rush to finish the math, but once you start math, don't drop it. Do it at your own pace." Another student echoed the importance of continuing the math sequence to maintain momentum and continuity, stating,

> One of the things the instructor did was the best way to take a math class. First we take all math classes consecutively; once we start, we don't quit. Take one math class after another. If there is an issue we struggle with, even if we fail, we basically continue on. Get a different approach, different instructor, more time at the learning center, more tutoring, whatever the case may be; we need to keep going with it.

Self-care and familial care was also a common topic of discussion through the study interviews. If the need arose to take time off from school, that was also perceived by the participating students as appropriate. One interviewee recalled,

> I would go a term and then, if life got too challenging, I would stop and take off a term. That was one of the things that the staff of Project Independence told me was okay to do. It's community college. If you need to deal with life, if you have a health issue or a family issue, you can stop and come back. I hadn't thought of that before. I thought that, if you went, you need to go and stay and focus. I had a more traditional mind-set about college or higher education.

Relationship to the literature. In the PI math-anxiety class, concepts are incorporated as the foundation for the class. The skills taught in the class are outlined in the Ooten text, which is also used as a resource by the course instructors. The students can check the book out from the Women's Resource Center. The first chapter dispelled some of the myths surrounding learning math and guided students toward confronting their negative beliefs about themselves and their ability to learn math (p. 2). The third chapter addressed learning types, multiple intelligences, and how to improve math learning based upon learning modes (p. 26). The fourth chapter covered time management (p. 37), and chapter 5 reviews study skills (p. 50). chapter 6 described the math resources available for students on a typical college campus (p. 67), and chapter 7 detailed exam preparation, taking an exam, and coping skills post examination (p. 81).

Two other books are not required reading, but are recommended to students enrolled in the PI math-anxiety class. One text is *Mastering Mathematics: How to be a*

Great Math Student by Smith (1998), covering many of the same topics as the Ooten (2010) text. The instructors use this text to supplement their curriculum. The second recommendation is *What Smart Students Know* (Robinson, 1993) and is at a reading level above the typical student, but is still recommended for reading beyond the course level. The content covered includes learning attitudes, time management, study skills, test taking, and paper writing. The text targeted overall college learning.

Summary. The participants in this study internalized many of the concepts and techniques for math learning. Note taking became an integral facet of their classroom routine. These notes could be used to create study guides for upcoming exams, solutions to important math problems, or problems concerning an important concept covered in the class. The students learned optimal test preparation and test-taking skills, relaxing and coping strategies to reduce anxiety, and techniques for successfully completing timed and multiple-choice exams. Study time was the most effective when performed daily, rather than a cram session the night before an exam. Study sessions are the most productive when inclusive of small breaks, especially when struggling with a difficult problem. Repetition is key to learning math. It is important to review notes and homework immediately after a class. After several days, important concepts taught in the class can be forgotten. The study participants expressed being motivated to complete their homework, even if the instructor does not grade it. They became aware that actively working problems helps to internalize global math concepts and problem-solving strategies.

The need for strong study skills is not unique to mathematics, and the learning styles the students participating in this study adopted from other PI classes were applicable to the math-anxiety class. The same dynamic holds true for organizational skills such as maintaining a day planner and organizing notes in a binder with dividers for each class and keeping quizzes, handouts, and notes together within the same section. The study participants learned accountability in the cohort setting, relying upon support from their peers. However, they were subsequently able to internalize and utilize these skills after graduating from PI and continuing their academic pursuits. Along with test-taking and study skills, these students learned and implemented classroom skills, as well, such as note taking, especially when the teacher repeated a concept. They learned to ask questions and interact with the professor, who is genuinely interested in their success and has the knowledge and skills to help them learn math concepts. The students came to realize that no question is stupid and others in the class are relieved when another student will ask.

Completing math classes in sequence is optimal; however, the study participants learned that, when they needed a break, taking a term off can be beneficial. Balancing life demands with education is their responsibility. Although not specifically related to math learning, these adult students learned to balance the complex roles of student, mother, employee, caretaker, recovering addict, and other demands on their time and effort. They acknowledged that taking time for self-reflection, eating healthy, and staying healthy are as important as academics. Consequently, balancing math learning with life demands is the answer.

Quality and Validity

As the researcher, I took great care to ensure each interviewee was comfortable and secure in the interview sessions. Reiterating the information in the consent form, I reassured them of the confidential nature of the information shared during the study interview and the transcription. All participants received a copy of their respective interview transcription to confirm accuracy. They were also assured of anonymity in the coding and reporting of results. The students were given the option to schedule interviews directly with me or through the Women's Resource Center, but all were comfortable with the center and unconcerned over the awareness of their participation in the study by center staff. As a White male, I was concerned over interviewing adult minority students, many with histories of abuse. However, the interviews were punctuated with laughter, tears, and genuine displays of emotion that could not be captured in the transcripts. It was clear that participant responses to the interview questions and the willingness of the students to tell their stories were genuine. Of the students and faculty who provided feedback after receiving their interview transcripts, only one requested the opportunity to add additional information.

Interviewing both students and faculty of PI provided different perspectives on the goals, implementation, and results of the program. For the students, it was a journey of finding self, resources, and purpose in their education. For the faculty and staff, it was careful orchestration of the cohort process to enable students to support each other while learning about available resources and the inner workings of community college life.

I reviewed the collected study data, conclusions, and evaluation with a peer from the math department of the participating community college. This was a math faculty member interested and involved in ameliorating math anxiety and actively working to solve the retention and learning problems experienced by the study-site college. She was not involved in the current study and provided feedback on the transition from high school to college math courses and why PI students struggled with this transition. Her experience was that a math-anxiety course taught without studying mathematics is insufficient. She perceived the optimal method of teaching students how to learn math is to teach these skills as part of an actual math class. Thus, students have the opportunity to apply the skills as they are learned. One PI math instructor brings actual math problems to the math-anxiety class, teaching students how to approach and solve the specific problems. Feedback from students who completed the class taught by this instructor revealed positive experiences with this approach. The students attributed a shift in their attitudes and confidence in math learning to this intervention.

As the researcher, I took advantage of the speed and versatility of a data-organization tool and recoded the entire data set following the interviews and initial coding. This provided a triangulation of the data from vantage points during and after the data collection, which provided additional insight into the codes and coding strategy. As a result, I refined two of the codes on early attitudes and experiences. The data-organization tool used is a versatile instrument intended for use with transcription data and, even if the coding is not perfect, the versatile nature of data retrieval renders

differing vantage points easily available to provide an overarching view of the phenomenon under study.

Section 3: The Project

Description and Goals

Project Independence

Project Independence is a college-readiness program, tuition free, and designed to provide adult women with an avenue to explore career goals and life planning. The program also introduces these students to the community college culture and resources intended to facilitate the development of self-confidence and a sense of belonging (PCC, 2013) with the academic environment. From time to time, male students have been admitted to the program, but in the last few years, program participants have been exclusively women. Program participants come from all walks of life and represent a diverse cross section of cultural and ethnic backgrounds; however, they tend to have had many common experiences. These students may be single parents, divorced, separated, or widowed. They may have recovered from drug abuse or have a history of incarceration. The majority are first-generation college students with the resulting lack of interest, understanding, and support from their families and friends in terms of their education pursuits. Many PI participants have been involved in abusive relationships and are survivors of domestic violence. Almost universally, they experience anxiety over returning to school or entering school for the first time.

PI is an immersion program designed around a cohort model. The women enrolled in the program work together as they complete seven credits, participating in the same classes. They complete classes on career and life planning, values clarification, introduction to assertiveness, college survival and success, adult fitness, and overcoming

math anxiety. In total, the students spend over 10 hours per week in classes together, as well as in counseling and discussion sessions. According to the PI program director in an interview conducted for this study, program goals are to "help students understand college culture, how to navigate it and the supports in place to help them. To be able to ask all the questions that they would normally never ask in college." A less formal goal of the program is to help adult female students develop a sense of belonging within a college environment, to feel, if not comfortable, at least invited and welcomed to a community college.

The focus of this study was the math-anxiety segment of the PI program. Math is the subject most feared by a majority of community college students, a trend that does not change with PI participants. The math-anxiety class covers the only subject specifically targeted by the PI college-preparation program. Other academic subjects, such as reading and writing, are covered through standard college course offerings. Members of the PI cohort meet once a week for this class. The duration of the term is 10 weeks, with the last week reserved for program graduation.

The themes covered during Week 1 of the math-anxiety class are math identity and factors that render math so fearful for so many students. Those attending are divided into groups of four or five students, each in a manner referred to as a jigsaw, which is random selection. An instructor uses a deck of playing cards to effectuate the selection and the assigned groups change from week to week. During Week 1, math identity is discussed, as well as fears associated with math learning. The students present their related ideas to the class. Group 1 discusses experiences that promote a positive math

identity. Group 2 discusses experiences that could promote a negative math identity. Group 3 discusses experiences that may foster math anxiety. Group 4 covers experiences and activities in which students can participate that can help overcome feelings of anxiety with learning math. College students are expected to be self-motivated and responsible for their own success. Group 5 discusses how this differs from high-school math classes. The instructor is not at the forefront, but judiciously contributes to the discussion as opportunity permits. The goal of this hour is to promote student realization they are not alone. There are others that share their fear of math, some that have more or less fear of math learning. All will learn techniques, habits, and attitudes to help them master math.

Week 2 of the math-anxiety class includes a discussion of the possible math sequences at the study-site community college. This is the class period that instills the most fear in students as they contemplate the math classes they will need to complete 100-level math classes. The instructor presents the various paths that these students can negotiate through the math sequence to arrive at their required course level. They discuss math placement, with most students placing in math 20, which is basic arithmetic. The instructor provides the students with resources for placement tests and Web resources (*Math,* n.d.). This elicits the most questions from the students to the instructor, both during and after class. Otherwise, the students dominate the class while the instructor merely directs.

Study skills are the subject of Week 3 and the students are introduced to a textbook authored by Robinson (1993). Skills include note taking, the effective use of the textbook, the approach to homework, and problem-solving skills. A wide disparity in

math identity is possible among students attending the class. Those with a weak math identity are instructed to focus on specific skills. Those with a stronger math identity will focus on learning skills appropriate for their level. The class is again broken into jigsaw groups. Group 1 discusses and presents those activities students can perform the day or the hour before class begins. Group 2 discusses and presents typical questions during class and how they are best asked. Group 3 discusses and presents taking notes in class, and Group 4 discusses and presents how to read a math textbook. Group 5 discusses and presents the ideal college student. In all of the jigsaw class sessions, if there are more than five groups, one of the subjects may be repeated.

Week 4 of the math-anxiety class is similar to Week 3 but with a focus on time management and homework. These seem like disparate topics; however, for these students with their complex, demanding lives, homework is an exercise in both time management and motivation. The students are again assigned to random jigsaw groups and Group 1 discusses and presents five time-wasting activities that detract from college success. Group 2 creates and presents a list of five ways calendars can be created and used to prioritize activities to optimize use of available time. Group 3 creates and presents a list of five ways students can keep themselves active and self-motivated during homework completion. Group 4 creates and presents a list of resources for help with homework. These may include tutors, fellow students, family members, online video helps, notes, and/or online tutoring. Group 5 discusses and presents ways of maintaining focus on math learning as new external challenges and demands emerge from week to week during the term.

Week 5 of the math-anxiety class involves a discussion on math anxiety and is centered around a video created by a community college on this topic (Bohrad, 2006). The class does not break into groups; the math-anxiety cycle is discussed as a class. The fact that the majority of students do not have math anxiety is a focus of the discussion; a lack of preparation is typically the causal factor. Each student lists factors that render math fearful, enumerating them from 1 to 5 (1 = *slightly scary;* 5 = *super scary*). Over the following weeks, the students periodically read their lists and think about action they can take to mitigate the reflected factors.

Week 6 of the math-anxiety class is focused on how to prepare for and take exams. The class is again grouped in a jigsaw format with Group 1 discussing and presenting a list of five areas of activities for presentation during the 2 weeks preceding an exam. Group 2 discusses and presents a list of five activities to prepare Week 1 preceding an exam. Group 3 discusses and presents test-taking strategies for exam day and four things on which students must focus. Group 5 discusses and presents a list of two activities for students to perform if they do well on an exam and two activities if they did not earn a satisfactory grade.

Week 7 of the math-anxiety class again involves the jigsaw grouping. Resources available for students to help them conquer math learning are discussed. Although seemingly unrelated, for the majority of students, anxiety is sourced in a lack of preparation. Group 1 focuses on how to optimally use the learning center. Group 2 discusses three experiences that can help each student master the fear of math. Group 3 develops a list of four techniques students can apply to foster motivation. Group 4

focuses on long-range goals, barriers to achieving these goals, and resources that can facilitate breaching those barriers. Group 5 discusses and enumerates the resources available at the study-site community college to assist students with general academic pursuits.

Week 8 of the math-anxiety class returns to learning styles, and jigsaw groups focus on the traits of each learner and strategies to enhance the learning of each student. Three groups focus on visual, auditory, and kinesthetic learning styles. Two additional groups focus on how visual and kinesthetic learners can use their learning styles to better focus on homework. Week 9 is a review session with a focus on how to optimally handle difficult situations. The format is again jigsaw groups. Group 1 details the obstacles PI students face as nontraditional students. Group 2 lists ways to work effectively with a difficult instructor. Group 3 reviews elements of test preparation. Groups 4 and 5 discuss what they learned on how the active student reads a math text, takes notes in class, and completes homework.

In addition to the jigsaw discussion groups, the instructor brings in videos to complete the class. These are homework videos, but if time permits, they are viewed during class time. An overarching goal is teaching by triangulation. The students see the perspective of the instructor, they see the viewpoints of other students on math learning, and they watch videos to understand the different perspectives. During at least one of the class periods, visitors are brought in to share their difficulties and successes in math learning. A favorite is one of the math faculty who also started with PI and the math-

anxiety class and went on to complete a bachelor's and advanced degree to now work as a math instructor.

Project Study

Through anecdotal evidence, as well as survey evidence from past program participants, PI has been shown to play a significant role in helping adult women begin or continue their community college education. Math learning is one of the greatest impediments to completing a college education (Geist, 2010), and math learning is the only class in the PI program that targets a specific academic subject. This current study was conducted to determine how successful the program is in helping students survive and thrive within an academic environment and, specifically, how successful the program is in helping students learn how to overcome their fear of math toward successful math learning. Rather than targeting current PI students and providing insight into their immediate impressions of the program, or focusing on recent graduates of PI, which would have provided a vivid and fresh recollection of the term from the point of view of the student, this study evaluated the long-term benefits of the program for graduates. An aim of the research was to determine any changes in behavior study habits, attitudes, and self-perceptions of the students as a result of the program. As the researcher of the first academic study of PI, I examined the long-term academic and life changes that are the ultimate goal of the program.

