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UMI®
THE MAKING OF A CHAMP

THE MODIFICATION OF MATHEMATICAL SELF-EFFICACY BELIEFS
OF NON-TRADITIONAL COLLEGE ALGEBRA STUDENTS USING
TECHNIQUES ADAPTED FROM SPORTS AND SPORTS PSYCHOLOGY

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

Ronald E. Zielke, M.A.

****

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ABSTRACT

Self-efficacy is the confidence that one has in one’s ability to do things. During the past decade, self-efficacy beliefs have received increasing attention in educational research, primarily in studies of academic motivation and self-regulation. Research has consistently shown that academic performance is strongly predicted by self-efficacy beliefs and often is better predicted by self-efficacy than by prior attainment indexes.

By the time a student reaches college, pre-determined efficacy beliefs regarding his/her ability to solve mathematics problems have been developed. For many students, a negative self-image has been created which further contributes to a negative attitude and negative expectations. Though few efforts to improve self-efficacy beliefs have been reported in the literature, it has been noted that efforts to identify self-efficacy beliefs and alter inaccurate judgements should prove beneficial.

Four sources of self-efficacy are defined in Bandura’s Self-Efficacy Theory. These sources offer guidance as to how to modify self-efficacy beliefs, but do not offer specific techniques for doing so. Therefore, the researcher turned to the world of sports for the identification of such techniques. By adapting techniques from sports and sports psychology, and using the four sources of self-efficacy for guidance, the CHAMP approach was developed.
The purpose of this study was to train three non-traditional college mathematics students in the use of CHAMP and assess the extent to which these intervention techniques enhanced mathematical self-efficacy, as well as the extent to which these students were able to both internalize these techniques and begin to use the techniques on their own. Combination word problems (e.g., mixture, investment, coin, ticket) served as the primary tool utilized in this training. Qualitative data were collected through individual interviews, direct observations, a focus group interview, and researcher and participant journals.

Changes in mathematical self-efficacy were noted throughout the study. These changes were: 1) changes in participation; 2) changes in preparation; and 3) changes in how each participant viewed word problems.

Three specific areas of demonstrated internalization of CHAMP were found and discussed: 1) awareness of CHAMP techniques already being used; 2) effective use of CHAMP; and 3) the ability of each participant to teach others CHAMP.

Upon internalizing CHAMP, the participants were able to make it his/her own by applying CHAMP to a variety of other classes, both mathematics classes and non-mathematics classes. Each was able to find real-life uses of CHAMP as well.
Dedicated to the true champions in my life

My parents, Margaret and Bennie Zielke

and

My children, Megan and Sean
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THE PROBLEM

When I got to high school, because I was so heavy, I didn’t fit in the chair and the math teacher told me to sit in the back of the room because I would take up too much aisle space. So I went to the back of the room and when I went to meet with him after school he said, “Well, you’re too dumb and ugly...you probably won’t make anything out of yourself.” So he said don’t worry about it. He said, “If you just show up and try, I’ll give you a D.” So that’s how I got my D in algebra.

Amy

If I had to choose, math was my favorite subject through all my years. I really did like it and I’ve been out of it for such a long time that I think that’s why my confidence level is not where it needs to be.

Melanie

In high school I did pretty poorly — had a lot of focus problems and a lot of things on my mind. Math was my particularly weak subject. I didn’t take very high math courses, although I did take really high physics courses which was kind of a contradiction. I was the only person ever allowed into honors physics without any of the math — most of the people in there were taking precalc and stuff like that. I managed to get a C in the class despite the lack of math. I feel I can understand some complex problems, but when it actually comes to staring at them in mathematical form, I just kind of freak out if I don’t know what exactly I’m supposed to do.

Mark

This dissertation is a story—a story of three non-traditional developmental mathematics students. It is a story involving these three individuals, mathematical self-efficacy beliefs, and something called CHAMP, a combination of intervention techniques designed to heighten the level of mathematical self-efficacy beliefs.
This story is told in three parts. The first part centers on the three individuals and the pre-existing mathematical self-efficacy beliefs each brought with them to the study. The second part details these three individuals being trained in the use of CHAMP, a researcher-developed toolkit of techniques designed to raise each individual's level of mathematical self-efficacy. The last part of the story documents the internalization of these techniques for the students to use the techniques on their own.

**Self-Efficacy Beliefs**

What is self-efficacy? Bandura (1986) defines such perceptions as "people’s judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (p.391). More simply put, self-efficacy is the confidence that one has in one’s ability to do things.

Why is self-efficacy important? Self-efficacy beliefs affect behavior in several important ways. They influence the choices individuals make and the courses of action they pursue. People engage in tasks in which they feel competent and confident and avoid those in which they do not. Self-efficacy beliefs help determine how much effort people will expend on an activity, how long they will persevere when confronting obstacles, and how resilient they will be in the face of adverse situations — the higher the sense of efficacy, the greater the effort, persistence, and resilience (Bandura, 1986). Efficacy beliefs also influence the amount of stress and anxiety individuals experience as they engage in a task and, ultimately, the level of accomplishment.

A strong sense of efficacy enhances human accomplishment and personal well-being in countless ways (Bandura, 1986). People with a strong sense of personal competence approach difficult tasks as challenges to be mastered rather than as threats to
be avoided. They have greater intrinsic interest and deeper engrossment in activities, set challenging goals and maintain strong commitment to them, and heighten and sustain their efforts in the face of failure. Moreover, they more quickly recover their sense of efficacy after failures or setbacks, and attribute failure to insufficient effort or deficient knowledge and skills. Conversely, people with low self-efficacy may believe that things are tougher than they really are — a belief that fosters stress, depression, and a narrow vision of how best to solve a problem. High self-efficacy, on the other hand, helps to create feelings of serenity in approaching difficult tasks and activities. As a result of these influences, self-efficacy beliefs are strong determinants and predictors of the level of accomplishment that individuals finally attain.

Self-efficacy breeds success, which in turn breeds more challenging performances; self-doubt breeds hesitancy, defeat, and failure to try. The important point, however, is not only that self-efficacy beliefs influence behavior, but that people actively use these beliefs to influence how they behave. For these reasons, Bandura (1997) argues that “beliefs of personal efficacy constitute the key factor of human agency” (p. 3).

**Need for the Study**

During the past decade, self-efficacy beliefs have received increasing attention in educational research, primarily in studies of academic motivation and self-regulation. In this arena, researchers have focused on links between self-efficacy and career choices, institutional practice, and students’ achievement and motivation (Pajares, 1996). This last area of research has consistently shown that academic performance is strongly
predicted by self-efficacy beliefs and often is better predicted by self-efficacy than by prior attainment indexes. This last area was the focus of the present study.

If self-efficacy beliefs are better predictors of academic performance than prior attainments, then would it not seem appropriate to intervene to heighten self-efficacy beliefs, which in turn would bolster academic performance? Though few efforts to improve self-efficacy beliefs have been reported in the literature, Pajares (1996) notes that efforts to identify self-efficacy beliefs and alter inaccurate judgments should prove beneficial. He further suggests that in order to accomplish this, “quantitative studies should be complemented by qualitative studies.”

**CHAMP**

The self-efficacy intervention program developed and tested in this study is called CHAMP. Obviously, CHAMP has a sports connotation attached to it. CHAMP is an acronym in which each letter of the word represents a technique for boosting performance adapted from sports and sports psychology.

- **C** represents cue words. In sports, an athlete uses cue words as a reminder to do certain things at certain times during a game or a match.

- **H** stands for “focus on the here and now.” This is tied to goal setting and the need to focus on the establishment of controllable and achievable goals.

- **A** represents arousal control. Every athlete knows it is important to control emotions throughout a competition and that a certain level of arousal is good, but too much can be devastating.
M represents two items—modeling and mental imagery. In sports, being able to model a performance after someone else or, more importantly, after one of your own particularly good performances is important. These performances can allow an athlete to create mental images that can be continuously repeated and perfected in the mind’s eye.

P in CHAMP represents a connected group of items: praise, verbal persuasion, and positive self-talk. It is important for an athlete to internalize praise and verbal persuasion from external sources in order to create positive self-talk.

The specifics of CHAMP itself and its theoretical basis will be addressed in Chapter 1. To better understand why sports and sports psychology were incorporated to help define these techniques, one needs to know more about the researcher’s background.

"You teach like a coach"

Glesne and Peshkin (1992) describe the act of researching as “autobiographical in that some aspect of yourself is mirrored in the work you choose to pursue” (p. 178). In their book, Peshkin discusses how his “subjectivities” operated in his research inquiry, particularly how his questions derived from his life history. He says the roots of his research focus are found in his biography, claiming, “If I know you well, I can’t predict what you will study and how, but I am able to understand why you have made the decisions you have made” (p. 103). In short, Peshkin concludes that reflecting on our research questions leads us to “greater understanding of our core values and beliefs” (p. 178). Like Peshkin, my research interests emerged from my own life story, particularly from the intersection of being a teacher, “successful” student, athlete and coach.
I have been a mathematics teacher now for 17 years, with stints at both the high school level and the college level. As a teacher I have always taken great pride in not only being able to teach my students some mathematics, but in always making it a personal challenge to raise the students’ level of confidence in their own abilities. Developmental courses create one of the greatest challenges in attempting to accomplish this task. These courses serve older students with faded mathematical backgrounds, younger students with inadequate secondary school preparation, and students with learning disabilities and other special circumstances. One key factor that older students, or non-traditional students, bring to class that traditional first-year freshmen do not is the amount of time elapsed since last being enrolled in a formal mathematics class.

I have been a “successful” student for a much greater length of time than I have been a teacher. Have I been a “successful” student in all my academic endeavors? That depends on how you define successful. If success is determined only by the grade received in a given class, then no, I have not always been highly successful in my academic adventures. If success is instead defined by working to the best of one’s ability and learning as much as possible from a given experience, then yes, I have been successful.

My coaching experience was gained first through participation in numerous sports beginning with Little League baseball, a three-sport high school career, then on to numerous intramural leagues in college. Over the years I have coached both organized and informal sports including three levels of high school wrestling (freshman, JV, varsity), novice wrestling (5 year-olds through 8th grade), high school varsity baseball, women’s softball, and my daughter’s T-Ball and softball teams.
Why such an interest in sports? I lived in a small town with limited entertainment and after-school job opportunities. Therefore, just about everybody played sports – football in the fall, basketball or wrestling in the winter, and baseball in the spring and summer. Coaching became a natural outgrowth of successful participation in sports.

This sports and coaching influence has carried over into my teaching. The very first written evaluation I ever received from my field experience supervisor read simply “You teach like a coach.” I initially thought this was a compliment, but as the phrase was periodically repeated throughout the course of my time with this supervisor, I soon came to believe that in his mind it was anything but a compliment. Yet, academic teachers can learn some valuable techniques from sports coaches, especially in the teaching of mathematics.

A review of educational literature for the past two decades establishes that certain educational leaders have made a concerted effort to align good teaching with the model of being a good coach. Sizer (1984), for example, argues as follows:

How are skills learned? By experience. How, then, are they best taught? By coaching....Ironically, it is the athletic coach, often arrogantly dismissed by some academic instructors as a kind of dumb ox, unworthy of being called a real teacher, who may be a school’s most effective teacher of skills. (p. 106)

Sizer’s coaching or teacher-as-coach model assumes that before the teacher becomes a coach he/she must also make students the agents of their own learning. It is common practice for all teachers to talk for a while then ask the student something. The student responds and the teacher talks once more to correct or add to the student response. In this situation the teacher is the doer and the active participant. This is
engaging for the teacher, but the students become disengaged unless they are the active doers. The teacher-as-coach model calls for the teacher to show students what it looks like when a class really works and students really succeed. The whole class can then become engaged in working and succeeding.

Not only can the teacher as coach aid in the teaching of skills, he can also aid in the assessment of these skills. Nettles (1992) claims that coaching might be as beneficial in the classroom as it is on the athletic field. Nettles pursued a detailed analysis of the various areas in which coaching could augment teacher training. Assessment is one of the areas he discusses:

To manage contingencies, provide information and feedback, and model correct action, the coach uses a goal or standard that the performer desires or is required to meet. The assessment function of coaching entails both the establishment or identification of targets for performance and the actions needed to determine accurately the performer's existing skills and knowledge. (Nettles, 1992, p. 8)

The coach's job is to do whatever is necessary so that athletes can reach their maximum potential. "Good coaches help players learn to coach themselves" (Sizer, p. 193). Coaches teach goal setting, self-analysis, self-correction, and teamwork. When athletes do not succeed or do not meet their potential, the coach does not let them get by somehow. Instead of teaching while the students watch, athletes play while the coach watches. The coach challenges the athletes to find motivation and drive from within themselves (p. 193).

A coach challenges athletes to believe in their own abilities and the abilities of their teammates. For example, how is it that in some instances a decided underdog in a sporting competition can rise to the occasion and win when never initially given the chance? One way is for the coach to instill confidence in the underdog team that they can
indeed win. It is that confidence that allows any team or individual, on any given day, to
win.

A perfect example of this phenomenon occurred in the most recent Olympics, when an unknown American Greco-Roman wrestler was able to defeat an opponent who had not lost a wrestling match in twelve years. This phenomenon is not limited to the world of sports. Remember Jaime Escalante’s (from *Stand and Deliver*) calculus students from Los Angeles who defied all odds and passed the Advanced Placement calculus examination? Is it any wonder that Jaime Escalante’s current students refer to him as “coach”?

The word *underdog* is a good description of many developmental mathematics students. Many of these students were never really given the chance to be successful in mathematics. What is worse, many of these students did not give themselves the opportunity to be successful. For whatever reason these students come into a developmental mathematics classroom with limited confidence in their own abilities.

How is it that these decided underdogs can still win? It was with that one question that my teaching life, student life, and athletic life all melded into one. For it was possibly the first time that I consciously realized the influence that my athletic life had played in the other two. When faced with a seemingly insurmountable task in my teaching life or my student life, what pushed me ahead? Where did I develop the mental toughness necessary to push myself, telling myself time and time again, “I can do this” or “It will get done.” Much of that mental toughness came from my experiences with sports. Quite honestly, the majority of this mental toughness was obtained through the sport in which I was least successful from a wins/loss perspective—wrestling.
Wrestling did not teach me about winning, but it did teach me about developing a winning mindset. I coached wrestling for 10 years and did pretty well, I might add. Was I a successful wrestling coach because I was a winning wrestler myself? No, I was a successful wrestling coach because I had developed a winning mindset and was able to help my wrestlers develop it also.

Maybe my previous advisor was right all along. I did teach like a coach and because of it, I was actually subconsciously transferring this winning mindset to my students. There have been numerous occasions, especially when teaching remedial or developmental classes, that students have come up to me or have noted in their evaluations, the fact that they had become more confident in their abilities to do math by having me as their instructor. Many, for the first time, noted that they believed in themselves.

This dissertation is not about winning; it is about developing a winning mindset. What developmental mathematics students need to succeed is to believe in themselves. Their mathematical self-efficacy needs to be enhanced to the point that they develop a winning mindset. CHAMP is designed to allow developmental mathematics students do just that—develop a winning mindset and succeed.

**Developing a winning mindset**

A winning mindset (i.e., expecting to do well) is the backbone of sports dynasties. It is often called tradition. A winning tradition is simply a “thinking process” ingrained in individuals or team members because of continued success.

Unfortunately, many students have not had the opportunity to develop this winning tradition with respect to mathematical performance. Over a period of time the
three students in this study have developed certain beliefs that limit their ability to successfully perform in mathematics.

The quotes at the very beginning of this introductory chapter, obtained through an initial interview, informally introduce the three individuals involved in this study. Each of these individuals entered the study with varying degrees of lack of confidence in their own mathematical abilities.

Amy is a woman who had grown to dislike mathematics, not out of her own inability to perform mathematics, but out of a hurtful experience that just happened to involve a mathematics teacher and a mathematics classroom. She had come to believe that when in a mathematics classroom, she was to be silent and simply exist through mathematics. Because of this experience, Amy had virtually no confidence in her own ability to succeed in mathematics.

Melanie is a young woman whose initial lack of confidence in her own abilities stemmed not from any one instance that may have tarnished her view of mathematics, but who had been out of a mathematics classroom for some ten years. Melanie had always enjoyed mathematics, but having been away from a formal involvement with mathematics for quite some time, had come to find her confidence in her own ability to perform mathematics wavering.

Mark has an extremely analytical mind, one that would seemingly be perfect for pursuits in mathematics and the sciences. The physics class Mark mentioned offered evidence that he was capable of performing adequately in a highly mathematics-dependent subject. Mark would never go so far as saying he disliked mathematics; it was more a case of never acquiring the same level of interest in mathematics that he acquired
in, say, literature or music. Much of his experience with previous mathematics courses and instructors left him feeling somewhat unfulfilled and looking for more, because much of his experience with mathematics had never allowed him to answer the question “why?” The physics class offered him the opportunity to see the application of mathematics; to see the “why” of mathematics. However, it was not the complexity of problems that impacted his mathematical self-efficacy, but more his confidence in his ability to convert things into the appropriate mathematical form.

Two of the participants in this study, Amy and Mark, had never been given the opportunity to develop a winning mindset. Melanie, on the other hand, had experienced success in the past, but out of inactivity had lost this winning edge, much like an athlete who is sidelined due to injury and returns to the field of play for the first time. As with the athlete, Melanie experienced self-doubts with respect to her abilities mathematics until she was certain her old form had returned.