By focusing on the long-term impact, it is more difficult to assess the details of the PI program interventions. What is vivid in the minds of the students immediately after graduating from the program may have faded in the intervening 2 years. A major goal of

this study was a program evaluation rooted in qualitative research and data analysis. The evaluation is from the student perspective, how they benefited from the PI program. The evaluation model is thus participant based and focused on changed attitudes, behaviors, and habits (Lodico, Spaulding, & Voegtle, 2010, p. 326).

Rationale

PI has never been formally evaluated for its efficacy in assisting participants to navigate the community college environment and complete an academic program. The most significant academic impediment to college success for these adult students is math learning; consequently, the focus of this study and the resulting evaluation are on how PI assisted participants to improve their attitudes and study behaviors in subsequent math classes. Assessing the long-term impact of PI could have been centered in a quantitative analysis of the program; however, quantifying the impact of PI would not illuminate the participant benefits from program participation in terms of how behavior, attitude, and habits change as a result of involvement in the program and how these changes impact student lives. The goal-based, summative evaluation provided by this research was focused on the long-term impact of PI on participant math learning, drawing from the qualitative data of the instrumental case study.

An instrumental case study is framed to research a specific issue (Creswell, 2012, p. 465); in this case, the framework surrounding improvement in math learning at PI. The focus was not on measuring or quantifying the improvements, but on the how and why (Merriam, 2009, p. 44). Program evaluations can be focused on the fiscal viability of a program or on making decisions related to whether to continue a program. In this case,

the goal was to document the long-term impact of PI on the education pursuits of program participants, specifically related to math learning, and through the analysis of data collected in a formal research setting, point out ways the program could be modified to enhance the long-term benefits to the math learning of college-level students (Weiss, 1998).

The program evaluation provided by this study is summative in nature, focused on the long-term objectives of an existing and continuing program (Lodico et al., 2010, p. 18). The how and why of this program evaluation are based upon the answers to the following research questions:

1. Why do women participating in PI find mathematics to be an obstacle to their progression at the Portland community college serving as the study site in this research?
2. How does PI help women acquire study, coping, and learning skills that improve their math performance at the community college serving as the study site in this research?
3. How do the women participating in PI apply the skills and knowledge they have learned to long-term improvement in math performance?

Based upon informal interviews and conversations between staff and students, as well as the resulting anecdotal evidence, PI has helped women master study habits in relation to math learning and develop more positive attitudes toward math in general. This study and the accompanying evaluation formalize this anecdotal evidence using accepted qualitative research practices. The evaluation documents the success of PI and highlights

possible improvements that will better prepare future participants to make positive, lasting changes in their academic performance.

Leadership of the community college participating in this study can also use the results of this study to determine justification for continued financial support of the PI program (McKinney, 2010). However, if they decide to use the data and conclusions of this study and evaluation to scale up PI, or introduce new programs not based upon the cohort model, they will do so with concurrent risk. Regardless of the solid scientific evidence from a triangulated and peer-reviewed academic study, the components of the resulting program may not maintain the same levels of efficacy (Olds, 2002).

Summary of Outcomes

Of the eight women who participated in this study, all but one specifically mentioned the cohort as key to their successful program completion. Of those, all but one stated that, if it were not for the cohort and PI, they would not be in school; they would have dropped from the program before completing their education goals. The one student who stated that she would still be in school qualified her statement with the comment that it would have been harder. All of the participating students acknowledged the counseling that PI offers both during and after the program term as a significant factor in their academic and life success. All of the students mentioned that PI gave them a sense of empowerment that was more than simply a feeling; the tools and skills necessary to follow through on that empowerment were provided. They all noted the help that PI extended to improve their time management.

All but one of the participants in this study mentioned math anxiety as a significant problem and the primary reason they were anxious about returning to school. The graduation ceremony (i.e., the 2-hour program at the end of the PI term) was cited by three of the study participants as one of the most significant and inspiring aspects of the program. One of the students specifically mentioned note taking as a long-term skill that has served them well throughout their academic pursuits subsequent to PI. Career exploration was specifically mentioned by five of the participants as a significant benefit from their PI experience. All of the students reported improved academic and life skills as a result of the program. All viewed PI as having a profound impact on their lives including the skills they acquired, the friendships they built, and the outlook they developed on their education and other life pursuits.

Review of the Literature

Program Evaluation

This review of literature related to this study is focused on the mechanics and theory of the provided program evaluation, the education theories supporting the findings, and the theories and research that point to potential improvements in the PI program. Tyler is considered the father of modern education evaluation, and one of the first education topics he considered was how to evaluate problem-solving skills. The prevailing consensus was that, if knowledge is evaluated, then how well students solve problems can be understood because problem solving requires knowledge. Tyler (1989) hypothesized that we cannot evaluate knowledge and infer problem-solving skills; these skills must be directly measured. The 8-year study conducted by Tyler set the standard

for evaluations within the field of education. The research was initiated in 1930 to evaluate college-admission standards and their impact on the ability of progressive, as well as traditional, schools to innovate in light of these standards. The Tyler study continues to be a model of how evaluators and teachers can collaborate when seeking to improve education curricula and practice (Bullough, 2007; Tyler, 1989).

Program evaluations are used to measure the merit and worth of a program under study (Mertens, 2014). In the current research, merit refers to how well the PI meets the needs of the program recipients (Patton, 2008). The goal for the evaluation provided in this study was to identify the various components of PI that enhanced long-term math-learning skills, behaviors, and attitudes, as well as how these components might be improved. In the case of a suboptimal outcome, the component of the program that resulted in the outcome may not have been appropriate for the target population, or the intervention itself may not have been the problem, but rather, an improper implementation (Blasé & Fixsen, 2013). Program evaluations can be categorized into the following five general approaches or orientations (Fitzpatrick, Sanders, & Worthen, 2004; Spaulding, 2008): participant, expertise, consumer, management, and objectives. Because a goal of this current research was to document the impact of PI on enhancing student math learning from the point of view of the students themselves, this was a participant-oriented study focused on the firsthand recollection of PI graduates.

Difficulties can emerge in program evaluation when stakeholders view the evaluation as a justification for funding. The process of data collection and collaboration between researcher and faculty or staff can become confrontational. Program evaluations

can be “ultimately afflicted with many of the problems it was meant to solve” (House, 1993, p. 11). A first step is to gain the trust of the stakeholders involved or impacted by the study (Lodico et al., 2010, p. 323). In this current research, I discussed the nature and implications of the study with the program director, several faculty members, and administrators and math faculty not involved with PI prior to beginning the study proposal. All were enthusiastic about the possibility of an academic study on the impact of PI on the education of students. To avoid any perceptions of a conflict of interest or bias in the outcome of the study, I chose a program of a different campus from where I had taught. Additionally, I had not taught for over 4 years at any of the college campuses. From the perceptions of PI staff, I was an interested, motivated stranger (Bogdan & Biklen, 2007, p. 57).

There are a number of reasons for education research inclusive of adding to the current base of knowledge or insight, to improve practice, and to inform policy debates. This study was conducted to improve practice (Creswell, 2012, p. 4) by authenticating the impact and potential improvements of an established community college preparation program. A research topic should be exciting and important to the researcher, and I am enthusiastic about math teaching. I also have a special interest in math anxiety due to an extreme case in my own family. It is important to be practical and limit a study to a reasonable size and complexity. It would behoove the novice researcher to think small because a qualitative study is labor intensive (Bogdan & Biklen, 2007, p. 54). The literature review provided for this study is extensive; however, the results of past research should not overshadow the findings of the current study. Qualitative research depends

more on the views of the participants than the literature (Creswell, 2012, p. 17). The focus of qualitative research is to interpret findings for larger meanings, convey personal reflections, and draw major comparisons to existing literature.

The Instrumental Case Study

The choice of a qualitative study best met the major goal of answering how and why—the core of the research questions. Most of the participants of PI are minority students, as well as female, and qualitative analysis is favored in minority studies because of the demographic emphasis (Bogdan & Biklen, 2007, p. 5). As an aspect of the study proposal for this research, I discussed with staff of the PI program the possibility of attending group sessions, various classes, and one-on-one student interviews. It was decided that interviews with faculty and staff, as well as access to selected summary statistical data would be sufficient to fulfill the needs of the study proposal (p. 84). As a researcher, I was candid with the faculty and staff on the nature and duration of subsequent study interviews following proposal approval. Such open communication with regard to data collection is another way to engender trust with study-site participants (Creswell, 2009, p. 217).

I followed the procedures for conducting an interview, as described by Lodico et al. (2010, p. 125). I first introduced myself and reminded the interviewees of the confidential nature of the recordings and resulting transcription. It is important to strive for neutrality and never act shocked, while concurrently being moved by the participant stories. During the interviews, I maintained an awareness of my own potential bias and

that of the participants and was hence careful with follow-up questions. I made conscious decisions on when to stop probing and move to the next topic.

The case-study format was ideal for this research and the subsequent program evaluation (Merriam, 2009, pp. 40, 203). PI is a relatively small program, admitting approximately 20 students per year. I was able to recruit eight students from an ample student-population base using purposeful sampling (Creswell, 2012, p. 206). I was seeking students at least 1 year out of the program who had completed two or more semesters of mathematics courses. I would like to have found participants with maximum variation in their math-learning experience and attitude, which represents a technique known as *intensity sampling* (Lodico et al., 2010, p. 269), but this was not mandatory. Following selection of the case-study format with interviews, the next step was to determine the nature of the interview. A structured interview is another way of conducting a survey (Merriam, 2009, p. 90), but is not suitable for answering the how and why of the research questions. Researchers use unstructured interviews if they do not have sufficient knowledge of the program under study to generate a standard list of questions; however, they must formulate and refine the questions throughout the interview process.

The program under study in this current research is an established component of the Women's Resource Center of the participating community college, and the research questions were well formulated and focused. The study interviews were semistructured to collect participant responses from a similar line of questions, but also allow for probing and follow-on questions to foster thick descriptions. Foreshadowed questions, or

questions based upon the research questions, helped to focus the data collection (Lodico et al., 2010, p. 265). The types of questions developed for the interviews revolved around participant experience and behavior; their opinions of the value of the program; their feelings garnered as a result of the program; and long-term change to behaviors, habits, and attitudes as a result of the program (Merriam, 2009, p. 96). To reduce speculation on the part of the interview participants, I rarely used a why question (p. 97).

As the researcher, I transcribed the interviews and conducted the data analysis to generate greater meaning of the interview results because qualitative data analysis is inductive and comparative, requiring significant time to review and contemplate interview responses (Merriam, 2009, p. 175). Choosing and updating categories or codes for the data analysis is critical to making meaning and must meet certain criteria (p. 210). Coding facilitates answers to the research questions and must be exhaustive, meaning that all pertinent data must reflect a relevant code. Codes should be mutually exclusive, with data fitting into solely one category. In the data analysis for this study, segments of data that fit into multiple categories were illuminating. For example, a segment of an interview transcript describing a particularly challenging experience during PI was coded as both a disorienting dilemma and a point at which the participant learned organizational skills. To find this transcript element in both codes highlighted the importance of the experience in the life of the participant. In this study, data were collected in the form of student interviews, interviews with faculty and staff, and program and class curricula. This triangulation of multiple sources of data strengthened the study validity (p. 215).

The participants of this study were motivated to learn math and were equipped with the skills and time-management techniques to master the math curriculum in their chosen fields of study. One participant did not initially admit to the cohort and the math-anxiety changing her beliefs related to her ability to learn math. This negative case added an interesting dimension to the data analysis (Lodico et al., 2010, p. 274). Case studies are not predictive (Merriam, 2009, p. 50), but rather, focus on a small group of individuals and study their experiences in a specific setting (Lodico et al., 2010, p. 15).

The findings of this research are not as generalizable as the results of quantitative studies; however, settings and populations exist for which the results of this research may apply (Bogdan & Biklen, 2007, p. 36). These may include other settings or programs with adult female students; however, generalizability was not the primary goal of this study and the resultant evaluation. Building an understanding of personal progress and experience from the point of view of the study participants was the major aim (p. 42). For member checks, I sent copies of the interview transcripts to each student and faculty participant. Those who responded were satisfied with the interview content. For peer debriefing (Lodico et al., 2010, p. 275), I reviewed my research questions, answers, and the contents of the program evaluation with a peer colleague at a different community college campus.

Adult Learner Theory

As noted earlier, the theories that grounded this study and the resulting evaluation were the andragogical learning models of Knowles (1998), Hilgard and Bower (1966), and Mezirow (1991). The Knowles models portray adult learners as self-motivated, self-

directed, and problem centered; however, this portrayal is only accurate when applied to the successful adult learner (Komarraju & Nadler 2013). The goal of PI is to assist program participants to reach a state at which the Knowles adult-learning model applies. There is a significant correlation between the self-concept of students and their self-efficacy and competence in academics. Additionally, their positive or negative self-concept may vary from subject to subject (Scherer, 2013). Adult learners may be self-motivated, self-directed, and problem centered when they are successful at mastering academics, but they are not necessarily otherwise endowed with those traits. These traits may need to be learned, as demonstrated by the participants in this current study who reported that, after their PI experience, they felt empowered and in control of their education pursuits. This locus of control and self-efficacy have a direct correlation to academic performance (Au, 2014), with those of lower self-efficacy profiles employing suboptimal learning strategies or void of a strategy (Kim, Wang, Ahn, & Bong 2015).

Major themes throughout the methodology discussion of this current study are organizational and study skills that allow self-direction and the identification of resources to progress with self-determination. Belief in self p

recedes a motivation to learn how to learn math; however, self-efficacy alone is insufficient. Participating in a cohort may improve self-efficacy, but improved self-efficacy may not to be sufficient to improve academic performance (Ainscough, Colthorpe, Foulis, & Zimbardi, 2014). Stereotypical threats, as explained by several participants in this study, also impact self-efficacy and can hamper academic performance. Examples are stereotypes that women cannot do math, or a person of color

does not belong in college. Lack of support from the family and friends of first-generation students can also inhibit the adult learner (Trujillo & Tanner, 2014). Members of the cohort must collectively work to address these threats and acquire the tools and knowledge needed to navigate community college.

To the participants in this study, the most important component of PI is participation in the cohort. Through the cohort, the students felt empowered and were bolstered with a sense of belonging and self-efficacy. These results were best documented using qualitative measures and the collection of thick description through personal interviews. Interventions, such as a cohort focused on overcoming barriers to college learning, can improve student attitudes, provide the tools and self-perceptions to deal with adversity on campus in a positive manner, raise GPAs, and increase retention rates (Walton & Cohen, 2011). Peer support and recognition by others improves math and science identity (Carlone & Johnson, 2007). Even small interventions can have lasting effects on student belief in themselves and the sense of empowerment (Yeager & Walton, 2011). Implementation of the PI cohort supports many interventions during the course of the term.

The sense of identity among women, particularly minority women, is lower than it is for their male counterparts (Hazari, Sadler, & Sonnert, 2013). The sense of belonging and acceptance in a math class, or math identity, has been shown to be an important factor for the success of women in mathematics, but even more so than for men (Good, Rattan, & Dweck, 2012). The women of PI are shown how to change their attitudes

toward learning and, as their attitudes change, their success concurrently increases (Yeager & Dweck, 2012).