Each of these students had difficulty with mathematics, not because they were incapable of performing successfully, but because they did not believe that they could perform successfully. What was needed was the opportunity for these students to remove the mental barriers inhibiting their performance. To establish the mindset for “winning” with respect to mathematics, these developmental mathematics students to experience success. One way to initiate this cycle of success was to modify the self-efficacy beliefs these students brought with them to college. To modify pre-existing beliefs requires intervention. By reflecting on all those years of experience as an athlete and as a coach, as well as reading numerous books on the subject of sports psychology, I developed CHAMP as an intervention technique and tried it out with these students.
Purpose

The purpose of this research was to apply CHAMP to the study of introductory college mathematics and assess the extent to which these modification techniques may have enhanced mathematical self-efficacy, as well as the extent to which students enrolled in these classes were able to apply the techniques contained in this program. Specifically this study was designed to answer the following questions:

1. What changes in mathematical self-efficacy occurred during the application of the CHAMP toolkit?
2. To what extent did the students seem to internalize the techniques of CHAMP?
3. To what extent did the participants begin to use these techniques themselves?

Significance of Study

The outcome of sporting events does not necessarily favor the most skilled athletes—but favors those who are mentally tough not only during preparations for an event, but during the event itself. The success an athlete achieves in an event is directly related to the attitudes and expectations he/she carries into the event. Psychological research supports the premise that “we are what we think about” (Curtis, 1988). Our self-image is determined by the thoughts and visualizations that we hold in our minds, both consciously and unconsciously. Self-image affects our attitudes, expectations, behaviors, and performances.

If a developmental mathematics student has a poor self-image or holds negative thoughts in mind, his/her behavior will support this negative image and poor performance and attitudes will result. Conversely, a developmental mathematics student with a positive self-image and positive expectations will support that image with positive
performance. Eventually this positive cycle of success leads individuals to a new attitude – they EXPECT to win, rather than HOPE to win. This is the thinking developed by true champions in all walks of life.

The three individuals studied here have become a major part of my life throughout the past year or so and for better or worse, I have become a part of their lives. As a researcher, I expected to be fascinated, troubled, delighted, intrigued, frustrated, and overwhelmed by working with these individuals. But what I could not expect to experience was the amazing sense of genuine affection, trust, and caring that developed between my case study participants and myself. Each put their trust in me that the techniques I had developed had merit, and each was willing to give these techniques an earnest trial. This trust was heightened even further when one considers the origin of CHAMP and the fact that only one of the subjects in the study, Melanie, had extensive experience in sports.
CHAPTER 1

THEORETICAL FRAMEWORK

This chapter presents the formulation of CHAMP by discussing in detail each of the two theoretical perspectives that were combined to create CHAMP: Bandura’s four sources of self-efficacy and techniques derived from sports psychology to instill confidence. A pictorial version of this developed framework introduces the chapter and acts as an outline for the rest of the chapter. The pictorial version of the framework is followed by a discussion of each of the four sources of self-efficacy: enactive mastery, vicarious experience, verbal persuasion, and physiological state. This discussion is followed by a discussion of self-efficacy mediation in sports, and in particular, a discussion of specific techniques used in sports and sports psychology to instill confidence. The chapter concludes with a matrix demonstrating specifically how each of the sources of self-efficacy is linked to CHAMP.

Social Cognitive Theory

In Social Foundations of Thought and Action, Albert Bandura (1986) wrote that individuals possess a self-system that enables them to exercise a measure of control over their thoughts, feelings, and actions. This self-system houses cognitive and affective structures and includes the abilities to symbolize, learn from others, plan alternative
strategies, regulate behavior, and engage in self-reflection. It also plays a prominent role in providing reference mechanisms and a set of subfunctions for perceiving, regulating, and evaluating behavior, which results from the interplay between the self-system and external environmental sources of influence. In all, Bandura painted a portrait of human behavior and motivation in which the beliefs that people have about themselves are key elements in the exercise of control and personal agency.

According to Bandura’s (1986) social cognitive theory, self-referent thought mediates between knowledge and action, and through self-reflection individuals evaluate their own experiences and thought processes. Knowledge, skill, and prior attainments are often poor predictors of subsequent attainments because the beliefs that individuals hold about their abilities and about the outcome of their efforts powerfully influence the ways in which they will behave.

How individuals interpret the results of their performance attainments informs and alters their environments and their self-beliefs, which in turn inform and alter their subsequent performances. The foundation of Bandura’s (1986) conception of reciprocal determinism is the view that (a) personal factors in the form of cognition, affect, and biological events, (b) behavior, and (c) environmental influences create interactions that result in a triadic reciprocality.

**Sources of Self-Efficacy**

According to Bandura (1986, 1997), self-knowledge about one’s efficacy, whether accurate or faulty, is based on four principal sources of information: 1) enactive mastery attainments; 2) vicarious experiences of observing the performances of others; 3) verbal
persuasion; and 4) physiological states from which people partly judge their capability, strength, and vulnerability. Any given influence may draw on one or more sources of efficacy information. It is Bandura's contention that drawing upon all four sources of self-efficacy provides the best opportunity to enhance self-efficacy, and in turn, enhance performance.

These four sources of self-efficacy offer guidance as to how to modify self-efficacy beliefs but do not offer specific techniques for doing so. The world of sports and sports psychology does, however, offer a glimpse into the identification of such techniques. A firm sense of self-efficacy has long been recognized as a key to optimal performance in athletic circles. After capabilities are perfected and practiced extensively, an athlete's self-confidence can make the difference between a good or poor showing in an athletic contest. It is not unheard of for a more talented athlete beset by self-misgivings to be easily surpassed by a less capable competitor who is self-assured. Within sports, mental training is as important as physical training. In these settings, techniques designed to develop and enhance self-confidence are integrated and practiced along with the physical skills required for the given sport.

Using Bandura's four sources of self-efficacy for guidance and drawing upon the world of sports for specific techniques to enhance self-efficacy, the two theoretical perspectives were combined to form the CHAMP approach. A pictorial version of this framework, outlining its key components, has been supplied in Figure 1.1. The remaining portion of this chapter will address the key details of each of these components.
Bandura's Self-Efficacy Theory

Sources of Self-efficacy
1. Enactive Mastery
2. Vicarious Experience
3. Verbal Persuasion
4. Physiological State

Techniques to Instill/Modify Self-confidence

Cues
Here and now
Arousal control
Modeling and Mental imagery
Praise, Persuasion, Positive self-talk

Figure 1.1: Theoretical Framework: Integration of Bandura's Self-Efficacy Theory and Techniques from Sports/Sports Psychology to form CHAMP
Enactive Mastery Attainment

Enactive attainments provide the most influential source of efficacy information because they are based on authentic mastery experiences (Bandura, Adams, & Beyer, 1977). Successes raise efficacy appraisals; repeated failures lower them, especially if the failures occur early in the course of events and do not reflect lack of effort or adverse external circumstances. After a strong sense of self-efficacy is developed through repeated successes, occasional failures are unlikely to have much effect on judgments of capabilities. People who are assured of their capabilities are more likely to look to situational factors, insufficient effort, or poor strategies as the causes of occasional failures. Failures that are then overcome by determined effort can instill the sense that one can eventually master the most difficult tasks.

Once established, enhanced self-efficacy tends to generalize to other situations, especially those in which performance has been self-debilitated by preoccupation with personal inadequacies (Bandura, Jeffrey, & Gajdos, 1975). As a result, behavioral functioning may improve across a wide range of activities. However, the generalization effects occur most predictably in activities that are most similar to those in which self-efficacy was enhanced.

In sports, this is a durable source of information because it directly influences the athlete’s sense of personal mastery (e.g., ‘if I’ve done it before, I can do it again’). Robert Weinberg and colleagues (1979) confirmed that, by directing the athlete’s focus towards performance accomplishments, both efficacy and subsequent performance were enhanced.
Vicarious Experience

People do not rely on experience as the sole source of information about their capabilities. Self-efficacy appraisals are partly influenced by vicarious experiences. Seeing or visualizing similar people perform successfully can enhance self-efficacy in that observers come to believe they too possess the capabilities to master comparable activities (Bandura, Adams, Hardy, & Howells, 1980; Kazdin, 1979). They persuade themselves that if others can do it, they should be able to achieve at least some improvement in performance. By the same token, observing that others perceived to be similarly competent fail despite high effort lowers observers’ judgments of their own capabilities and undermines their efforts (Brown & Inouye, 1978).

There are several conditions under which self-efficacy appraisals are especially sensitive to vicarious information. The amount of uncertainty about one’s capabilities is one such factor. Self-efficacy can be readily influenced by relevant modeling when people have had little prior experience on which to base evaluations of their personal competence. Lacking direct knowledge of their own capabilities, they rely more heavily on modeled indicators.