The Culture of Higher Education

The community college and university system in the United States is designed to foster individualism and independence, creating obstacles to first-generation students who rely upon a network of interdependence (Stephens et al., 2012). Over the past 50 years, the difference in performance between first-generation students and continuing-generation students has widened (Fiske & Markus 2012). First-generation students are not familiar with the conventions and social norms of college life and therefore question their right to even attend college. A student who harbors a negative perception of his class and status at college is more likely to perform poorly compared to those comfortable with their class status (Inzlicht & Schmader, 2011). First-generation students do not understand that their lack of success is not rooted in inferiority, but rather, because they do not yet understand the system (Stephens, Hamedani, & Destin, 2014).

Another difficult factor many first-generation students encounter is the need to work while attending school. Most institutions discourage this, but in many cases, lower income students have no choice and many professors will not accommodate the needs of these students (DeRosa & Dolby, 2014). First-generation students must seek to understand their diverse background and cultivate the strengths of their cultural heritage to learn and work with college norms and practices (Steele & Cohn-Vargas, 2013). Customizing interventions for students with diverse backgrounds eliminates the first-generation achievement gap as this student population learns to seek out campus

resources and interact with their professors (Stephens et al., 2014). PI models this concept as it teaches students to be independent by fostering an environment of cooperative interdependence. The program could boost its focus on independence through mutual cooperation and interdependence by implementing more targeted interventions such as inviting successful former students to tell their stories.

The culture of first-generation students from working class backgrounds differs from the multigenerational culture of independence, which is dominant in contemporary institutions of higher learning. First-generation students cope with the added stress of an unfamiliar culture, in addition to the more routine stress of academic life (DeRosa & Dolby, 2014). Bourdieu (1990) defined culture as the social norms, way of living, and accepted practices of a given population. His theory of social class provided a fitting theoretical framework for this current study. Failure to adapt to the cultural norms of college negatively impacts the overall college experience of first-generation college students and also has a direct impact on academic outcomes as well (Thompson & Subich, 2011). During an intervention for incoming freshman, senior students told their stories of how they learned to navigate the college experience. They used their strengths to overcome the weaknesses of their socioeconomic background and enhance their academic success (Stephens et al., 2014). Describing experience within the context of a socioeconomic background is referred to as a *difference-education intervention.*

PI students informally meet and become acquainted with past program participants. As one participant in this study described,

> We ran into them while we were in Project Independence; we walk around campus a lot and instructors would notice somebody that was in a previous class. We would hear their conversation: "I'm going full-time now; you ladies stick to it." . . . I try to do the same thing for the new classes now.

This informal contact made a significant impression on several study participants, and the practice could be formalized by including past program participants in the curriculum. Jigsaw group selection and peer-to-peer teaching is an effective alternative to the traditional lecture format (Karacop & Doymus, 2013). In a cohort with extremes in math identity, the instructors used those in the jigsaw with a strong math identity to encourage and motivate those less sure of their math-learning skills. One study interviewee recounted,

> One thing [the instructor] explained that I never heard a teacher explain since is the benefits of there being unequal levels of skill. It was important that there were people who were not very confident in the same group with people who were overly confident. Overly competent people really needed that engagement. You can lift some people up and, for the people who are already skilled, it helped them develop other skills.

When studied in isolation, there are gender differences in math achievement; however, these differences disappear when personality and attitude are considered (Alcock, Attridge, Kenny, & Inglis, 2014). PI provides a cohort infrastructure within which their female participants discover campus resources and strive to overcome their negative attitudes toward math learning. Interventions fostering a student sense of

belonging, coupled with utilizing campus resources, improve attitudes toward science, technology, engineering, and math (Walton, Logel, Peach, Spencer, & Zanna, 2014).

The PI math-anxiety class takes a triangulation approach to teaching, using the perspective of the teacher, invited guests, multiple video resources, and reference and textbooks to prepare students for foundational math classes. In a three-course foundational math sequence, course-to-course retention of 54% left 16 out of 100 students enrolling in college-level math. Using a more interactive, self-paced curriculum with online resources, continuous feedback, and greater peer interaction, referred to as ALEKS (Okimoto & Heck, 2014), success rates in course-to-course foundational math classes increased threefold. Accelerated programs known as "Achieving the Dream" are designed for fast-tracking students through developmental math to the courses required for their degrees or certificates and have also proven to be beneficial for first-generation college students (Fong & Visher, 2013). Web-based homework is more favorably accepted by students with average to below-average math performance. The immediate feedback results in improved attitudes surrounding math learning (Leong & Alexander, 2014).

The described models may be applicable to college-level courses, removing the stigma of what one study participant described as the "hazing ritual" of college math learning. She recounted,

> I withdrew from math 95 because everything that I had been taught to apply suddenly "flew out the window." The ethical basis of what we were taught in Project Independence became very hard to apply all of a sudden. Suddenly, math

> is super geared up, really competitive, and the teachers are teaching it at a pace that is uncomfortably fast for them. Stress is everywhere. . . . It is one of the hazing factors of [the] college experience.

The Hilgard Andragogical Model suggests that learning be developed from the simple to the complex in a meaningful manner (Hilgard & Bower, 1966, p. 562). The transition from foundational to college math should not be a quantum leap, but rather, a relevant, incremental flow that allows students to draw upon skills and knowledge garnered from the foundational classes. The transition from a foundational- to college-level math class was a disorienting dilemma for some of the study participants in this current study (Malkki, 2010).

Saturation

For the literature review conducted for this study, simple search terms were entered into Google Scholar such as *cohort, program evaluation, case study, learning models, locus of control, stereotype threats in education, first-generation college students,* and *jigsaw groups in education.* Once I found a relevant article, I used the session-manager browser add-on to allow an extensive examination of all articles cited within the article of interest. For each interesting link, I would right click and open a new window in the Web browser, subsequently repeating the examination of citations. At times, I had over 40 windows open in the browser. If I needed to continue the search at another time, I would simply save the session with session manager and restore it upon resuming work. By using the library links featured in Google Scholar, I was able to open any article available through Walden, as well as all articles publicly available. Thus, I

was able to peruse thousands of potentially relevant articles and focus on several hundred with the potential for inclusion in the literature review.

As I worked up and down the stack of open Web pages, I began to see increasingly more articles that I had already checked or referenced. When it was clear I had saturated the literature for the respective keyword, I moved on to the next search term. At points during the writing of the literature review, if I determined I had insufficient literature on a topic, I would enter related keywords and begin another search.

Implementation

Data collection for this study consisted of interviews with staff members and previous program participants, as well as a review of curricula material, handouts, and course descriptions. The latter were gathered in increments over the course of 4 months. Coded data from interviews, as well as participant feedback and peer review, were important to the creation of the program evaluation.

Existing Supports

The IRB of the participating Portland community college would not allow access to student contact information; consequently, flyers and e-mail were distributed to graduates of the PI program by staff of the Women's Resource Center (see Appendices C & E). Students were invited to contact the PI staff to arrange interviews or to contact me directly. All of the study participants chose to schedule through the PI staff. PI made an office within the Women's Resource Center available that opened into the common area. I left the door a little ajar for all interviewees; however, three participants opted to close

the door. There were glass windows in the office; hence, we were visible to the common area, which was more comfortable for the interviewees. The NIH recommendations with regard to the protection of human participants were followed (see Appendix F).

The PI math instructors made their curricula, handouts, and video links available, and the project director provided course descriptions and summary statistics gathered on past program participants. I conducted interviews with two math instructors, as well as the project director. All three were anxious to contribute to the study and made themselves and their offices available for interviews.

Potential Barriers

As a White male interviewing primarily minority female students, it was critical to avoid interview sites where informants may feel coerced or intimidated (Bogdan & Biklen, 2007, p. 49). Participants had the choice of scheduling the study interview through PI at the Women's Resource Center or contacting me directly if they felt uncomfortable discussing their involvement in the study within the offices of the project staff. All participants agreed to interviews at the resource center where they felt comfortable in familiar surroundings. While conducting the interviews, I remained discreet, even inclusive of the clothes I wore because clothing can communicate impressions of character. I dressed in a clean, casual, and modest manner, and conducted the interviews in a manner that engendered trust, never judging any student responses and showing genuine interest in all participant comments. I treated the interviewees with discretion and respect, made the recording process simple, and stressed to each interviewee the care I would take with the field notes and recordings (p. 98).

Evaluations are often conducted on programs that service minority groups or populations with social issues such as addictions or a history of abuse. These programs are frequently in competition for financial and other resources; consequently, evaluations can foster conflict and contention (Mertens, 2014). I was an interested outsider to the PI, and the staff were enthused about the prospects of a formal study of their program. They extended every courtesy and resource.

Proposed Implementation and Timetable

Data collection could not begin until after authorization by the IRB of both Walden and the participating community college. The timeline for data collection was 1 month, but with the passing of my wife of 37 years, I suspended data collection for 3 months and another 2 months were necessary to regain momentum. At that point, I completed the data collection and coding, progressed through the participant and peer-review process, and subsequently wrote the program evaluation.

Roles and Responsibilities of Students and Others

Eight students volunteered to participate in this study. I informed all participants that the interview recordings and transcription would be held strictly confidential and they could withdraw from the study at any time without repercussion. A coded copy of the transcription was sent to each participating student with a request to reply if they wished to clarify any segment of the interview or if they wished to add any further insight. The three staff members I interviewed also participated voluntarily and were given the same options as the student participants. The interviews lasted approximately 1 hour, which included time to review the consent forms and how data from the interview

would be handled. In summary, the responsibilities of both the staff and student participants were to schedule and attend a 1-hour interview and, at a later date, review the respective transcription for accuracy and completeness.

As I researcher, my responsibility was to maintain objectivity during the interviews, follow the semistructured interview protocol, and solicit additional information with follow-up questions. The interviews were recorded twice to protect against potential equipment failure during the sessions. As the interviewer, I practiced extensively with the recording equipment to determine range and clarity and to confirm I was comfortable with the equipment. My responsibility was to ensure the recording process progressed in as unobtrusive a manner as possible. The first recorder was simply a cell phone positioned on the table and left in record mode. The second recorder was a simple dictation unit, smaller than a standard cell phone, which I also activated and placed on the table at the beginning of the interview. At no point during the interviews did I touch or in any way manipulate the recording equipment. I needed the interview environment as comfortable as possible for the participants.

After recording each interview, I transferred the audio files to my computer, backed them up on a thumb drive, which was stored in a secure place, and deleted the audio files from both recording devices. Therefore, if my cell phone or dictation recorder were lost or stolen, no confidential information related to the study would be present on these instruments. I subsequently transcribed the interviews by listening to the recordings through a set of headphones and dictating the interview into the computer using dictation

software trained to my voice. It consumed approximately 3 hours to transcribe and proofread a 1-hour interview.

Other essential personnel involved in the study were the IRB members representing both Walden University and the study-site community college. The Walden IRB first granted a conditional approval, based upon PCC acceptance and approval of the study. PCC would not consider the study until I had Walden IRB approval. Once the conditional approval was granted, the PCC IRB reviewed and approved the study in under 1 week. The staff of the Women's Resource Center graciously allowed use of their offices and conference rooms during the data-collection phase. Instructors of the math-anxiety course walked me through the class outline, discussing daily class execution and sharing all relevant course material, instructor notes, handouts, and video files. The program director supplied descriptions of all PI courses, the goals of the program, and summary statistics gathered from past program participants.

Implications Including Social Change

Local Community

PI serves adult women, primarily of ethnic minorities, who are attempting to return to or begin a community college education. Education is a significant factor in alleviating poverty (Jepsen, Troske, & Coomes, 2014). One of the most significant impediments to students seeking a degree or certificate at a community college is the requirements for math learning. Students must first successfully navigate the foundational-math sequence, which has a 54% course-by-course achievement rate, and those who are required to complete college-level mathematics must then also successfully

complete that required sequence. All of the participants in this study credit PI with helping them improve their math identity and successfully navigate foundational math classes.

This study explored facets of the PI program, such as the cohort and jigsaw-based math discussions, that enabled math learning, as well as recommended additions or modifications to the program intended to enhance math success. No academic study had ever been conducted on PI. This current study provides insight into how the program has positively changed the academic math performance of the study participants and the components of the program the participants viewed as pivotal to that success. The most important change, according to the study participants, was a real sense of empowerment with knowledge of the tools available within the community college culture and the practice of successfully navigating the math requirements of their chosen degree or certificate. The components of the program that facilitated that empowerment are examined in the program evaluation resulting from this study.

Far Reaching

PI collaborates with programs for minorities and women that are designed for community colleges and universities across the state of Oregon through an organization known as the Oregon Transition Coalition. This group meets twice per year to share curriculum and best practices within the realm of education. The coalition is primarily focused on the education of women. The findings of this study, and the resulting practices implemented, could be used by many academic institutions. The insight reported is based upon qualitative study and is therefore limited in terms of generalizability; however,

other programs within the participating community college and other colleges and universities can incorporate and experiment with these interventions. The math departments of Oregon colleges are transitioning from budgets based upon enrollment to budgets based at least partially upon student success. Interventions such as self-paced, college-level math courses and cohort-style, peer-to-peer support could be considered possible solutions to the low course completion rates that plague institutions of higher learning.

Conclusion

Section 3 contains an overview of the PI program in general, as well as a more detailed description of the math-anxiety course taught as part of the term-long college-preparation program. Included are the goals of the project for helping adult women prepare for community college education or return to this educational venue for an advanced degree. One rationale for this study is the fact that the program has never been evaluated with academic research, which is also addressed in section 3. The literature review covered program evaluations in general, their bases in education theory, literature grounded in qualitative case study as the foundation for data collection, and the theoretical basis for this current study and ensuing program evaluation. Section 4 completes this project study with reflections and conclusions.

Section 4: Reflections and Conclusions

Project Strengths

Statistics are available on women and math, course-by-course advancement in foundational-and college-level math sequences, and on community college graduation rates. These statistics are used by PI as rationale for the program, but no evaluation has been conducted to analyze how PI has achieved success and the aspects of the program most beneficial to student participants for math learning. The fundamental questions answered by the program evaluation provided in this study revolve around what program participants learned from the program that has given them long-term benefits. It is only the long-term behavior, attitude, and habit changes that matter. It is these improvements in the academic and life skills of program participants that foster positive change.

This study is a qualitative instrumental case study. Students who had graduated from PI and subsequently completed two or more math classes were recruited for participation. The majority of the study sample had graduated from PI 1 or more years preceding the study interviews. After 2 years, memories of the daily details of the program are lost, but what remains are those experiences that made a significantly positive difference. It is the interventions that fostered real change in their behavior and their attitudes that they recall. The study data were collected through semi structured interviews with student participants, as well as math faculty and program leaders. Interviews were used to gather thick, meaningful descriptions of the most vivid memories of the participants during their term in PI. These rich descriptions included the changes these participants made as a result of PI interventions. The most significant changes

reported by all of the participants were a sense of empowerment and a sense of belonging. With these developed strengths, the students were able to internalize and implement strategies learned in time management, math homework, study, and test and classroom skills.