If prior experiences with a task have created a sense of inefficacy, a person can still benefit from modeling. A good example of this in mathematics is when dealing with the concept of factoring quadratics of the most general form $ax^2 + bx + c$. Students who have learned only the trial and error method of factoring sometimes continue to have difficulty factoring by the time they reach college. However, when introduced to the
grouping method of factoring this type of expression, many who have never seen this method before become confident in their ability to factor expressions of this type. Even some of those students who are confident in their ability to factor by trial and error, find that grouping offers a better way of factoring. Therefore, even the self-assured will raise their perceived self-efficacy if models teach them better ways of doing things.

Theoretically this source of efficacy is somewhat vulnerable because it is inferred from social comparison (e.g., “If he can do it, then so can I”) and not from personal experience. However, Feltz and colleagues (Feltz, 1982; Feltz & Mugno, 1983) found various forms of modeling did improve efficacy and subsequent performance.

Although vicarious experiences are generally weaker than direct ones, vicarious forms can produce significant, enduring changes through their effects on performance. People convinced vicariously of their inefficacy are inclined to behave in ineffective ways that, in fact, generate confirmatory evidence of inability. Conversely, modeling influences that enhance perceived self-efficacy can weaken the impact of direct experiences of failure by sustaining performance in the face of repeated failure. A given mode of influence can thus set in motion processes that augment its effects or diminish the effects of otherwise powerful influences.

**Verbal Persuasion**

Verbal persuasion is widely used to try to talk people into believing they possess capabilities that will enable them to achieve what they seek. People who are persuaded verbally that they possess the capabilities to master given tasks are likely to mobilize
greater sustained effort than if they harbor self-doubts and dwell on personal deficiencies when difficulties arise.

People, of course, do not always believe what they are told concerning their capabilities. Skepticism develops from personal experiences that often run counter to what one has been told. But there are many occasions when individuals are persuaded to try things they avoid or to persist at tasks they were ready to discontinue, only to discover, much to their surprise, that they were capable of mastering them. This is because performance attainments on many tasks are determined more by how hard one works at them than by inherent capacity. Mixed experiences with persuasive efficacy appraisals are common because they are used for flattery, perfunctory encouragement, or manipulative “hype,” as well as for realistic assessments of how well recipients can manage prospective situations. Consequently, persuasive efficacy appraisals have to be weighed in terms of who the persuaders are, their credibility, and how knowledgeable they are about the nature of the activities.

The impact of persuasive opinions on self-efficacy is apt to be only as strong as the recipient’s confidence in the person who issues them. This is mediated through the perceived credibility and expertness of the persuaders. The more believable the source of information about performance capabilities and task demands, the more likely are judgments of personal efficacy to change. People are inclined to trust evaluations of their capabilities by those who are themselves skilled in the activity, have access to some objective predictors of performance attainments, or possess a rich fund of knowledge gained from observing and comparing many different aspirants and their later
accomplishments (Crundall & Foddy, 1981). Skill in a given pursuit does not necessarily confer competence in gauging talent for it. For performers who realize this, evidence of extensive experience in judging talent is apt to be the more persuasive indication of evaluative competence. Others often voice opinions of what performers can do without being thoroughly acquainted with the difficulty of the tasks or with the circumstances under which they will have to be performed. Therefore, even the judgments of otherwise credible advisors may be discounted on the grounds that they do not fully understand the demands of the task.

Attempts to boost self-efficacy persuasively often take the form of evaluative feedback about ongoing performances. Schunk (1982a, 1983b) shows that such feedback can affect self-judgments of capability. In these studies children who lacked arithmetic skills were periodically given different attributional feedback for their rate of progress in a self-paced learning program. The same progress credited to underlying talent or concentrated effort raised perceived cognitive efficacy and accelerated mastery of arithmetic skills more than feedback implying either lesser ability, thus calling for harder work, or no feedback at all. The more the encouraging feedback instilled efficacious self-beliefs, the more effort children exerted and the more they accomplished.

Persuasive efficacy appraisals are most likely to become believable when they are slightly beyond what individuals can do at the time because better performances are achievable through extra effort. Those who are persuaded they can succeed are more likely to expend the necessary effort than they would if troubled by uncertainties. Performance successes raise the perceived evaluative competence of the persuaders.
Inflated persuasive appraisals that mislead performers to failure quickly undermine the evaluative credibility of the persuaders.

It is probably more difficult to produce enduring increases in self-efficacy by persuasive means than to undermine it. Illusory boosts in self-efficacy are readily disconfirmed by failure. But those who have been persuaded of their inefficacy tend to avoid challenging activities and give up quickly in the face of difficulties. By restricting choice behavior and undermining effort, self-disbeliefs can create their own validation.

Persuasive efficacy attributions, therefore, have their greatest impact on people who have some reason to believe that they can produce effects through their actions (Chambliss & Murray, 1979). However, the raising of unrealistic beliefs of personal competence only invites failures that will discredit the persuaders and will further undermine the recipient’s perceived self-efficacy.

**Physiological State**

People rely partly on information from their physiological state in judging their capabilities. They read their somatic arousal in stressful or taxing situations as ominous signs of vulnerability to dysfunction. Because high arousal usually debilitates performance, people are more inclined to expect success when they are not beset by aversive arousal.

A number of factors, including appraisal of the sources of arousal, the level of activation, the circumstances under which arousal is elicited, and past experiences of how arousal affects one’s performances, are likely to figure in the cognitive processing of emotional reactivity. Activities are often performed in situations containing varied
stimuli. This creates ambiguity about what caused the physiological reactions. The resulting impact on self-efficacy will, therefore, vary depending on the factors singled out and the meaning given to them.

In the social cognitive view, knowledge concerning bodily states is acquired, in large part, through social labeling processes. Arousing experiences contain three significant events, two of which are publicly observable — affective elicitors give rise to internal arousal and expressive reactions. The internal arousal itself cannot play a differentiating role in the social labeling because the arousal is unobservable to others. Moreover, different emotions appear to have too many similar physiological reactions to be differentiable by the person experiencing them. In classroom situations, teachers must, therefore, infer the presence of internal arousal in students from their expressive reactions and from environmental elicitors known to produce particular types of emotions. Coaches too must draw on these observable events in order to describe and differentiate the emotions athletes are experiencing and explain their causes. Through repeated social linkage of elicitors, expressive reactions, and internal arousal, both students and athletes eventually learn to interpret and to differentiate their affective experiences. Different personal interpretations of internal arousal (e.g., "frightened," "fired up") will have different impact on self-efficacy.

The self-efficacy implications of arousal derive from past experiences with how labeled arousal affects performance. For example, high achievers often view arousal as a facilitator, whereas low achievers regard it as a debilitator (Hollandsworth et al., 1979). The fact that it is not arousal per se but rather its level that carries the greater weight in
judging operative capabilities complicates the judgment process. As a general rule, moderate levels of arousal facilitate deployment of skills, whereas high levels of arousal disrupt it.

What constitutes an optimal level of arousal depends not only on the nature of the task but on the individual’s inferences concerning the arousal. Those who are inclined to perceive their arousal as stemming from personal inadequacies are more likely to lower their judgment of self-efficacy than those who regard their arousal as a common transitory reaction that even the most competent people experience. Accomplished athletes, who become anxious before a competition but lose their apprehension once the competition gets under way, are likely to ascribe their anticipatory arousal to normal situational reactions rather than to personal deficiencies.

Much of the previous discussion has centered on how affective arousal may be read as one indicator of self-efficacy. The research of Bower (1981) shows that mood states can affect cognitive processing and retrieval of experiences. People can learn faster those things that are congruent with the mood they are in, and they recall things better if they are in the same mood as when they learned them. Memory involves an associative network of concepts and encoded events. In Bower’s network theory of how emotional arousal affects thought processes, emotions become associated in memory with different events, thus creating multiple linkages within the associative network. Activating a particular emotional unit in the memory network will facilitate recollection of events linked with it.
Mood-biased recollection can similarly affect people's judgments of their personal efficacy. If a sad mood readily leads to thoughts of past failings, self-efficacy will be diminished, whereas if a positive mood activates thoughts of accomplishments, self-efficacy will be boosted. Evidence appears to be consistent with this view. People judge their capabilities in social, academic, and athletic pursuits higher under hypnotically-induced positive mood than under a neutral state, and they regard themselves as least self-efficacious in a negative mood (Kavanagh & Bower, 1985). The impact of mood on self-efficacy is widespread, rather than confined to the particular domain of functioning in which happiness or sadness was experienced. In dealing with cognitive tasks, persons act in accordance with their mood-altered perceptions of self-efficacy, choosing more challenging tasks in an efficacious than in an inefficacious frame of mind. Despondency can thus lower perceptions of self-efficacy that give rise to ineffective performance breeding even deeper despondency. In contrast a good mood, by raising perceptions of self-efficacy, can set in motion a positive reciprocal process.