As noted earlier, this study represents the first program evaluation of PI. It provides academic insight into the interventions best received and remembered by program participants, as well as how the students perceived these interventions as changing their attitudes toward math learning and equipping them with the necessary classroom, study, and homework skills to master the mathematics required for their degree or certificate goals. Student perceptions of the efficacy of program interventions can be used to enhance those implemented in the math-anxiety class and the cohort development of PI. Although the focus of the program evaluation of this study was on math learning, other PI classes and interventions played a role. The evaluation demonstrates how the overall cohort experience is a major factor in the efficacy of the math-anxiety course imbedded within the PI curriculum. The program-evaluation will be presented to PI staff, management, and interested math faculty and administrators in the form of a white paper. The intent is for this insight to enhance the PI experience and ease the transition from foundational to college math for students.

The intervention cited the most by study participants is the availability of the PI staff for counseling, guidance, or just informal conversation following program graduation. This facet of PI is not formally recognized by college administrators as a

function of the program. The program evaluation documents the role continued counseling plays in the academic and life success of former PI graduates.

Recommendations for Remediation of Limitations

The program-evaluation white paper was based upon this qualitative study focused on how PI enables math learning for program participants. Qualitative studies are less amenable to generalization to a broader population. The goal of the study and resulting program evaluation was to document long-term behavior and skill and attitude changes among past program participants. However, because graduates who had graduated long before this study were interviewed (i.e., students who had experienced the program 1 or more years preceding the study), their detailed knowledge of the day-to-day operation of PI was forgotten and an evaluation of program details was not possible. Eight former students were interviewed as a part of the data-collection phase of the study.

It was clear in the final interviews that data saturation had been reached as repeating patterns developed in the interview results centered around the cohort, empowerment, and study and learning habits. However, the stories were unique and increasing the number of interviewees would have added to the thick descriptions of experiences lived by former program participants (Creswell, 2009). The study could also have been expanded to include both recent and long-term graduates of the program, as well as participants currently enrolled. This becomes an issue of scope and the need to carefully craft the goals of the study and program evaluation, the research questions, the structure of the interviews, and the interview questions.

This study and the resulting program evaluation were focused on math learning; however, the tools and attitudes participants learned in other classes and interventions of PI added to the math-learning experience. The study could have been expanded to an analysis of PI as a whole, rather than solely the math-learning course and interventions. This would have also entailed an expanded interview pool to include faculty of other courses with the PI program. The structured interview questions would also have been expanded to include the program as a whole. Counseling is a large facet of the PI experience. This critical intervention would benefit from further evaluation of questions related to how to enhance counseling skills, how to encourage more former participants to engage in counseling, and how to extend academic and life counseling from the PI staff to a wider base of female students attending the participating community college.

This instrumental case study is qualitative in nature and therefore did little to quantify the impact of PI on the lives of program participants. The research behind the program evaluation could have been a mixed-method study, answering questions related to the extent of impact the program has had and the how and why of program success. Again, expanding the scope of the study would require careful crafting of the research questions, as well as experienced researchers to navigate the more complex mixed methodology. Any such attempt would also require scrutiny of the study goals and focus.

All of the participants in this study described improvement in their math-learning and coping skills; however, two students described difficulty in making the transition from foundational to college math. Based upon the literature review conducted for this research, college math has the highest failure rate of any community college course. This

study and program evaluation documented the experiences of PI participants, but did not answer questions of why this transition is so difficult and curriculum changes and interventions that could reduce the stress of this transition and increase success and retention rates.

Scholarship

In any scholarly work, it is important to first establish the goals of the study and the intended use of the resulting analysis. The outcomes should reflect the study goals, and carefully crafted goals will limit the scope of the study to remain within the constraints of available time and resources. Important aspects are the purpose of the study and problems of interest, the target recipients, how the findings will be applied, and whether the results will justify an existing program or define a new program.

To shape this qualitative study and the resulting program evaluation, I used several of the resources introduced in the Walden Ed.D. curriculum (Bogdan & Biklen, 2007; Caffarella & Vella, 2010; Creswell, 2012; Lodico et al., 2010; Merriam, 2009; Spaulding, 2008). Once the goals of a study have been carefully defined, actual implementation can begin with the formulation of the research questions to correlate to the goals of the study. The research questions should reflect the nature of the desired data to be collected. If the data are quantitative in nature, the research questions should reflect the extent of the impact of the problem under study. If the desired outcome of the research is qualitative in nature, the research questions should address the why and how of the problem under study. Put simply, the scope of the research questions encompass

and reflect the overall goals of the research. By answering the research questions, data appropriate to achieve the desired goals of the study will be available from the collection.

Once the goals of the study and the research questions are established, the next step is to determine the best study approach to answering the research questions. If the goals and questions are likely to draw quantifiable results that will be generalized to larger populations, a quantitative study is in order. If the goals are to understand the how and why of a program or intervention, the study should be qualitative in nature. If the goals are to understand the lived experiences of the study participants and the research topic from the viewpoints of the participants, phenomenological study will provide the best data. It is important to invest the time to sufficiently determine the nature and mechanics of the study.

The research method must be fitting for the resources allocated to the study and the timeframe within which the study results will be timely and useful. Study results after the deadline for determining program funding or composition are of no use to the program designers. Once the research methodology is established, the research instruments are selected. These can be established instruments or custom designed specifically for the study. Using previously established instruments is more time effective because their reliability and validity have already been established, although there are times when crafting an instrument for a quantitative study is the only recourse. For a qualitative study, the instruments can be observation; participation in group interventions; interviews such as those performed in this current study; or the collection of stories, photos, or videos. Whether study interviews are structured or semi structured, the

interview questions must be carefully selected and, if possible, tested on a small pilot sample. While crafting the research instruments, it is important to build upon the strengths of the research method and understand the genre. If crafting a qualitative study, data-collection instruments should focus on qualitative measurements.

During the data-collection phase, it is tempting to expand the scope of the study. As data are collected, new questions often emerge or new insight into the target population is gained. It is important to minimize the expansion of scope and maintain the study within the bounds of available resources and time constraints. Altering the nature and scope of the study midstream is appropriate for some phenomenological or other qualitative study formats; however, is rarely appropriate for quantitative or qualitative case studies. The scope and extent of data analysis must be determined during the definition phase of the study. For qualitative study, codes are based upon the research questions and should be defined prior to data collection. In this current study, few changes were made to the codes following initiation of the data collection. The focus of data analysis should be to answer the research questions and build to the strengths of the research methodology. The weaknesses of the study methodology should continually be acknowledged so interpretation of the data and the corresponding analysis is not extended beyond the capabilities of the research method. The presentation of the study results should be timely, with the depth of analysis appropriate for the research goals and the needs of the study and evaluation recipients.

Project Development and Evaluation

I have devoted the majority of my career working on medium- to large-scale integrated devices for the semiconductor industry, with an emphasis on project development and leadership. Although the goals were technical in nature, developing high-technology products within the laws of physics used the same principles as project development and leadership, inclusive of working within budget and resource constraints to produce the highest quality results. Finding and working with talented people who are motivated and knowledgeable in the field is another guiding principle, as well as working creatively and thinking beyond the bounds of existing paradigms. In my role as a technical leader and project manager, I have always placed an emphasis on developing the individual. I would seek out the strengths and weaknesses of each member of my team and utilize their strengths to push our projects forward while relying heavily upon training and education to strengthen their weaknesses. Many of my team members were young engineers straight from college and I helped to develop them into talented contributors to a worldwide technology.

Universally, engineers and technicians who worked with me were already motivated and had successfully negotiated the post-secondary education system as well as the high technology work place. My evaluation of projects revolved around timely results and efficient use of resources, while the development of individuals was secondary. The primary focus of PI is to develop the individual by helping each program participant find meaning, motivation and resources. Success is not measured by project deliverables and adherence to timelines, but changes in the hearts and minds of individual

students. One could measure the success of PI by comparing quantitative measures of student success with a control population of community college students, measures such as grade point averages, course and program completion rates, but such quantitative analysis would not tell the whole story. This project study transformed my perception of what it means to be a successful educator, and how to measure success in the lives and educational pursuits of my students. What does it mean to develop a successful course? How do I evaluate the success of a course or program? Such an evaluation covers more than the content of the course or program and the evaluation of student performance through tests and grades, just as important is an analysis of how the course or program impacted the individual.

In evaluations, both personal and formal of future programs or courses, I will consider not only how students successfully navigated the program, but the factors in the failures of individual students as well. What changes can and should be made to present information in a manner relevant to each student's culture and experience? How can I as an educator identify these students and adapt a course or program to meet their needs in a timely manner?

Leadership and Change

The faculty and leadership of PI are a talented and motivated team, working to change the world, one individual at a time. Over the last 20 years, they have developed and honed much of the program they are utilizing today and have shared their curricula and methods with many other schools within in the state of Oregon. Interventions that they have developed for PI have been implemented within other Oregon community

colleges as they freely share their successful methods. Their work is challenging and they are genuinely committed to the development and betterment of each of their program participants, and the gratification they receive is commensurate with the tremendous effort they extend. My challenge is to emulate their performance.

My foremost motivation for earning a doctorate was to expand horizons of community service for myself and my wife. Before she passed, we were looking at several genre of service. One was water and sanitation projects in third world countries and there are a number of organizations that sponsor infrastructure for producing and delivering water to rural third world communities. A prevalent issue with such projects is that the local community does not have the knowledge and skills to maintain the infrastructure, or sufficient understanding of western culture to find resources to help with that maintenance. As a result, many of these projects fail within a year and the community is forced to return to their original sources of water. With my wife's exceptional people skills and my background in both engineering and education, we were looking to assist an NGO with solutions to these long term problems.

PI focus on helping individuals find resources, help communities identify and utilize resources. While working with the staff of PI, I considered community education projects to compliment programs such as PI. A wave of baby boomers is at or near retirement from the technology community, individuals with considerable talent, motivation and connection. Many of my colleagues are community oriented and would welcome the chance to apply their skills and knowledge to an education oriented cause.

My affiliation with PI and the work on this program evaluation has affirmed new avenues for potential service.

Analysis of Self as Scholar

My background and focus has been in the sciences and engineering, developing computer hardware and software, designing integrated circuits, and developing teams of highly talented engineers. The work has been highly fulfilling. I have also taught as an adjunct math professor at the local community college, working with students in foundational math and early college-math classes. As rewarding as it is to see designs I have created employed within billions of microprocessors around the world, it is even more gratifying to help math students overcome their anxieties. If they did not learn to love mathematics, they at least learned to master the subject.

I deliberately chose a qualitative study to stretch my own horizons. I have performed quantitative work throughout my career and have generated 45 or more patents within various fields of analog circuitry, computer clocking, and synchronization, as well as high-speed transmission circuitry. In the process, I have completed volumes of quantitative research. Working with PI through a qualitative study, interviewing students whose lives have changed due to the efforts of the PI faculty and staff, has broadened my own capabilities as program interventions have been analyzed and brought to light through this research. The study brought a keen appreciation for the power of qualitative research in probing human behavior and effectuating change.

My strength is developing programs with measureable deliverables and goals of efficiency. Through this study and evaluation, I have learned to analysis the impact of

programs on people. Though it is important in any scholarly endeavor, it is critical to formulate the right questions when approaching a study of a program with the overarching goal of assisting people in their development. The weeks of thought I put into clarifying of the research questions allowed me to focus and organize data collection and analysis. Women are making inroads in advanced technology development, but the field is still dominated by Caucasian males, and the makeup of my engineering teams reflected this demographic. Through this research, I learned to minimize bias, both intentional and bias due to circumstance such as gender, ethnic and age gaps. The informal feedback I received from the staff of PI was that the study participants felt comfortable and respected during their interview.

I also focused on the ability to ask probing questions and solicit heartfelt, profound response. There is no correct answer to questions posed in a qualitative environment, only insight to be gained through understanding the experiences of the study participant. Soliciting honest, unfeigned answers requires thoughtful structure and methodology in a study, structure which enables protection of participants and analysts, also provides a haven for breaking down barriers to honest communication. In previous research, I have had little reason to consider the environment for interviews and data collection, as most work was done in situ. Early in the study definition, I realized the importance of the venue for conducting interviews, and with the PI staff, carefully considered the ramifications of several interview sites.

Conducting a literature review is another area where I experienced considerable growth. For technical information, there are different criteria for trusting a source. Even

online sources such as Wikipedia tend to be more reliable. Bias is a more prevalent issue in the qualitative analysis of human interaction and development, and it is important to vet sources of information with structured criteria for determining veracity and credibility. I also developed systematic methods for traversing references and citations using various apps and add-ons for web browsers.

In discussing the results of this study with several colleagues, they encouraged me to expand on the topic of math and learning anxieties by publishing a book. The idea is intriguing. Math anxiety books tend to focus on the experience of the student, featuring information and resources on how to overcome anxieties. There is a need for literature tailored for the math instructor and program developer on techniques for building rapport and self confidence in the math class, and helping students do more than identify, but use available resources.

Analysis of Self as Practitioner

As a math teacher, I was clearly "old school." My math classes were of a traditional lecture format, with plenty of time to answer student questions and work problems on the board while explaining problem-solving skills. For each math class, I scheduled ample time out of class for group study and review, inviting all students to come to study sessions or to schedule private time with me to work through their math-learning issues. One motivator for beginning this doctoral journey was a daughter who suffered from an extreme case of math and test anxiety. I would help her learn the material to the point that she could tutor others and subsequently watch her fail as she froze during exam after exam. It was heart wrenching and left me with a sense of

helplessness. I began the doctoral program to learn what I could do to improve my teaching skills and repertoire of interventions to help students struggling in the same manner.

The instructors of the math-anxiety course of PI have assembled effective interventions for empowering students and teaching them the skills, attitudes, and behaviors necessary to overcome their fears and master the subject of mathematics. They provide students ample opportunity to learn the concepts of motivation, problem solving, time management, study habits, and testing skills through triangulation. They approach the subject of math from many different directions using many different resources (e.g., group discussion, videos, multiple textbooks, external resources, and guest lecturers). The goal is to approach each concept from multiple directions, which if not carefully implemented, can be confusing. I have seen students bewildered by multiple approaches to problem solving, thinking they must master each technique and not understanding that they need only master the technique that best fits their learning style. The math faculty of PI surmounted this problem.

As a result of the Walden Ed.D. curricula and working through study of the PI math interventions, I have gained invaluable knowledge that will significantly change my future teaching methods. I will borrow many of the techniques and interventions from PI such as group discussion and ample classroom time for practicing problem-solving skills. During the literature search conducted for this study, I found many references to inverted classrooms and other nontraditional styles of teaching that make the most of classroom interaction between teachers and students, as well as between students. Study time

outside the class room then becomes less frustrating and more fulfilling. Students are able to make meaningful progress in mastering mathematical concepts.

Analysis of Self as Project Developer

The study surrounding PI and the resulting program evaluation have been an excellent exercise in qualitative research. Many of the organizational skills I have learned over the years as a project manager and technical content expert transfer well to a broad variety of research and development projects. Such skills include scoping available resources; limiting a project to an effort that can be accomplished within the time allotted; and cultivating stakeholder's interest and motivation to help the project succeed. For me, the learning was in the application of these skills in a qualitative environment with more personal interaction. As a White male, interviewing minority female adults, many with histories of abuse and addiction, posed the possibility that the study participants would not feel free to respond openly to the interview questions. I took great care in setting the tone and the environment for each interview, and rapport was rapidly developed as the participants worked with me toward a common cause, describing the various attributes and interventions of PI that had changed their lives.

Through this study and evaluation, I have a deeper appreciation for the benefit and utility of locating and utilizing existing resources. PI teaches this as a core skill, and in the execution of their program, they live this skill by leveraging the Women's Resource Center and other programs on the college campus. To find solutions for educational issues, the last resort should be to start a new project or program. Building

from scratch is inefficient and time consuming and it is better to reshape or expand an existing program.

To build anew or modify an existing project, it is critical to identify and earn the trust of all those who may play a part in defining, building and benefiting from the program. Through this project study and evaluation, I sharpened my ability to approach and earn the trust of individuals of diverse backgrounds. I had no previous relationship with the PI program, which facilitated an unbiased study. However, to begin this study, I had to earn the respect and trust of the project faculty and staff. To execute this study, I spent considerable time considering to how to approach and interview diverse participants. These are skills which will benefit future project development efforts.

Like all fallible humans, I am a finite resource and must choose projects with care. We cannot solve all educational problems or provide the perfect campus experience for every student. I must learn to utilize my unique talents to affect the most change commensurate with my bounded time and abilities.

The Project's Potential Impact on Social Change

The raison d'être for PI is social change. The goal established for the program is to support adult women desiring to return to college for a degree or certificate, as well as to contribute to the improvement of their overall lives. Although this study and the resulting program evaluation are focused on mathematics, highlighting the PI interventions that promote math learning, the program evaluation may have more general application. Community colleges across the state are struggling with success and

retention in their math courses, particularly as a student transitions from foundational to college math courses. The conclusions and recommendations of the program evaluation provided in this study can be used to soften that quantum leap between foundational and college math that one study participant referred to as the hazing ritual.

Project Independence serves about 20 students per term. Sixty people a year whose lives are changed. Can the techniques and structure of PI be leveraged across a more general population of community college and university students? The college Success and Career Guidance department offers a number of classes in college survival, personal responsibility, goal setting, and self-management and study skills. These classes could be organized to offer coordinated help to students who are struggling with the community college experience, but may not need the comprehensive emersion experience of PI.

As part of the foundational math class experience, students are taught where to find resources for help with questions and homework. Based on learnings from PI, it is important to do more than instruct students how to find resources, but to show and introduce them personally to the people who can help them. For early foundational math classes, this can take the form of field trips to the learning center and personal introductions to tutors who specialize in foundational math. Even though PI is an immersion program, mathematics instructors can leverage the techniques of PI into their foundational and transition math classes.

The students of PI were receptive to math concepts and math learning when presented in a way that resonated with their ethnic and cultural background. Such

culturally relevant instruction will encourage diverse students to appreciate the value and even the beauty of mathematics.

Implications, Applications, and Directions for Future Research

This was a qualitative study on the math-learning segment of a community college preparation program for adult women. The success of PI has been discussed from the viewpoint of past program participants. Further study could analyze the program from a quantitative viewpoint, gathering statistical data on the success rates of PI students related to term-by-term success and attrition rates, as well as analyzing success rates course by course through foundational and college algebra and college completion rates by the degree or certificate. All of these quantifiable measurements could be compared to the community college population as a whole or colleges in general.

PI could also be studied qualitatively as a program. Beyond PI, a success gap exists from foundational math to traditional college math courses, a gap which college math departments are working to close across the state of Oregon. This is also an opportunity for further research. Why do students who are successful in foundational math classes flounder with the transition to a college-level math course? What can be done to remediate this reduction in student understanding? Perhaps changes in foundational math courses to better prepare students for college-level mathematics is in order. This could also mean changes to the college-level course sequence to allow for accommodations such as self-paced learning and combinations of online versus traditional classroom courses.

Continued counseling at PI has been a decisive factor in the success and retention of program graduates through the community college experience. This counseling and encouragement could be extended to non-PI students. At the study-site community college there are no programs similar to PI for male students. Further research could be conducted to ascertain whether such programs would be beneficial to the college and to the population of adult men seeking to begin or return to college. The math-anxiety course in PI is taught in two different ways, depending upon the instructor. One instructor focuses exclusively on math-learning skills and attitudes. The other teacher brings concepts, such as order of operations and basic algebra, to the course and teaches students math-learning skills while working through actual math problems. A study could be formulated to determine which approach is best for developing long-term math-learning skills and attitudes.

Conclusion

This research has enabled the provision of findings based upon accepted education theory and academic research practices. As a qualitative study, the research did not entail quantification of program success in terms of graduation, retention, course-by-course success rates, or other quantitative measures. The research and resulting program evaluation are focused on participant experience with one aspect of PI—math learning—although all facets and interventions of the program were instrumental in contributing to participant improvement of their math identity and resulting math performance.

Few graduates of the program develop a love or even an appreciation for math, but most developed the attitudes and skills necessary to succeed in the math class.

Graduates come away with critical problem solving, education and life skills and credit the program as a life-changing, lifesaving experience. Through this qualitative case study and resulting program evaluation I have provided PI with findings related to those program interventions that are successful in improving the math-learning skills, behaviors, and attitudes of program participants. The program evaluation also yielded recommendations for curriculum changes, incorporation of graduates into the program and better use of available campus resources.

Project Independence is a successful program serving approximately 20 students per term, participants that faced a plethora of life issues such as drug rehabilitation, abuse, and incarceration. Expanding elements of this program to encompass a larger segment of the community college population will be difficult. Core to the success of PI is the trust and comradery developed in the cohort, traits difficult to achieve in non-emersion programs but may be possible for students struggling with fewer life issues. Another recommendation from this evaluation is a complementary program serving men who are struggling to resume or begin their post-secondary education.

In terms of my own learning as a scholar, project developer, practitioner, and leader, the qualitative study format was new for me. Through this program evaluation, I have come to appreciate a more humanistic approach to teaching mathematics, using techniques such as group participation in the classroom, personally introducing students to available resources outside the classroom and a multi-faceted approach to teaching key mathematical concepts. Through the execution of this research I have gained compelling insight into qualitative academic research. I have developed key skills in perfecting

research questions, conducting interviews and analyzing qualitative data, skills, which I will use in future teaching, volunteer and literary efforts.

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Appendix A: White Paper

Program Evaluation of the Project Independence
Math-Anxiety Program at Portland Community College

Overview

This goal-based qualitative evaluation (Spaulding, 2008, p. 18) is focused on the long-term effectiveness of the Project Independence (PI) program in terms of changing habits, skills, attitudes, and behaviors toward improved math learning. This is a participatory-oriented evaluation, considering the success of the program from the vantage point of the program participants (p. 12). The logic model of PI is composed of the program resources and the activities comprising the mathematics intervention. An evaluation of the PI math-anxiety program cannot be conducted in isolation, but rather, must be studied from within the context of the overall program.

The data collected and analyzed for this evaluation were drawn via a qualitative instrumental case study, a research design tailored to explore a specific issue within a bounded environment. The research questions are grounded in the struggles of PI participants with math and the long-term efficacy of the math-learning interventions of the PI Cascade campus program. The detail and direction of the program evaluation are guided by the answers to the research questions. This evaluation follows that recommended by Spaulding (2008, p. 15) and his guidelines for the content of a program-evaluation report (p. 29).

Purpose

PI is located within the Cascade campus Women's Resource Center of Portland Community College. It is an established, ongoing immersion program designed around a cohort model. The multifaceted goals of PI are to help women prepare for the community college experience, gain self-confidence and examine their education and career goals (Portland Community College [PCC], 2013). Program participants come from all walks of life and are of a diverse cross section of cultural and ethnic backgrounds. These students may be single parents, divorced, separated, or widowed. They may have been in recovery for substance abuse or have a history of incarceration. The majority are first-generation college students with a lack of interest, understanding, or support from family and friends with regard to their education pursuits. Many have been in abusive relationships and are survivors of domestic violence. Nearly all of the students enrolled in PI experience anxiety related to starting or returning to school.

The PI immersion program is considered successful by the faculty, staff, and administration of Portland Community College. However, no academic study prior to this research had been conducted to evaluate the impact of this program on the lives of participants. Although the scope of the research grounding this evaluation was limited to the math performance of the study participants, the interventions used by PI to improve attitudes, behaviors, study habits, classroom skills, and testing skills are not isolated to the math-anxiety course of the program. The cohort, career-goals class, physical education, and other PI courses, as well as the ongoing guidance and counseling by PI staff, factor heavily into the long-term math success of PI graduates.

Project Independence

PI admits approximately 20 students per term into the program. In addition to delivering the courses and interventions throughout the term, the PI staff and director provide counseling for any previous graduate and any other women who come to the PI office seeking academic or life counseling. The program staff and administration collaborate on an ongoing basis with similar programs at other Portland community colleges, as well as community colleges across the state of Oregon. The math faculty of PI collaborate with all other math faculty within the community college implementing the program, utilizing a wide variety of resources including locally developed videos and other materials to assist students experiencing math anxiety.

Logic Models

The students of PI meet 9 hours per week for formal course work. Six of these courses are physical education, math anxiety, and four career-guidance classes. In addition to the classroom work, PI students also meet three times per week in group counselling sessions with the project director. In this immersion program, all participants take the classes and counseling sessions concurrently. The Physical-Education Course 182 H is designed to help participants improve their cardiovascular fitness, flexibility, and overall strength. This course meets three times per week with the intended outcome of teaching physical conditioning, helping participants develop lifelong health habits, and promoting student recognition of the value of physical fitness. Throughout the course, students demonstrate their progress through demonstrations, pretesting and posttesting of physical fitness, and written exams.

The Career Guidance 101 college-survival course teaches participants individual responsibility. It helps students learn to navigate the community college system, finding the resources and services available to help them achieve their academic and life goals. They personally visit or search for available online campus resources while learning the expectations of them within a college classroom. Participants are encouraged to be personally responsible for their academic success. The Career Guidance 140 B career-and-life-planning course focuses on providing participants with the tools and resources they need to make informed career choices. The students research career information and take various assessments measuring their skills, values, interests, and personality. During the course, they develop a written plan outlining their career goals, they assess both written and online career-guidance information, and demonstrate skills and knowledge through in-class demonstrations and reports.

The Career Guidance 144 introduction-to-assertiveness course instructs participants on how to properly apply assertive communication techniques and conflict resolution in both their personal and professional lives. They demonstrate these skills throughout the course in written and oral assignments, group exercises, role-plays, discussion, and quizzes on course content. The students develop competency and learn skills in the areas of effective listening, paraphrasing, and their personal rights as students and citizens. The Career Guidance 146 value-clarification course helps students understand that all choices have consequences and their choices must reflect their attitudes and beliefs. Throughout the course, students journal their personal behaviors and

the values that affected their decisions. They write an essay on how their belief system is constructed and discuss and role-play various aspects of their value systems.

In addition to the six described courses and math-anxiety course, the students meet three times per week with the program director in a group counseling session. All of the participants in the study conducted for this evaluation specifically mentioned the group counseling and informal one-on-one counseling available during or after their PI experience as a highlight of the program and a significant factor in their subsequent academic and life success. Math is the subject most feared by the majority of community college students. Consequently, the focus of the study conducted for this evaluation was the math-anxiety course taught within the framework of the PI experience. For this course, the PI cohort meet for 1 hour, once per week, for the duration of the 10-week term. Week 10 is reserved exclusively for the program graduation so students attend a total of nine 1-hour class sessions. Since class members, as members of the PI cohort, meet 10 hours per week in other courses, as well as counseling sessions, they have already developed a rapport and trust outside the math-anxiety class.

The majority of the math-anxiety classes are conducted in a *jigsaw* group-discussion format. Groups are reformed with each class, rather than maintaining the same groups for the duration of the term. This ensures against one student dominating the group; students who are stronger or better versed on a topic are encouraged to participate in the group discussion and assist those with weaker skills. Using this format, all students benefit from the group discussion. On jigsaw group-discussion days, the instructors utilize other resources during the class period. If time permits, they show videos on

various aspects of math learning that were created at the PCC Rock Creek campus. The faculty invite individuals with similar backgrounds to the PI students who have moved forward and achieved academic and life success to attend a class session and tell their stories. One visitor in particular was mentioned by three of the study participants. This woman was a math instructor at PCC. She began her education in the foundational math courses familiar to many of the program participants and worked her way to a math degree and a teaching position. The PI students were particularly impressed that she came from a similar background and had overcome much of what they were experiencing in their own lives.

Math-Anxiety Interventions

Three themes or overarching concepts guide the curriculum and interventions of the PI math-anxiety course. The first is to help students understand and address their own math identity. The second is the study skills related to the self-motivated student, which include seeking available resources such as tutoring or counseling. The third theme encompasses learning styles and how students can identify their styles and subsequently develop study, testing, and classroom skills conducive to the identified learning style.

In addition to the course content provided in Table A1, PI math instructors also use many handouts and written assignments in the daily execution of their classes. Handouts include segments of various textbooks, reproduced with the permission of the authors, and worksheets to be completed by the students either in class or as homework. Course content and homework assignments also include various online content including YouTube videos.

Table A1

Math-Anxiety Course Content

Week	Subject	Format	Content
1	Math identity	Jigsaw groups	Group 1: Experiences promoting negative math identity Group 2: Experiences promoting a positive math identity Group 3: Experiences potentially fostering math anxiety Group 4: Activities that help overcome math anxiety Group 5: How college differs from high-school math
2	Math sequence	Instructor-led discussion	Review the math sequences and discuss the math classes needed to earn a certificate or degree
3	Study skills	Jigsaw groups	Group 1: What students should do the day and hour before class Group 2: How to ask questions during math class Group 3: How to take notes during class Group 4: How to read a math textbook Group 5: How the ideal college student can be described
4	Time management and homework	Jigsaw groups	Group 1: Present five time wasters that detract from college success Group 2: Present five ways to create and use calendars Group 3: Present five ways to motivate homework Group 4: List resources for help with homework Group 5: List ways to keep focused on math from week to week
5	Math anxiety	Video	Video followed by discussion on math anxiety. List five things that make math fearful, ranking the list from *not so scary* to *super scary.* Refer to this list during the balance of the term to overcome fears.