Self-Efficacy Mediation in Sports

Skilled athletes give considerable weight to the contribution of perceived self-efficacy to skilled performance. King (1979) put it well when she observed that in tennis "more matches are won internally than externally" (p. D4). The performance dividends of perceived self-efficacy are equally evident in collective competitive accomplishments. Whether or not a team performs up to its potential depends partly on whether its members execute their functions in a highly efficacious frame of mind. Whatever the contests might be, coaches acknowledge that the game is a matter of ability and hard work, but
above all, it is a matter of self-assurance. Adept coaches can motivate a team to play beyond what one would normally expect of its members.

The various methods used to create athletic competencies, such as modeling and proficient enactment, have been shown to be self-efficacy builders as well (Feltz, Landers, & Raeder, 1979; Gould & Weiss, 1981). Many practice routines are designed as much to boost perceived self-efficacy as to perfect skill. The benefits of “psyching up” strategies may also operate partly through this mechanism. Wilkes and Summers (1984) have shown that cognitive preparation emphasizing self-efficacy improves performance.

Moreover, the higher the perceived self-efficacy, the better athletes are likely to perform in such diverse sports as track (Morelli & Martin, 1982), tennis (Barling & Abel, 1983), diving (Feltz, 1982), and gymnastics (Lee, 1982). When athletic tasks are performed for the first time, preexisting self-efficacy predicts initial performance (Feltz & Albrecht, 1985), but given adequate performance feedback, initial experience with a new task is likely to prompt reappraisals of self-efficacy, so it is the updated self-perception that affects subsequent performance (Weinberg et al., 1981).

Self-efficacy also affects how much anxiety athletes experience. In analyzing many potential determinants of athletic anxiety, Leland (1983) found that self-efficacy emerged as the major predictor of precompetition anxiety, whereas a measure of anxiety proneness accounted for little of the variation in apprehensiveness. The distinction between preparatory and performance efficacy is especially pertinent to athletes. In preparing for contests, coaches raise some doubts to get athletes to practice seriously, but
just prior to contests they try to raise self-efficacy persuasively so that players can get the most out of themselves.

Within sports, mental training is as important as physical training. Specific techniques designed to develop and enhance self-confidence are integrated and practiced along with the physical skills required for the given sport. In the pages that follow, some techniques derived from coaching and sports psychology will be described. The discussions of each technique will not only focus its use within a sport setting, but more importantly how the technique can be adapted to a mathematical setting. Similarities will be drawn and differences noted.

**Techniques Designed to Instill Self-Confidence in Sports**

As any coach or any mathematics teacher will tell you, one key to being successful in a sport or the mathematics classroom is practice, practice, practice. It is continual practice that leads to mastery and it is this mastery that acts as the major contributor to the development and enhancement in self-efficacy. Although almost any athlete or student would agree to the importance of practice, the level of effort each is willing to put forth in practice varies. By combining mastery skill development and techniques adapted from sports psychology, that draw upon modeling, persuasion, and arousal control, mathematical self-efficacy can be enhanced.

**Cues**

Concentration is a relaxed state of being alert. Athletes need to be capable of shutting out distractions and paying attention to the things that matter in their sport performance. This is particularly the case at the “critical moments” of performance. It is
essential at these times that athletes are completely focused on the necessary cues for successful execution of a skill. For an athlete, these cues come in three basic varieties: verbal, visual, and physical (Bull, Albinson, & Shambrook, 1996). A verbal cue is usually a single word that is silently repeated at the appropriate moment. A visual cue involves focusing intently on something very specific to the environment. A physical cue involves actually doing something behavioral. Within a given performance, cues can be used to elicit initial activation of the overall performance, evoke a desired action or response, or to control anxiety by blocking out negative thoughts.

Students working in mathematical settings can also benefit from cues. In many cases students have trouble getting started with mathematics problems. Having a self-determined cue word to “get started” on a particular problem would prove fruitful. Having one-word cue words for each step in the process could enable the student to proceed in locations where he/she might have otherwise been stuck. In addition, calming cue words could be elicited when the student feels anxious either before attempting a problem or within the process of solving a problem.

The activation and process cues should be succinct, preferably one word and determined by the student. This can be accomplished by asking the student to analyze carefully the necessary steps required to solve a particular type of problem. The student should then write out the steps involved in solving the problem. Each step of the process can then be reduced to a one-word cue which best emphasizes what is required in each step. The first word in the list represents the activator. These cue words should be practiced along with the regular practice associated with the solving of problems.
The student should also develop self-affirmation cues or negative-thought squelching cues. These can be attached to positive feelings generated by a successful past performance or by a positive image created from a successful performance. By having a student recall a successful past performance with respect to solving a problem, cues can be drawn from this description by listening for words or statements expressed with conviction, metaphors, or vivid images.

When students can approach a particular type of problem and know they have tools available that will not only get them started, but tools that help them to continue the process with a positive frame of mind, these students will approach the problem with a great deal of confidence in their ability to complete the problem successfully.

**Focus on the Here and Now**

When an athlete or a student feels he/she cannot seem to reach a goal, the discussion usually goes something like this:

**Advisor:** Did you set specific goals for yourself?

**Student:** Oh, yes -- I tried it and it didn’t work, so I stopped setting goals.

**Advisor:** What were your goals?

**Student:** To compete in the Olympics; To finish my thesis by December (a personal favorite of mine); To get an A in my math class.

**Advisor:** Oh, I see. Do you have any short-term goals that are totally within your control...like what you are going to do today that will bring you one step closer to being your best?

**Student:** No.

**Advisor:** What about tomorrow?

**Student:** No.
It is not unusual for people to set only long-term, far-off goals without focusing enough energy on the present. It is the present that moves a person to the future. Long-term goals can help with motivation, but an individual also needs lots of little daily goals that move progressively to the desired destination.

When an athlete is pursuing personal excellence, it is best to focus energy on specific aspects of performance that are potentially within the athlete's control — skills, preparation, execution, routines, time. An individual athlete must avoid focusing on outcome goals that are beyond immediate control, such as scores, placing, or winning. Generally outcomes are not within the direct control of the athlete because competitors, teammates, judges, officials, playing conditions, the weather, or other outside influences.

For goal setting to be effective, an individual must establish daily specific goals that encourage, compliment, and reward oneself while moving toward long-term goals (Orlick, 1990). The concreteness of progress in most sports is readily obvious. New tricks, better technique, faster times, higher jumps, better plays, improved rankings—all can be seen and felt. An athlete knows exactly where he/she is and each can see progress in a way that is often not possible in other aspects of life. In mathematics this progress takes place in the use of more efficient techniques, better understanding, faster completion of problems, improved quiz and/or test scores.

Certain goal-setting attributes should be consistently included. Butler (1996) suggests that goals should be phrased positively (avoid negative statements of what not to do), be related to performance tasks rather than outcomes, be controllable (something to
work on), be specific (focus on the pieces of the whole rather than the whole), and be realistic (achievable with hard work).

Having set a goal, the description of the goal can be checked against the following points before working on it:

- Is it positive?
- Does it describe what has to be done?
- Do I have control over making it happen?
- Is it described in sufficient detail?
- Can I reasonably be expected to carry it out? (Butler, 1996, p.24)

An affirmative answer to each question suggests a workable task. The advantages of having goals to work on include (1) they focus on what is required; (2) they provide and clarify direction; (3) they increase determination and persistence to achieve a task; and (4) they increase confidence when tasks and goals are achieved.

Some other goal-setting factors should also be kept in mind. First of all, goals should always be written down. By having a hard copy of goals, review of progress toward meeting goals is enhanced. Secondly, the goals should be reviewed on a regular basis. Carrying out this regular assessment allows the individual to identify early if goals are too lenient or too hard. Finally, goal setting should be viewed as a dynamic process; after closer inspection one needs to be able to alter goals. If progress is slower or faster than originally hoped for, the individual needs to feel it is alright to change goals in order to reach the most important target.

When setting goals in mathematics, for example, one must establish long-term goals (I will become proficient at solving mixture, motion, and interest problems in 3 weeks), intermediate goals (I will be proficient in solving mixture problems this week),
and short-term goals (I will become proficient today in solving mixture problems where the total amount of mixture is known).