(*table continues*)

Week	Subject	Format	Content
6	Exam day	Jigsaw groups	Group 1: List things a student should do 2 weeks prior to an exam Group 2: List things a student should do 1 week prior to an exam Group 3: List things a student should do the day before an exam Group 4: Discuss test-taking strategies Group 5: List two actions to take with a satisfactory grade and two with an unsatisfactory grade
7	Math-anxiety interventions	Jigsaw groups	Group 1: How to use the learning center Group 2: Three interventions to master a fear of math Group 3: Four techniques to enhance motivation Group 4: List barriers to long-range goals and ways they can be breached
8	Learning styles	Jigsaw groups	Group 1: Visual learners Group 2: Auditory learners Group 3: Kinesthetic learners Group 4: How visual learners can better focus on homework Group 5: How auditory learners can better focus on homework
9	Review	Jigsaw groups	Group 1: How to work with a difficult instructor Group 2: Obstacles encountered by nontraditional students Group 3: Elements of test preparation Group 4: How an active student reads a math text Group 5 : How to take notes in class and complete homework

The math-anxiety program is grounded in the trust and rapport developed among the cohort, with the majority of the classroom work performed via student-led discussion and presentations. The curriculum is focused on a triangulation of knowledge and ideas. Students learn the perspectives of their instructors, their peers, guest lecturers, various videos, and online content, as well as textbooks and reference materials.

Rationale and Criteria

In addition to college preparation, PI has been supporting the life and career goals of female students for over 20 years; yet, the program has never been studied and evaluated using accepted research and analysis practices. The study conducted for this evaluation was focused on the math-learning aspects of PI; however, the study and classroom skills, attitudes, behavior, and time-management skills needed to improve math learning are not taught exclusively in the math-anxiety course, but are also acquired in the broader context of the PI program. The goals of the study were not to quantify the success of PI graduates in terms of course-by-course attrition, their success at math learning, graduation rates, or other quantitative measures, but to learn from the participants themselves how PI has instilled positive long-term change in their lives. The classroom, homework, and study skills they acquired and implemented in their academic pursuits were also of interest, as well as how their attitudes changed toward math learning in the long term. The goal of this program evaluation is to document the long-term impact of PI on the education pursuits of program participants, specifically math learning. Through the analysis of data collected within a formal research setting, potential

modification could be recommended to enhance the long-term benefits of college-level math learning (Weiss, 1998).

Evaluation Plan

This program evaluation and the qualitative case study conducted toward its creation document the efficacy of the PI program in changing the lives of the female participants. The evaluation was designed to provide the long-term impact of PI interventions, the attitudes, behaviors, study habits, and knowledge gained by the participants and applied to their subsequent academic and personal lives. The overall success and efficacy of the program are described by participant accounts, describing how changes in their academic achievement and math learning were made possible as a result of the PI program.

The research conducted for this evaluation was designed as an instrumental case study. This is a heuristic form of study suited to gauge long-term ramifications—both overt and subtle—of math learning in the PI program. Qualitative case studies are conducive to answering how and why questions within a finite study environment over a specific time frame (Merriam, 2009, p. 44). An instrumental case study is not focused on the case itself, but on an understanding of academic phenomenon addressed by the research questions. The research questions of the study grounding this evaluation were formulated to explore how past PI participants overcame their fear of learning mathematics and developed tools, attitudes, and behaviors suited for successfully completing math courses within an academic environment. The instrumental case study is based upon established learning theory (Mills, 2010) and, in the case of the study

preceding this evaluation, the andragogical learning models of Knowles (1998), Hilgard and Bower (1966), and Mezirow (1991), as well as the Bourdieu (1990) theory of class.

The majority of data collected for the study grounding this evaluation were in the form of the interview transcriptions of former PI graduates. Participants were purposely selected with preestablished criteria. They are successful graduates from PI within the 2 years preceding the study and have taken at least two math courses after completing the PI immersion program. All but one of the participants mentioned math anxiety as a significant problem and a causal factor for their anxiety surrounding their return to school. During the interview process many participants described problems with asking questions in class. One interviewee stated, "Lots of instructors tell you no question is dumb, but the answer they come back with makes you feel dumb. You can tell me no question is dumb, but the way they reply is another story." Being asked to work problems in the front of the class was a terrifying and humiliating experience. The majority of the study participants formed their opinions of math from their classroom experiences. Another interviewee stated, "The second week of class my teacher made me do math problems in the front of the class. It was humiliating; a horrible experience."

Each participant in the study conducted to provide this evaluation considered math a significant barrier to their education progress, and this lack of success in math transferred to their other academic endeavors. They did not have the skills or knowledge to seek available resources to help them with their math-learning dilemmas. One student participant described her experience in the following manner:

> I had the mind of a very stubborn 18- or 19-year-old girl. I didn't really know anything about tutoring, getting extra help. I wasn't going to engage with anything like that because I felt that I can't do it and I should be a leader on my own. . . . My self-talk was that I was retarded. This tape played in my head over and over. A large number of us were really concerned about our ability to do math. . . . I didn't feel confident in any area, especially math.

The life experiences of these students are peppered with abuse, drug addiction, incarceration and dysfunctional families. Although not directly related to math learning, these experiences colored and delayed their overall education pursuits. As one student revealed,

> Twenty years of not going to school, taking any kind of classes. A big part of the 20 years was drug addiction, on the streets, stuff like that. Literally, it was the farthest thing away from school that you can get.

The majority of students participating in the PI program are first-generation college students, dealing with the unfamiliar culture and language of academic life with little or no family support. As one student expressed in a study interview, "No one close to you was talking about college at the dinner table night after night. No one knew what a PhD was, or had even heard of it." Another student explained,

> Nobody in my family graduated from high school. My mom had me at 16 when my dad was 17. School was important to them, but they did know how to help me and they didn't know anything about the math I was doing; it was just a foreign language to them.

Each student participant in the study conducted for this evaluation was asked to complete a demographic survey prior to the actual interview (see Table A2). Two of the study participants chose not to complete the demographic survey. As the researcher, I did not attempt to force the issue. I was more interested in setting a comfortable, nonthreatening environment than I was in collecting the survey data. I stressed the fact that participation in the survey was strictly voluntary and the participant decisions in this regard would be honored. Two math instructors were also interviewed, as well as a program administrator. The instructors provided curricula material in the form of daily course content, handouts, textbooks, and online links to resources. The program administrator supplied overall program descriptions, content, and summary statistics collected on the PI program.

The interview format in the study conducted for this evaluation was semistructured in nature. A preestablished interview protocol was followed, with open-ended questions allowing interviewees to provide thick descriptions of their experiences and attitudes. In a semistructured interview format, follow-up questions are acceptable and even desirable, to solicit deep and thoughtful responses. The duration of the interviews ranged from 40 minutes to 1 hour and 20 minutes, depending upon the conversational style of the study participants. The interview sessions were conducted at the Women's Resource Center of the participating community college. The interviewees chose, and were comfortable within, that environment, surrounded by individuals they know and trusted. Every effort was made by the researcher to assure the participants of the private nature of the conversations, the care that would be taken to secure and

Table A2

Demographic-Survey Results

Student	Age-group	High-school math classes	Grades	College math classes	Grades	Race	Annual family income
1	35–50	Algebra	DNR[a]	Math 95	C	AA	$50K–$100K
2	51–65	DNR[a]	DNR[a]	Foundational	DNR[a]	AA	Not reported
3	26–35	Algebra	A	20, 60–70	A	White	> 25K
4	35–50	None	N/A	20, 60, 63, 63	B	White	> 25K
5	35–50	Prealgebra	A	20, 60–65	A	AA A Ind	> 25K
6[b]	35–50	Prealgebra	F	10,20	A	White	> 25K
7						AA	
8						White[b]	

Note. DNR = did not respond; AA = African American; A Ind = American Indian. [a]The study participant does not remember. [b]The participant did not complete a survey; this is the best judgment of the researcher.

maintain the privacy of the recordings and subsequent transcription, and the opportunity for each participant to review the transcription results for accuracy and completeness.

The data collected through these interviews provided a rich and insightful description of how these participants viewed the long-term benefits derived from the PI

experience. Qualitative in nature, the outcomes described in this study may not generalize to different programs or the more general community college population. However, some concepts, such as developing a sense of community through the cohort and encouraging the use of advisors and counselors, could be generalizable to other community college settings.

Transcription analysis for a qualitative study is performed by sorting relevant transcription segments into appropriate codes chosen specifically for the research. The codes used in the study conducted for this evaluation were linked with the research questions. Research Question 1 asked, "Why do women participating in PI find mathematics to be an obstacle to their progression at the Portland community college serving as the study site in this research?" The codes associated with this research question were early experiences, attitudes, disorienting dilemmas, self-efficacy, learning behaviors, and learning anxieties. Research Question 2 asked, "How does PI help women acquire study, coping, and learning skills that improve their math performance at the community college serving as the study site in this research?" The codes for this research question were PI methods, math teaching methods, cultural relevance, and community support. Research Question 3 asked, "How do the women participating in PI apply the skills and knowledge they have learned to long-term improvement in math performance?" The codes associated with this research question were math testing, problem solving, classroom skills, coping skills, and study and organizational skills. The definitions of the codes and coding schemes, as well as the assignment of transcription segments to the actual coding, were all decisions made by me as the researcher. A

qualitative data-management program was used to facilitate the mechanics and bookkeeping aspects of the actual coding process.

The Researcher

I am an adjunct faculty member of the PCC Rock Creek math program offered by the Portland Community College that served as the study site in the research conducted for this evaluation. However, I have not taught during the 5 years preceding this evaluation due to work and family obligations. I have never taught at the specific Cascade campus where the PI program is delivered, nor have I been involved directly or indirectly with any faculty, staff, or participants in the PI program. With no previous ties to the program, I am able to provide an evaluation with minimal bias or conflict of interest.

Although my education background is in mathematics, I have significant electrical-engineering experience as a designer and team leader on several large-scale microprocessor design projects. I have earned over 45 patents in the definition of synchronous, mesosynchronous, and plesiosynchronous microprocessor systems, analog data-transmission circuits, physical-layer architecture, and volume manufacturing. This experience has given me in-depth experience in quantitative data collection and analysis. My first love is teaching mathematics, with an emphasis on foundational math and supporting students struggling with math-learning anxiety. My passion for teaching mathematics, as well as my interest in those with math-learning anxiety, is what drew me to design and to implement the project study that resulted in this program evaluation.

Outcomes

Project Independence Interventions

According to the participants in the study conducted for this evaluation, the cohort played a major role in the success of the math-anxiety class. The students attended multiple classes together and had already formed bonds of friendship and trust upon beginning the math-anxiety class. Motivation was not an issue in this class. The participants were able to speak freely and discuss their anxieties without embarrassment, as well as their negative self-talk and negative attitudes surrounding math. This would not be the case had these students entered a class of other unfamiliar students. As one study interviewee expressed,

> Maybe the difference with taking [the math-anxiety class] with the Project Independence people was the fact everyone is starting out at a place in life where most of them had not been to school for a very long time; another percentile had struggles in other areas. That was the difference.

The PI program is modeled around the cohort as the basis for motivation and collaboration and is designed to encourage the natural formation of personal bonds and trust. As described by another interviewee,

> Part of what made Project Independence what it is, is having a group of students that you go to with all of your classes. . . . We are able to discuss what we are doing [in] all the classes; we ended up all sitting together for lunch . . . discuss math, and work on homework together. We were encouraged to do that, but it was something that came out organically as well. It was a big community support

> amongst us and so, when I had fear or apprehension about math, I would have all these classmates to talk to and to work through these issues. . . . I think that, if I just came in randomly, I would not want to admit [to] anybody how fearful I was; I wouldn't be comfortable with asking for help. I would be so worried that I would appear stupid. I have a lot of anxiety around it.

The PI students understood and appreciated the cohort-based implementation of the program and embraced the resulting learning community. One student stated,

> It did make a difference [the cohort]. It totally made a difference. It was key. . . . We had support from each other. That was intentional. This is an intentional learning community of people. To just go into a class not knowing anybody, people are trained and programed to stay isolated in that individuated way. You really have to "push on the wall," and that "wall" was already dismantled.

The study participants described the camaraderie that developed within the cohort and the encouragement and the motivation they derived from each other as they tackled math learning, a common adversary. One study interviewee explained,

> Even if you got a little overwhelmed or off track, there was always going to be someone there on your left and on your right, saying, "No, we are going to this class or that. Did you remember to bring your homework?" The balance was really good.

This determination and self-worth developed as a result of the PI cohort and was fostered and leveraged by the math faculty, as expressed by the following faculty member:

> I don't know how they do such a good job at this, but the students really develop a sense of self-worth, a sense of core orientation. They really want to do some change in their life. That does not all come from my [math] class; it comes from Project Independence.

Four of the study participants tied the physical-education class to an improvement in their morale, their motivation, and their sense of self-worth. These attitudes carried into math learning. One of these students recalled,

> One of the things that we talk a lot about was lots of physical activity. It helped. When you are physically healthy, you are rested and breathing, letting your mind get real still. I don't know what to say—relying on what you can learn and know to keep your[self] self-centered.

Counseling during and after the PI experience helped students overcome the dilemma of math learning in their subsequent math classes. This was succinctly described in the following interview excerpt:

> Project Independence gives people a safe place to get rid of their fears and to tackle math a little bit at a time, no matter where they are or their style of learning. I come to the Women's Resource Center two or three times a week. This is my safe place.

After formally graduating from the PI program, students were encouraged through continued personal counseling to tackle the math sequence necessary to complete their education goals, as exemplified in the following study-participant comments:

> The project director brought it up. "Okay, you haven't taken any math yet." We talked about what was going on in my head. . . . "Even if you don't get an 'A' in math class, you're going to be okay. There's no outcome of this that you can't get through." She basically brought up all of the ideals that have been instilled in us during Project Independence. . . . That's a great thing about Project Independence. They don't just push you out at the end of the term . . . the support is definitely here. If we want advice or help, [the director] and all the instructors are really great. I've continued relationships with all of them.

Math-Anxiety Course

A goal of the math-anxiety intervention is to place a math teacher in front of students who is relatable, tolerant, caring, and patient. The role model of an excellent teacher helps students develop classroom, communication, learning, and questioning skills in a math-learning environment. The success of this effort is evident in the following student-interview excerpt:

> [The instructor] is just a rare individual. He could make any program work; it's his personality. Seeing how he teaches us in the math anxiety-class, he is so approachable. He reiterated over and over again, "No question is dumb. You don't need to feel ashamed. You are not alone." He made sure that people felt comfortable asking questions. "Don't shrink back. It doesn't matter what, raise your hand and I will answer you; no question is dumb."

The study participants recognized the importance of their instructor as a role model and, through the classroom interaction, were able to recognize and develop their math-learning styles. One student offered the following teacher description:

> As a teacher, he [the math-anxiety instructor] has a unique ability to be able to be in front of a class and have a unique connection with each student. He was very gifted to be in touch with individual learning styles.

Over one half of the study participants mentioned role models in the form of guest speakers who came to speak to them in the math-anxiety and other PI courses. One of the math professors at PCC spoke about her background, which was similar to the backgrounds of many of the students in the program. The description of her journey to academic success had a profound impact on these study participants. One student recalled,

> Another professor . . . came to speak to us about math. . . . She came from a very working class background; neither [of her] parents went to college, she got married quite young, and again, this is something that many of us in Project Independence can identify with. She was a nontraditional student. . . . She explained to us that she hated math. She felt like she would never be able to succeed in school because of math. . . . Of course, now she is a math professor. Having our instructor bring in somebody who is so relatable really resonated with so many of us that, if somebody else can do this, coming from the same place that I am, I can do this too.

The study participants recognized not only the different approaches that the instructors took to teaching math learning, but also the triangulation format of the curriculum itself. Course content the participants remembered and internalized included journaling, open discussion, videos and online content, textbooks, handouts, and peer perspectives and encouragement. One student interviewee recounted,

> He showed us videos; he basically gave us that information verbatim. We journaled; he had open class discussions. He opened up the mystery of it. I always thought that there was a mystery that girls couldn't do math. That was a big belief system. He challenged that. "Why not?" He asked us those questions. . . . He asked us direct questions. . . . "Let's talk; let's figure it out together." You feel a part of it. Sometimes, when I went to a class, I felt like the teacher talked at me. He made me a part of the solution. He made me feel more empowered than just okay.

The study participants appreciated the multiple resources available to them for learning how to learn math. As another student described,

> He had us go online [where] there were short tutorials about study skills and where we can go for help all around the campus. I believe that the woman who does these tutorials is from PCC. She talked about the resource center. That helped a lot.

Another student interviewee remarked,

> We went on a scavenger hunt where we went around and tried to find all the resources that could help us. . . . We made posters in groups of what we found

> around the campus—the underground, the student center, something that somebody who is just coming to school wouldn't know was there.

The math-anxiety course is designed to give each student a "taste of success." Although student success may not be directly related to learning math, genuine success is indeed experienced when students have developed their unique math identities and math-learning skills. A study interviewee described the process in the following manner:

> He would give us work that we were able to do, and if we were not able to do it, he would take it down a level until he would get to our individual ability and then let us build on it by giving us something a little bit more difficult but along the same line. He allowed us to get success. . . This [math-anxiety class] got me to a place where [it] felt like it was something I could tackle. This allowed me to succeed, succeed at my own pace, to build a foundation of belief that I could do math, and then move forward.

Students who had actual math problems presented to them in class were able to gain confidence in their ability to do math and that their mastery of subjects, such as algebra, was attainable. As one student described in the following interview excerpt:

> We broke the problem down and we were all able to follow through and complete this math question. When it was done he said, "Well, you're doing algebra right now. "Basically, he got us to do a problem that we all felt we could do. . . . He allowed us to have success and do something we were comfortable with, but we were moving forward.

Through the math-anxiety course, students developed a sense of control over their math education. One student participant stated,

> It wasn't so much doing math as exploring math as a phenomenon and different ways to engage in it. I could totally get into that. It gave me a point of reengagement. I have some control here. That was cool.

Another student commented, "Project Independence gave us the tools to be able to look at ourselves and get over our math anxieties." Another student participant described the confidence-building aspects of the math-anxiety course in the following manner:

> The first part of this class is talking about our anxieties about math, challenging our belief system about math. . . . I was really surprised at his approach. The things that he taught us about math had nothing to do with numbers at all. It was about changing the way we thought about math. . . . Yes, it was dealing with your anxieties, your negative belief system. Your personal experiences affect why you think that, challenging those beliefs. It's about building up your confidence with math.

Addressing math-learning anxiety involves attitudes. Adult learners who fit the Knowles (1998) andragogical learning models are self-motivated, self-directed, and problem centered. However, these traits are not inherent; they are acquired through life experiences (Komarraju & Nadler, 2013). The associated skills are acquired principal upon principle, from the simple to the complex (Hilgard & Bower, 1966, p. 562). For the participants in the study that led to this evaluation, math learning was a disorienting

dilemma requiring reflection and reevaluation (Malkki, 2012). One student stated, "My best experience was more of an overarching experience. It was coming to understand how I learned. . . . Everything was relevant and supportive, and I'm dealing with it out here in the math world." For the following study participant, the course meant empowerment:

> It wasn't the experience, or one particular thing that [the instructor] said; it was the way he made me feel. I will never forget. He made me feel empowered, he made me feel confident, and he made me feel that I could do it. That is something that I will take with me forever. There is not one epiphany, one moment, one exercise that he made us do in class. I can't remember those things, but I remember the way he made me feel.

Long-Term Program Impact on Math Learning

All eight student participants in the study conducted for this evaluation described the improvement in their daily study skills as a direct result of PI. They learned to spread out their math studies, complete homework, and review material each night rather than cramming before an exam. As one study interviewee cautioned, "Make sure you go over your notes throughout the week instead of cramming before a test." Small, frequent study sessions are optimal, as the following student explained, "With math, it was made clear that, in order to do well in math it would be better to prioritize smaller amounts of time every day than to do a 5- or 6-hour study session." Another student participant in the study described the importance of consistency in learning math in the following interview excerpt:

> A big part [of test preparation] was daily study. I am revisiting that over and over again—consistent study. . . . I study all term long. I don't just do the assignment and I'm done; I go over my notes and really study all of the material. I do that continually.

Through the math-anxiety course, students learned the importance of the textbook as a tool for study and test preparation. One student explained,

> I go over my math notes, the sections that we are doing. If we're doing primes or factoring, I'll open my solution book and have my math book on top and I will do the pretest, the chapter test of the book to prepare me for that.

The students wrote their own study guides by compiling difficult or important problems that they could review preceding an exam, as described by the following student interviewee:

> When we see a question is really hard, one that we needed help on, even if we solve it ourselves . . . we should write that problem down, as well as the answer, in separate places; one page for the problem and a page for the answer. . . . When you get to midterms you already have a premade pretest and study guide. . . . I have used that ever since [PI] and it has been very helpful. I have major test anxiety, especially when it comes to math. I was able to do very well in all my classes.

Seven of the eight study participants described how PI helped them improve their test-taking skills. One study interviewee commented, "Journaling about it, checking in with myself about how I feel before a test." This included preparation both in study and

mental attitude prior to an exam, as well as honing test-taking skills. Another student opined, “Think positive. If you go in with a bad outlook you’re going to screw up the test. When you have those bad thoughts in your head, you won’t answer the questions correctly.” The students learned how to take timed tests, how to address problems they did not understand, how to make appropriate guesses, and the importance of checking work. As another student interviewee explained,

> I check three times to make sure I didn’t make a mistake. I just had an exam yesterday; we had the whole class time to do it. I make sure I took almost the whole class to go over it.

These were skills the students learned in PI and applied in their subsequent math learning. One student participant recalled,

> He gave us a lot of material to show us how to do tests. “Don’t stress over the first question. If you don’t get it, move on to the next question, then come back to what you don’t know. If you don’t get it, don’t even sweat it.”

Another study participant described the test-taking strategies she learned through the math-anxiety class in the following manner:

> If it was a timed test . . . you go through and answer all the ones you know [and] come back later to the harder ones. If it was a test where a guess is better than no answer, the book covers how to make an educated guess, the best guess.

All participants in the study that led to this evaluation described the campus resources available to them to help with their math studies and how they continue to use those resources long after their graduation from the PI program. One student referred to

accessing "the resources that were available such as the math tutoring and the Web sites." Another study participant now works to form study groups, and another described the multiple resources available for help in learning math and the importance of keeping current with each topic taught. She stated,

> Knowing to go to the learning center and getting that extra help, forming study groups, that was another thing we were taught. . . . For math, everything builds on the section before it, so he stressed the importance of making sure that we understand.

Simply reading a math textbook in a useful manner can be one of the hardest concepts to teach; however, PI teaches this skill successfully within the math-anxiety course. As one student participant described,

> He also taught us how to read our textbooks. These were different approaches than I'd had in previous school experiences. I would read a problem and do the problem, but he taught us the importance of reading every word in the textbook on whatever chapter we were assigned.

Seven of the eight participants in the study preceding this evaluation described time management as one of the most important skills they gained from PI and this skill was reinforced by the cohort experience. As one student commented, "They showed me how to schedule things. I write things down in a day planner, which I have never done before. Now, at home, I have a huge whiteboard in which I put down all my notes." The cohort helped the following study participant overcome a tendency toward procrastination.

> One of my challenges, personally, is procrastination, and there was a lot of emphasis put on that. Accountability, working with a team really helped. Because you knew you are going to see folks, or even just talk to them, they would ask you; folks get this done.

An important aspect of time management learned by the study participants was organization. In order to effectively utilize their time they needed to have their notes, homework, and study materials organized and accessible. As one study interviewee commented,

> The push to get organized and not be so scattered was really helpful. There's your binder; you need dividers. They really structured and laid it out so that, if you had never ever been to school before, I would tell you this is a good way to get started.

Another participant commented on organization in the following manner:

> I also organize all of my work chronologically. . . . I have the notes in the assignments, a quiz, whatever all the stuff that is covering the same specific subject, I keep together. . . . When I review that area, I have all the stuff that I need.

The participants in the study conducted for this evaluation learned and internalized classroom skills such as asking questions and taking notes. One student participant commented, "The note taking is big; I take notes every day. My notes are bigger than my homework folders. I write down everything. Everything that teacher has

to say, I believe is important in one way or another." On note taking, another study participant stated,

> There were some basic techniques, such as taking notes, in math class. People are usually taking notes in the English class or history class, but actually taking notes in a math class to make sure that we understand what the teacher wants us to answer in a sentence format versus just put[ting] your basic things down.

The PI students also learned how to work with math teachers and use them as a resource rather than perceiving them solely as potential antagonists. As one study interviewee expressed,

> We were very much encouraged in the math class and in Project Independence as a whole to use our instructors. . . . The instructor is there because they want to teach. . . . Tell your instructor that you don't understand something.

Learning how to ask questions in class was mentioned by the majority of the study participants. One interviewee stated,

> I realize that there are no stupid questions. . . . We underestimate a math teacher's ability to explain things in different ways. . . . It was a real "eye-opener" for me and helped me get through my math classes.

Also on the subject of questions in class, another study participant commented,

> What did help me was being comfortable asking questions about math. Everyone gets to a point where they feel as though the rest of the class has passed you by. You're the only one who doesn't have the answer. . . . You have to ask those questions.

Coping skills learned and implemented by the participants interviewed in the study preceding this evaluation were effective in helping them negotiate the math-learning experience. The nontraditional students enrolled in PI are required to balance the demands of life with the pressures of school. As one student explained,

> The ways that we learned to look at things to be successful in math, you could apply to the overall experience in school—time management—staying rested, balanced, and healthy [and] not going overboard . . . doing this all or nothing kind of thing.

PI students learn to take breaks away from a problem rather than continuing to struggle with the same concept, as the following participant expressed: "If I'm doing 40 minutes . . . worth of problems and it's really tough . . . it's important to take a break." Another commented,

> He taught us to take breaks when it was beginning to be too much. "Don't overexert yourself when it comes to a final. Study, but also get some rest. . . . Take your time, breathe, making sure you communicate your special needs.

Allotting time for self-reflection and working to have a positive attitude was also mentioned by the participants in the study interviews. One student commented, "Particularly as a female, we tend to be caretakers of others and we tend to get lost in that. [It is important] to have a safe place to just talk or a place to think . . . to gather yourself, reorganize if need be."

Participants in the study conducted for this evaluation learned to take math classes in sequence, with as few breaks as possible to retain important skills and knowledge

gained. One student interviewee recalled, “One of the things the instructor did was the best way to take a math class. First, we take all-around math consecutively; once we start, we don’t quit.” Another participant commented, “It really helped when I broke it down into sections. Don’t be in a rush to finish the math, but once you start math, don’t drop it. Do it at your own pace.” It is also important to take care of self and family. If time off is needed from school to balance these demands, it is appropriate. Another student explained, “I would go a term and then, if life got too challenging, I would stop and take off a term. That was one of the things that the staff of Project Independence told me was okay to do.”

PI graduates developed an attitude of accomplishment with the knowledge that school can be mastered. As one participant of the study preceding this evaluation expressed, “I can follow my dreams and accomplish them. PI was definitely the key to my education.” As described by the following interviewee, the students acquired and retained a sense of empowerment: “In my core, I believed that I would never have a chance to do anything academically again. . . . It was Project Independence that turned me around.” All but one study participant reported that, if it were not for the cohort and PI, they would not be in school; they would have dropped from school before they completed their education goals to earn a degree or certificate. One student qualified this by adding that, although she would still be in school, school would have been harder. All the students acknowledged the counseling offered by PI both during and after program completion as a significant factor in their sense of empowerment and subsequent academic and life success. A study interviewee stated, “Before Project Independence, I

was very intimidated. I was a returning student, having been out of school for more than 20 years. . . . Project Independence 'opened my eyes' to the importance of, and the ability to, investigate."

Summary of the Findings

Of the eight student participants in the study conducted for this evaluation, six stated during the interviews that, without PI, they would have either never started school or would have dropped from school prior to completing their desired certificate or degree. The PI program is successful as a college-preparation immersion program teaching students study, testing, college-survival, and coping skills. All eight of the student participants attributed their college success to the counseling they received both during and after the PI program. The students learned to work with a math instructor, and how to ask questions, how to use the instructor as a resource toward math learning. They learned and implemented organizational skills useful in allocating time for their math homework and subsequently used that time in an effective manner toward math learning.

The group discussion and other interventions of the math-anxiety class work well precisely because of the cohort format of the program. The students know each other and have developed rapport and trust outside the class. With a strong peer support group, program participants are better able to cope with their math-learning and test-taking anxiety. As a result, they graduate from the PI program with the attitudes and study skills necessary to effectively complete the math course subsequently required to earn their desired degree or certificate.

The trust and rapport among members of the PI cohort are developed due to the immersion nature of the program. Students devote 10 or more hours per week in the classroom together and are encouraged to study and work together outside the classroom. Immersion interventions of one or two classes may or may not be sufficient to develop the necessary mutual concern and motivation to build an effective cohort. In addition to the organizational and study skills PI participants develop their self-esteem and attitudes of self-worth also dramatically increase. The sense of belonging, coupled with the available tools and resources, lead to success within an academic environment.

Recommendations

PI offers a career-guidance course as part of the immersion program. One participant in the study preceding this evaluation recommended that PI provide greater detail on the numerous certificate programs available through Portland Community College. The certificate programs are tailored to prepare students for numerous fields of endeavor within the workforce and require varying levels of math learning. Further knowledge surrounding the breadth of certificates and available degrees will allow students to set academic goals in line with their desired level of math courses.