**Arousal Control**

Faced with a situation that is potentially stressful, confrontation, or dangerous, an individual almost invariably reacts with increased arousal, so much so that the reaction might be construed as universal. The process, which might be almost instantaneous, goes something like this:

- The individual anticipates the possibility of harm, either physically (e.g. pain) or psychologically (e.g. humiliation). For an athlete both of these are concerns; for a mathematics student, the second possibility is of particular concern.
- Physiological changes rapidly occur which prepare the body to face up to the confrontation, including elevated heart rate, increased perspiration, and accelerated respiration.
- This state is commonly known as a “fight or flight” response because the physiological changes prepare the individual for action—either by taking on the danger or quickly escaping from it. (Butler, 1996, p. 100)

Given the potential and perceived “dangers” of sporting competition it is no surprise that athletes regularly report such feelings prior to competition. The manner in which athletes deal with the increased arousal inevitably affect the way they perform. Students of mathematics will commonly report such feelings prior to a quiz or an exam. The manner in which these students deal with the increased arousal will inevitably affect the way they perform as well.

A characteristic of high level performers is that they control the level of stress in their bodies—they are not controlled by the stress. This is not to say that stress and tensions are necessarily negative. Most people are more active, more in-vigorated, more
creative, more productive, in general, more alive because of stress. Therefore, stress is not something to be avoided, but it is a state we must understand and control if we are to fully appreciate and profit from it (Butler, 1996).

What is important to understand is that the physical reactions of the body that take place when one is under stress are designed to prepare the body for action. As a result of the physiological changes that take place during the stress response, most athletes perform better when under stress than they do without stress. The key is being under the proper amount of stress – not too much, not too little. As the saying goes (a favorite of an ex-coach):

"Butterflies are not a problem. It's just a case of getting them to fly in formation."

Gould and Udry (1994) have posed three pertinent questions related to arousal control as a means of assisting athletes to improve their performance:

1. How does the athlete construe the arousal?
2. What is the relationship between arousal and performance?
3. What strategies can be employed for managing anxiety and arousal in order to achieve optimum levels for performance?

Each of these questions is appropriate in determining how best to control arousal in mathematics students in order for an increase in confidence level. Knowing more about how a student approaches an upcoming test or mathematical exercise, whether arousal is construed by a student positively or negatively, the impact the arousal level has on
performance, and determining appropriate techniques in order to ensure optimal
performance — all will aid mathematics students in their endeavors.

**How is arousal construed?** As is the case in athletics, the practical starting point
in determining how arousal is construed is to ask the participant. In sports one would ask
the athlete to describe what it feels like in the lead-up to a competition or how the
individual felt during different situations within the competition. In a mathematics
classroom, asking the student to describe his/her feelings prior to attempting a particular
problem or how the individual feels at different points while solving the problem would
serve the same purpose.

The descriptions offered by an athlete help to determine whether the athlete views
the arousal in a positive or a negative sense. Negative descriptions include responses
like “nervous” or “tense,” while positive descriptions might include “pumped up” or
“energetic.”

Butler (1996) notes that in addition to how an athlete views an event, where the
athlete physically experiences the arousal also can be telling. Some describe heart rate
changes, others muscle tension or stomach churning, and yet others sweating palms. The
site of arousal is important in identifying ways to control the arousal (see below).

**What is the relationship between arousal and performance?** Having already
noted that a certain amount of arousal is beneficial to performance, the next appropriate
question focuses on what the optimum level of arousal should be for each individual
athlete in order that he/she can reach an optimum level of performance.
In Figure 1.2, the dotted line represents an athlete’s performance. Notice that as the level of arousal increases, the athlete’s performance increases as well, until it reaches the arousal level represented by point A. At this tension level, the performance level peaks (point B, the upper point on the dotted line). Point A is the ideal arousal level for a particular athlete in a particular sport in order to achieve “maximum” or “peak” performance. Ideal tension level varies; it might be different for a golfer versus a football player, and it might be different from individual to individual within the same sport. Similarly, the ideal arousal level is different for different individuals in a given mathematics setting.

![Level of Arousal](image)

**Figure 1.2: Relationship Between Performance and Arousal Level**

*Note.* From *A Mindset for Winning* (p. 27) by John D. Curtis, 1988, La Crosse, Wisconsin: Coulee Press.
In either case, if an athlete or student experiences increased tension beyond point A on the baseline, performance level diminishes. The higher the tension level moves beyond point A, the lower the performance level becomes. The downward movement of the dotted line illustrates this diminished performance.

It is also clear from this graph that too little stress can also have a limiting impact on performance. Athletes recognize they often do not perform well when under-aroused. For example, underestimating the opponent can have dire consequences. Similarly for students, underestimating the difficulty of an upcoming exam or not taking it seriously, can have dire consequences.

Orlick (1986) addresses the relationship between arousal and performance by asking athletes to describe differences in arousal levels for two contrasting performances – previous poor performance and a previous good performance. This leads to the identification of an optimum level of arousal. By comparing the two performances, the athlete can determine what actions led to the poor performance versus what actions led to the good performance. By inviting the athlete to focus on the good performance and incorporating such actions consistently into his/her preparation routines, he/she can approach each event with an anticipated optimum level of arousal.

Mathematics students can also be asked to compare a particularly good performance to a poor one. In so doing, his/her actions preceding each can be analyzed to determine the differences between the two. By inviting the student to focus on the good performance and incorporating such actions consistently into his/her preparation routines, each student can approach a test, quiz or mathematical exercise with an appropriate level
of arousal. Moreover, by focusing on the positive use of imagery, the student’s confidence will be enhanced.

**Strategies for managing anxiety and arousal.** When athletes or students experience elevated levels of anxiety, they are usually worrying about three things. First, they worry about the demands of the situation. Second, they worry about their ability to cope with these demands. And third, they worry about the consequences of not meeting the demands of the situation.

It is not only a case of what is being worried about, but also where the worry is felt. The “site” of arousal may determine the method used to assist the athlete in controlling the arousal. Butler further suggests that the descriptions or metaphors used to convey how the individual is feeling, should be accepted and employed by the coach when exploring issues of arousal control.

If a student’s level of confidence is being played out in the form of an increased heart rate, choosing methods of relaxation which lower the heart rate may in turn impact the student’s self-confidence. Listening to the key words used can help the teacher determine the most appropriate method of control.

Negative thinking inevitably results in anxiety and usually in poor performance. One of the most consistent findings in sport psychology research over the past 25 years is the direct relationship between positive thinking and successful performance (Bull, Albinson, & Shambrook, 1996). An athlete can become more confident by practicing positive self-talk on a regular basis. The principle is that the mind is trained to think positively as a natural response to a challenge. If done successfully, anxiety gets
translated into feelings of challenge and excitement. Techniques for enhancing positive thinking include the following:

- Re-appraise the situation with a positive frame of mind
- The use of coping self-talk
- The development of cues in association with self-talk
- Set realistic personal performance goals
- Focus on doing the things that will help you meet the challenge
- Know in your heart that you remain a valued person regardless of the performance outcome
- Recalling previously good performances and imagining future success

If you don’t have much time to reduce anxiety then taking a few deep breaths is a tried and tested technique that works for most people. Any breathing routine will be most effective if it has been practiced regularly during training and the individual is comfortable and familiar with the exercise.

As with any mental skill, one needs to practice it on a regular basis so that your images are clear and controllable. The following section discusses in some detail the varying aspects of mental imagery.

**Modeling and Mental Imagery**

As noted in Bandura (1977, 1986), observing someone of equivalent ability accomplish a task successfully can go a long way in improving self-efficacy. Various forms of modeling have proven to be an effective approach for improving efficacy and subsequent performance (Feltz, 1982; Feltz and Magno, 1983).
Many athletes routinely use other performers as role models. Watching videos of those of equal ability, achieving goals they themselves have established, allows athletes to believe that they too can accomplish a desired goal. Observing athletes who are slightly better than themselves can foster a determined effort to train harder to reach the next level of achievement. Allowing students to observe videos of students like themselves successfully completing mathematical problems serves a similar purpose of modeling.

Another effective use of video modeling involves compiling a selection of footage that captures the individual's recent excellent performances. Watching the "highlights" video can be an enjoyable way of improving self-efficacy and fostering a positive attitude toward future tasks and performances.

The use of these videos can also aid in the development of mental imagery. The term imagery is commonly used in sport psychology. It is not uncommon to see skiers or high jumpers prior to performance with their eyes closed making slight movements. These athletes are using imagery to enhance their performance. Although imagery refers to "seeing" in the mind's eye, it is very important to point out that the most effective imagery goes beyond simply seeing a skill performed. Well-practiced imagers will incorporate the sensations of hearing, smelling, tasting, and most important of all, feeling, into imagery sessions. In essence, imagery is the reproduction, in the mind, of all the relevant sensory information which contributes to the successful execution of a skill, or the correct behavior for a specific situation (Curtis, 1988). The more detail that can be included in the imaging, the more impact the training is likely to have.
Using imagery is very much like having your own "Virtual Reality" system in your head, which is connected directly to your body. In sports, there is strong evidence to suggest that the muscles you would use to perform the skill are activated at a very low level (Bull, Albinson, & Shambrook, 1996). This muscle activation is not enough to make the movements you imagine, but a "blueprint" for the movements. In a mathematical setting an image is not so much a blueprint of movements, but rather the blueprint of the situation. The more a student images, the stronger the blueprint becomes, and the more likely he/she is to produce the correct response during performance. The focus is on the seeing of oneself performing to the best of one's abilities. Having the ability to see oneself performing to the best of one's abilities increases the likelihood he/she will actually perform in a confident manner during performance.

When you image it is likely that you will see yourself performing in one of two ways. Some performers image from what is called the internal perspective. When you imagine yourself performing, you create an image that replicates exactly what you see during a performance, i.e., you are looking from inside you, to the outside world. Other performers image from an external perspective. External imagers create a mental picture in which they see themselves as if they were watching the performance on video.

Although sports psychologists think that the different perspectives are more useful in certain sessions than in others, there are no hard and fast rules. Both perspectives can achieve positive results regardless of what you are striving to achieve through imagery. Most people begin with one perspective, then over time and with practice improve their
ability to image in both perspectives. However, as Bull (1991) notes, the overall
effectiveness of imagery training will not be limited if only one perspective is used.

Imagery serves numerous uses in the world of sports. Those uses that seemingly
have the greatest adaptability to mathematical settings are:

- Mental practice of specific skills
- Improving positive thinking
- Tactical rehearsal
- Controlling arousal and anxiety
- Preparation for performance
- Performance review and analysis

**Mental practice of specific skills.** Perhaps the most common use of imagery is
the rehearsal of a skill in the mind. The skill can be one that you are attempting to
improve, or a well-learned skill that you want to adapt for a particular situation.
Through repeatedly seeing yourself performing something in the correct manner, you are
increasing the likelihood of performing the skill correctly when it comes to putting
practice into action. If a person imagines something going wrong, it usually does. All
you are doing with imagery is making this self-fulfilling prophecy work for you by
imagining things going right for you. The more you see things happening the way you
want them to, the more likely they will be to actually go right for you. In general, if you
can identify any skills or situations in which you feel you would like to improve, then this
type of imagery training should be useful (Bull, Albinson, & Shambrook, 1996).

**Improving positive thinking.** Previous performances can be a very powerful way
to build self-belief. Lists of previous best performances, or positive performance
attributes, can be the basis for a confidence building imagery program. Replaying images
of past success can recall all the good performance points by reliving them through imagery and provide a positive platform from which to prepare for competition.

**Tactical rehearsal.** Athletes have certain tactical strengths, and if a performance does not allow these strengths to be used, then anxiety will often increase, confidence will drop, and performance will suffer. Similarly to a student who practices only one particular type of mixture problem, say one where one of the quantities being mixed is already known, and then discovers the problem on the test actually assumes the total amount of mixture is known, can experience increased anxiety, a drop in confidence, and subsequently, a decrease in performance. As with the athlete, if the student regularly images different scenarios, an increase in confidence to deal with the less than favorable situation should occur. Seeing himself/herself successfully performing each of the different possible word problems will enhance confidence and thereby improve performance.

**Controlling arousal and anxiety.** In athletics, when all things are equal, the player who deals best with the pressure is usually the one who triumphs. The same can be said for a student in a mathematical setting. The ability of a student to deal with this pressure usually will perform better in these situations. There are many ways to deal with anxiety and arousal but imagery has an important role in reducing performance worries (Curtis, 1988). Further issues regarding peak arousal are discussed separately. This discussion will focus on the role imagery, in particular, plays in the control of arousal and anxiety.
Many athletes enjoy using images of relaxing places to help them achieve a relaxed state of mind. Regardless of the relaxed place they choose, be it a mountain stream or favorite tranquil place, an athlete focuses on the positive feelings associated with that place. The thinking is if the mind is relaxed, the body will follow suit.

In the same way that imagery training can help to give the athlete an air of confidence when going into performance, imagery training can also be used to help the athlete get into his/her optimal performance zone. As with confidence building mental imagery, the athlete may want to use a past performance to provide the relaxed images.

When a mathematics student enters into a stressful situation, most notably an exam, it should also be a goal that the student gets into his/her optimal performance zone. Training students to relax by the use of imagery, whether thinking about a quiet place or thinking upon a successful past performance, offers each student the opportunity to reach his/her optimal zone.

**Performance review and analysis.** Most of the imagery training that has been suggested thus far relates to getting ready for competition in the case of the athlete, or in the case of a mathematics student, getting ready for an exam. However, imagery can be just as useful after an athlete has finished a competition or after a student has finished an exam.

During the first few hours after competition, an athlete often finds it a good idea to review the strengths and weaknesses of his/her performance. It is often worth spending a short amount of time carrying out a structured review of your performance in detail, rather than pondering frequently on the performance for several days afterward.
Reviewing the performance offers a form of immediate feedback, but rather than coming from the coach, the feedback comes from within the athlete. Bull, Albinson, and Shambrook (1996) have found the use of a performance review list extremely helpful in obtaining this feedback.

The *Performance Review List* (see Appendix A) is a simple, yet effective way of developing a positive attitude towards preparation and performance. An athlete lists all the things that went well and the things that did not, then tries to determine what is needed to turn the bad points into good points. Students, too, can focus on the positives and turn the negatives into positives to produce a boost in confidence.

One key difference between an athletic setting and an exam setting is the initial feedback. This performance review list should be formulated in a short period after the competition. The feedback during or after an exam is not so direct or apparent. Unless a student specifically asks a question during or after the test, very little communication is offered between the teacher and the student. Therefore the majority of the feedback during or directly after the test depends on how the individual student rates his/her own individual performance, which may not be consistent with the actual performance. Thus, it would seem appropriate to create the *Performance Review List* immediately following the return of the graded exam by the teacher. For some students, turning negatives into positives may be best accomplished by working more closely with the teacher.

Establishing goals for preparation and performance with respect to the next test could further enhance this activity. As with the other skills being practiced, the technique of performance review needs to be practiced as a part of the student’s preparation for the
next performance. In this way, the good-points, bad-points comparison can act as a self-reflective review of progress.

Using this instrument directly after the exam, as well as after the actual results have been obtained could also prove beneficial. This would offer a means of comparison for the teacher to identify students most likely to demonstrate a gap between their self-assessment and their actual performance.

**Praise, Verbal Persuasion, and Positive Self-Talk**

Probably the most widely used means to instill confidence in an athlete is by using rewards. Sometimes a reward is something physical, like a trophy. Other times, a reward may be recognition in the newspaper. The most commonly used form of reward is, however, much more subtle and comes by way of the coach praising the efforts of athlete. This praise is best delivered with emphasis, genuinely directed, and immediately following a successful attempt or accomplishment.

Praise also represents a standard motivational technique in any classroom. Students love to be singled out for their accomplishments. A “good job,” “way to go,” or “keep up the good work,” can go a long way in motivating a student to continue his/her efforts. This same type of encouragement can greatly enhance a student’s belief in his/her ability to perform a mathematical task. Even if a task is not successfully completed, the teacher can identify the good points associated with the attempt. By pointing out these accomplishments and positively persuading a student to move forward, a teacher can continue to instill confidence.
As noted by Bandura (1986, 1997), verbal persuasion, although effective in the short-term, offers the weakest possible source of efficacy over the long term. Research in sporting settings also bears this out. Verbal persuasion is considered a weak source because it represents an external source of efficacy, thus resulting in no experiential basis for the athlete or the student. For verbal persuasion to have its greatest impact, these positive statements need to become internalized.

One of the most important determinants of developing and maintaining confidence is what athletes say to themselves (Butler, 1996). This determinant is referred to as self-talk and it is through this thinking that confidence is either enhanced or diminished. If athletes have a mental self-image of positive characteristics, positive perceptions, and positive traits, they will be confident—and perform better. If negative characteristics, negative descriptions, doubt about ability or preparation creep in, then confidence is bound to drop—and of course, performance suffers.

Self-affirmation is a process of directing self-talk to affirm both the positive abilities and skills of the athlete, as well as the appropriate training and preparation which has gone before (Butler, 1996). Through the use of self-affirmation the athlete immerses in the conscious mind positive thoughts which are associated with producing excellent performance. Repeated use of such affirmations causes them to be planted in the subconscious mind and hence influence the athlete’s personal perception of ability and skills. This enhanced perception increases confidence before and during competition, and ultimately performance is likely to improve.
Students can also develop their own individual affirmations to call upon when needed. Students need to learn how to handle themselves and how to sustain an intrinsic feeling of competence in completing more and more difficult mathematical problems. Such conditions will create longer-lasting benefits. Realizing an intrinsic achievement orientation will lead to the enhancement of each student’s motives, performance, and self-efficacy.