Multiple student participants in the study conducted for this evaluation viewed the interaction and support from previous PI graduates as a significant factor in their motivation and resolve to continue their community college education and expressed a desire for more frequent input from program graduates. One graduate expressed a sincere desire to help current PI students as she had been helped. The encouragement received from random encounters with graduates on campus or within the Women's Resource

Center was invaluable to students. It was suggested by study participants that PI could facilitate and coordinate such encounters by inviting past program participants to counseling sessions or having them available during certain time periods at the Women's Resource Center. PI graduates who successfully navigated their chosen math sequence could share stories of how they applied their math-learning skills acquired at PI.

Several of the participants in the study preceding this evaluation successfully negotiated their foundational math courses, but faltered when transitioning to post–high-school and college-level math. This barrier is not unique to PI students, but is a common problem across community college and university campuses. As students transition from foundational math, which is a review of what they learned or should have learned in high school, to the new material of college mathematics, their study habits, organizational skills, and learning attitudes are stressed to new levels. The Portland Community College partially addressed this problem by introducing a math sequence up through statistics for students not seeking a science, technology, engineering, or math degree or certificate. The courses are taught in tandem with a career-guidance course on math-literacy success within the same classroom.

The study of math-learning skills out of context with actual math learning, as is sometimes taught within PI, may not be sufficient for students who wish to tackle a science, technology, engineering, or math academic program. One of the PI math instructors teaches math vocabulary, order of operations, and some basic algebra in context with the math-anxiety intervention. The program participants who completed this class commented on the success they had with learning actual math. Consequently, it

would behoove future instructors to consider teaching math-learning and anxiety coping skills in context with actual math-learning experiences.

When students approach post–high-school or college mathematics courses, PI and other students must renew effective math-learning skills. PI can support program graduates through this transition by encouraging them to take math-literacy courses in conjunction with their more advanced math classes. The Rock Creek campus mitigates this transitional problem by requiring all math teachers to spend a percentage of their out-of-classroom time in the learning center conducting help sessions. This provides students the opportunity to meet with teachers in a group setting for extra help and allows the teachers to work with and improve existing tutoring services. PI could encourage the adoption of these interventions on other campuses and help program graduates by guiding them toward these resources. Collaborating with the Portland Community College Subject-Area Committee (Macias, 2015), PI math faculty can share insight with math instructors across Portland Community College on math-learning difficulties. Together they can further knowledge and interventions on math learning, which can be used in conjunction with existing math classes.

Implications for Social Change

The PI title may be misunderstood if viewed through the mainstream concept of college independence. To the traditional, multigenerational college student, independence equates to the capacity to navigate the college infrastructure and academic system without the need of help from others. PI fosters the acquisition of college-survival skills through the interdependence of the cohort. This approach is more in line with current

adult-learning theory for first-generation college students (Stephens, Fryberg, Markus, Johnson, & Covarrubias, 2012).

Education is a significant factor in alleviating poverty (Jepsen, Troske, & Coomes, 2014) and PI supports women of all ethnic and socioeconomic classes toward succeeding in college by leveraging the interdependence fostered in minority cultures. The most significant impediment to college success for the majority of students is the math class. Teaching math learning to students in an established cohort fosters the communication and self-evaluation necessary to overcome math-learning anxiety and develop effective study, learning, and coping skills. As noted earlier, PI fosters motivation through interdependence. A primary student motivation to continue daily attendance of the PI program is the knowledge that others are depending upon them for support, just as they are depending upon other students.

There are no equivalent college-preparation programs for men within the Portland Community College. In the past, PI has invited and admitted male participants to the program, but in the view of the project administrator, interventions such as the group counseling were not as effective with male participants present. The PI program may or may not work for an equivalent all-male program without major adjustments. PI was developed over 2 decades of experiment and innovation on the part of program administration and faculty. The same investment may be needed to develop an equivalent college-preparation program for nontraditional male students.

Conclusion

The PI program has been honed over its 2-decade existence into an effective college-preparation immersion program for adult women with varied backgrounds of education and home, family, and personal struggles. The staff of PI have been working together for many years, with a desire to help program participants succeed in college and improve their lives. Addressing math-learning issues and math anxiety is a significant aspect of the program, but must be viewed within the context of the cohort and the larger college-preparation immersion experience. PI is not only a significant asset for the Portland Community College, but the program has been effective in promulgating college-preparation interventions within community colleges throughout the state of Oregon.

Appendix B: Student Demographic Survey

Information from this demographic survey will not be used in any way that could identify you. Only Mr. Frodsham, the researcher, will see this data.

Only summary information from this survey will be used in the study. Information such as "the average age of participants in the study was XX" or "most students completed developmental math while in high school"

In what age group do you fall:

- 18-25
- 26-35
- 35-50
- 51-65
- Older than 65

What math classes did you take in high school?

- None
- Developmental math
- Pre-algebra
- Algebra
- Algebra 2
- Pre-calculus

What grades did you receive in your high school math classes?

- I don't remember
- F
- D
- C
- B
- A

What math classes did you take in College?

_____
_____
_____

What grades did you receive in your college math classes?

- I don't remember
- F
- D
- C
- B
- A

Race and ethnicicity

This portion of the survey is derived from the racial and ethnic questions from the 2010 census

Please andwer BOTH question 1 about Hispanic origin and Question 2 about race. For this questionare, Hispanic originis are not races.

1. Are you of Hispanic, Latino or Spanish origin?

☐ No, not of Hispanic, Latino or Spanish origin

☐ Yes, Mexican, Mexican Anmerican, Chicano

☐ Yes, Puaerto Rican

☐ Yes, Cuban

☐ Yes, anotehr Hispanic, latino orSpanigh origin – print origin, for example, Argentinean, Colombian, Dominican, Nicaraguan, Salvadoran, Spaniard and so on

_____

2. What is your race? Mark one or more boxes

☐ White

☐ Black, African American or Negro

☐ American Induian or Alaska Natibve – Print name of enrolled or principal tribe

_____

☐	Asian Indian	☐	Japanese	☐	Native Hawaiian
☐	Chinese	☐	Korean	☐	Guamanian or Chamorro
☐	Filipino	☐	Vietnamese	☐	Samoan
☐	Other Asian Print race for Example, Hmong, Laotian, Thai, Pakistani, Cambodian, and so on			☐	Other Pacific Islander – Print race, for example Figian, tongan, and so on

_____

☐ Sone other race – Print race

_____

Annual family income

< $25,000
$25,001 - $50,000
$50,001 - $100,000
> $100,000

Appendix C: Participant Recruitment

Flyer

Improving Math Performance at Project Independence
A Doctoral Study

Why is the Project Independence math program successful?
What can the faculty and staff do to make the program even better?

Mr. Frodsham of Walden University invites you to participate in a doctoral study to determine how Project Independence helped you acquire math study, coping and learning skills.

This is not a test of your math skills, but an interview on how Project Independence helped you survive your math classes.

Here are some sample questions.

- Describe some of your early experiences in learning math.
- How did Project Independence help you learn math study skills and develop good study behaviors?
- How did Project Independence help you change your attitude about your ability to learn math?

Study Participation

To participate in the study you should:

Have graduated from the Project Independence (PI) program
Have completed at least one year of community college education
Have taken at least two math courses
Still be in in school or a PCC graduate of less than one year

Even if you do not meet all of the criteria above, but feel you have unique insight into how Project Independence helped you with math learning, please consider participating in this study.

This study is voluntary. If you decide to help, Mr. Frodsham will schedule an interview with you in the Cascade campus Women's Resource Center. This interview should last about one hour. Later, you will have the opportunity to discuss your interview results.

Privacy

Any information you provide will be kept confidential. He will not use your personal information for any purposes outside of this research study, and no personal information that could identify you will be included in any study results.

Who to Contact

Please contact Tim Frodsham if you are interested in participating in this study.

Tim Frodsham 503-869-9128

Invitation to participate

Improving Math Performance at Project Independence
A doctoral Study

For over 12 years, Project Independence has helped women learn the skills necessary to succeed in college. In addition to reading, writing, college survival and career and life planning, Project Independence uses a unique program to help women succeed in math learning. Why is this math program successful? What can the faculty and staff do to make the program even better? Mr. Frodsham of Walden University invites you to participate in a doctoral study to determine how Project Independence helped you acquire math study, coping and learning skills. You do not have to be good at math to participate. This is not a test of your math skills, but an interview on how Project Independence helped you survive your math classes.

Here are some sample questions.

- Describe some of your early experiences in learning math.
- How did Project Independence help you learn math study skills and develop good study behaviors?
- How did Project Independence help you change your attitude about your ability to learn math?

Study Participation

To participate in the study you should:

Have graduated from the Project Independence program
Have completed at least one year of community college education
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Even if you do not meet all of the criteria above, but feel you have unique insight into how Project Independence helped you with math learning, please consider participating in this study.

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Who to Contact

Please contact Tim Frodsham if you are interested in participating in this study.

Tim Frodsham tim.frodsham@waldenu.edu 503-869-9128

Appendix D: Interview Protocol

Interview Questions for Student Participants

These interview questions address the following three major topics: (a) how and why was math a barrier to the education of the interviewees, (b) how Project Independence (PI) helped the participants learn how to learn mathematics, and (c) what aspects of this learning were beneficial in the long term. For each topic, there are five questions probing the respective aspect of math learning.

How and why was mathematics a barrier to your community college education?

1. Describe some of your early experiences in learning math at school and at home.

2. In your early experiences with math, what were the barriers with which you struggled?

3. In your early experiences, what steps did you take that were successful in learning math?

4. Describe your attitudes and your ability to learn mathematics prior to your participation in PI.

5. Recount some particularly vivid experiences with your early math learning.

How did PI help you acquire study, coping, and learning skills necessary to learn mathematics?

6. Describe the PI approach to learning math.

7. Describe experiences in PI that helped you change your attitude toward learning math.

8. How did PI help you learn math study skills and develop good study behaviors?

9. Describe your best experience in the PI math-learning course.

10. What segments of PI math learning could you not relate to or seemed irrelevant?

What aspects of the skills and knowledge acquired in the PI program have you used to successfully complete your math classes?

11. What were the best things PI taught you about learning math? What did you retain the most?

12. Describe the study and coping skills you learned at PI that worked best for you.

13. Describe how you prepare for an exam. How did PI help you in exam preparation?

14. How did PI help you change your attitude with regard to your ability to learn math?

15. What long-term changes have you made in how you learn mathematics since your participation in PI?

Researcher Note

If it became apparent that there was more to a participant response, I followed up with probing questions sucvh as the following simple examples: Could you explain more? What else did you learn? What was one thing that stood out? Could you give me some examples? What makes you feel that way? I am uncertain what you meant by. . . .

Based upon the probing interview questions exemplified by the University of Wisconsin, probes that begin with How or What solicit a more detailed answer to the original question. “Do you” or “Are you” probes invite greater reflection. Those that begin with “Why” tend to place the participant on the defensive. Probing questions did not delve into subjects not immediately related to the question at hand; they simply probed for further information on a question just posed.

Interview Questions for Staff Participants

1. Please describe the PI math curriculum and approach to teaching math learning.

2. Please share with me any pertinent curriculum materials and handouts.

3. How do you view the participants of PI as math learners compared to other community college math students?

4. How do you encourage student participation and interaction?

5. What aspects of the math-learning program do you deem most effective and why?

6. What aspects of the math-learning program would you like to improve and why?

7. What aspects of PI outside the math class help students learn how to learn math, and why do they work?

The goals of these questions are to

1. Acquire sufficient information on the PI math program to outline the program and draw a schematic.

2. Understand how the PI math program fits into the balance of the curriculum and how the overall program helps with learning how to learn math.

3. Understand the successes and desired improvements in the program from the perspectives of the faculty.

Appendix E: University and Institutional Review Board Approval

from:	IRB <IRB@waldenu.edu>
to:	Tim Frodsham <tim.frodsham@waldenu.edu>
cc:	"Barbara J. Salice" <barbara.salice@waldenu.edu>, Doctoral Study <DoctoralStudy@waldenu.edu>
date:	Wed, Jul 30, 2014 at 11:42 AM
subject:	Notification of Approval to Conduct Research - Tim Frodsham
mailed-by:	waldenu.edu

Dear Mr. Frodsham,

This email confirms receipt of the IRB approval notification for the community research partner and also serves as your notification that Walden University has approved BOTH your doctoral study proposal and your application to the Institutional Review Board. As such, you are approved by Walden University to conduct research.

Please contact the Office of Student Research Administration at doctoralstudy@waldenu.edu if you have any questions.

Congratulations!

Libby Munson

Research Ethics Support Specialist, Office of Research Ethics and Compliance

Leilani Endicott

IRB Chair, Walden University

from: Laura Massey <laura.massey@pcc.edu>
to: Tim Frodsham <tim.frodsham@waldenu.edu>
cc: Debbie Stone <dstone@pcc.edu>,
Linda Reisser <lreisser@pcc.edu>
date: Tue, Jul 8, 2014 at 1:01 PM
subject: PCC IRB Approval

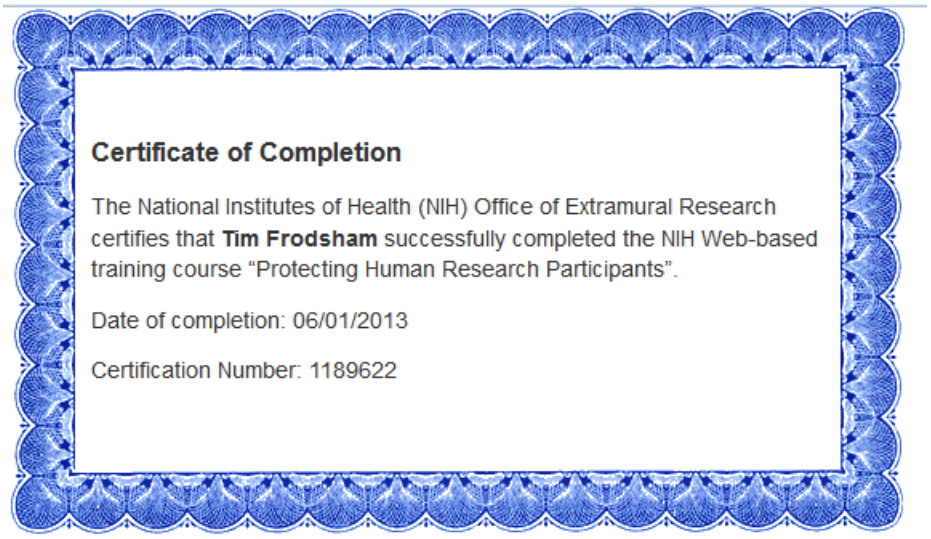
Hi Tim -

Debbie Stone confirmed in a July 2nd email that she would make the initial student contact for locating potential participants for your study. This resolved the prior concern of protecting student contact information.

Please consider this message as notification of PCC IRB approval for your project "Improving Math Performance at Project Independence."

Best wishes for a successful study!
Laura Massey

Appendix F: Certificate of Completion



Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Tim Frodsham** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 06/01/2013

Certification Number: 1189622