Putting all these techniques and devices together creates a coaching and teaching strategy with the mnemonic CHAMP. These techniques with summary descriptions are:

C: **cue words**
Develop and use activation, process, and arousal control cue words

H: **focus on the here and now**
Stay in the present, review the controllables, and establish achievable goals

A: **arousal control**
Determine appropriate levels of arousal and reappraise situations with a positive frame of mind.

M: **modeling and mental imagery**
Use modeling to create positive mental images that can further be used to picture success using techniques such as mental recall and mental rehearsal

P: **praise, verbal persuasion, and positive self-talk**
Internalize praise and verbal persuasion from external sources to create positive self-talk
Summary

By using Bandura’s four sources of self-efficacy for guidance (enactive mastery, vicarious experience, verbal persuasion, physiological state) and drawing upon the world of sports for specific techniques to enhance self-efficacy, the combination of these two perspectives resulted in the formulation of CHAMP.

The following matrix summarizes the links between Bandura’s sources of self-efficacy and CHAMP.

<table>
<thead>
<tr>
<th><strong>Sources of Self-Efficacy</strong></th>
<th><strong>C</strong></th>
<th><strong>H</strong></th>
<th><strong>A</strong></th>
<th><strong>M</strong></th>
<th><strong>P</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enactive Mastery</strong></td>
<td><strong>Cue Words</strong></td>
<td><strong>Here and Now</strong></td>
<td><strong>Arousal Control</strong></td>
<td><strong>Modeling</strong></td>
<td><strong>Praise</strong></td>
</tr>
<tr>
<td></td>
<td>Process cues used as an aid to master skills</td>
<td>Goals allow for focus on, and mastery of, particular skills</td>
<td>Mental imagery allows for the mastery of skills through mental practice of these skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vicarious Experience</strong></td>
<td>Establish achievable goals by observing others</td>
<td>Observing others of equal ability being successful has calming effect</td>
<td>Connected directly to modeling</td>
<td>Creates a form of positive self-talk</td>
<td>“if others can do it, so can I”</td>
</tr>
<tr>
<td><strong>Verbal Persuasion</strong></td>
<td>Use of encouraging cue words</td>
<td>Adequate performance feedback can have calming effect</td>
<td>Encouragement offered through modeling and own mental imagery</td>
<td>Praise and verbal persuasion internalized as positive self-talk</td>
<td></td>
</tr>
<tr>
<td><strong>Physiological State</strong></td>
<td>Use of calming cue words</td>
<td>Establish goals that encourage and compliment</td>
<td>Recalling previously good performances and imagining future success</td>
<td>The use of coping self-talk</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.1: Summary comparison of Bandura’s sources of self-efficacy and CHAMP
CHAPTER 2

RELATED LITERATURE REVIEW

The related literature found in this chapter will begin with a general discussion of self-efficacy, followed by a discussion of self-efficacy and its relationship to education, and close with a discussion of literature related to non-traditional students and their learning. In the general discussion of self-efficacy the construct of self-efficacy itself, its history, and its use in various disciplines and settings will be discussed. This discussion will be followed by a comparison of self-efficacy to other related beliefs such as outcome expectations, self-concept, perceived control, and motivation. From the academic perspective, self-efficacy and related constructs will be addressed as they relate to self-regulated learning and academic performance and achievement. The strength and accuracy of these self-perceptions also play a role in academic settings and will be addressed next within the literature review. Finally, within the academic discussion, the instructional and social influences on self-efficacy beliefs will be addressed. Since this study involves non-traditional college students, the final two sections of the literature review are devoted to specifically addressing educational issues related to non-traditional learners and the influences these issues have on the teaching of adult students.
The Construct of Self-Efficacy

The construct of self-efficacy has a relatively brief history that began with Bandura's (1977) publication of "Self-Efficacy: Toward a Unifying Theory of Behavioral Change." The tenets of self-efficacy have since been tested in varied disciplines and settings and have received support from a growing body of findings from diverse fields (Maddux & Stanley, 1986; Multon, Brown, & Lent, 1991). For example, self-efficacy has been the focus of studies on clinical problems such as phobias (Bandura, 1983), depression (Davis & Yates, 1982), social skills (Moe & Zeiss, 1982), and assertiveness (Lee, 1983, 1984); on smoking behavior (Garcia, Schmitz, & Doerfler, 1990); on pain control (Manning & Wright, 1983); on health (O'Leary, 1985); and on athletic performance (Barling & Able, 1983; Lee, 1982). During the past decade, self-efficacy beliefs have received increasing attention in educational research, primarily in the area of academic motivation (Pintrich & Schunk, 1995).

Studies have investigated the relationships among efficacy beliefs, related psychological constructs, and academic motivation and achievement. Self-efficacy has been prominent in studies that have explored its relationship with attributions (Schunk, 1981, 1982a), goal setting (Locke & Latham, 1990; Wood & Locke, 1987), modeling (Schunk, 1981, 1987), problem solving (Bouffard-Bouchard, 1989; Larson, Piersel, Imao, & Allen, 1990), reward contingencies (Schunk, 1983b), self-regulation (Bandura, 1991; Schunk, 1982b), social comparisons (Bandura & Jourden, 1991; Schunk, 1983a), strategy training (Schunk & Cox, 1986), teaching and teacher education (Ashton & Webb, 1986; Gibson & Dembo, 1984; Woolfolk & Hoy, 1990; Woolfolk, Rosoff, & Hoy, 1990),
anxiety and self-concept (Pajares & Miller, 1994, 1995a), and varied academic performance (Bandura, 1993; Zimmerman & Bandura, 1994; Bouffard & Vezeau, 1996; and Malpass & O’Neil, 1996, across academic domains). Researchers have reported that self-efficacy beliefs are positively correlated with other self-beliefs, motivation constructs, and academic choices, changes, and achievement, although effect sizes and relationships greatly depend on the manner in which self-efficacy and criterial tasks are operationalized and assessed.

The role self-beliefs play in motivating individuals is the primary focus of theoretical perspectives other than those of social cognitive theory. These include theories about self-concept, attributions of success and failure, expectancy value, goals, and self-regulation. Self-beliefs specific to one’s perceived competence, or expectancy beliefs, are also prominent in the area of academic motivation. To better understand the role that self-beliefs play in academic settings, researchers have investigated the relationships between these beliefs and various academic performances, as well as the relationships among the beliefs themselves.

**Self-Efficacy and Related Beliefs**

Self-efficacy beliefs differ conceptually and psychometrically from closely related constructs, such as outcome expectations, self-concept, perceived control, and motivation.

**Outcome Expectancies**

The conceptual distinction that Bandura (1986) drew between academic self-efficacy and outcome expectancies was studied psychometrically in research on reading and writing achievement. Shell, Murphy, and Bruning (1989) measured self-efficacy in
terms of perceived capability to perform various reading and writing activities, and they assessed outcome expectancies regarding the value of these activities in attaining various outcomes in employment, social pursuits, family life, education, and citizenship. Efficacy beliefs and outcome expectancies jointly predicted 32% of the variance in reading achievement, with perceived efficacy accounting for virtually all the variance. Only perceived self-efficacy was a significant predictor of writing achievement.

Self-Concept

One of the closest constructs to self-efficacy is self-concept. The conceptual difference between self-efficacy and self-concept is not always clear. Some researchers use the terms interchangeably (Reyes, 1984). Others describe self-concept as a generalized form of self-efficacy (Harter, 1990). Still others refer to academic self-concept as self-perceptions of ability and suggest that one reason why these self-percepts affect performance is because of their effect on students' effort, persistence, and anxiety (Felson, 1984). Eccles, Alder, and Meece (1984), in an overview of self-concept theories, wrote about a self-concept of ability that affects "a variety of achievement behaviors including academic performance, task persistence, and task choice; people with positive perceptions of their ability approach achievement tasks with confidence and high expectations for success and, consequently, perform better on these tasks" (p. 27).

Historically, self-concept was defined by phenomenologists (e.g., Rogers, 1951) as a global perception of oneself and one's self-esteem reactions to that self-perception, but this global measure of self-belief was not found to be related consistently to students' academic performance (Hattie, 1992; Wylie, 1968). As a result, a number of theorists
e. g., Harter, 1978; Marsh & Shavelson, 1985) reconceptualized self-concept as a hierarchical construct, with a global self-concept at the apex of the self-hierarchy, but added subcategories such as academic self-concept in the middle of the hierarchy and academic domain-specific self-concepts at the bottom. The latter self-concept measures emphasize self-esteem reactions by posing self-evaluative questions, such as “How are you in English?” By contrast, self-efficacy items focus exclusively on task-specific performance expectations, such as “How certain are you that you can diagram this sentence?” Because judgments of competence are considered integral components of an individual’s self-concept, self-efficacy beliefs are often viewed simply as requisite judgments necessary to the creation of self-concept beliefs. Rosenberg and Kapland (1982) wrote that self-concept precepts include judgments of confidence, along with judgments of self-esteem, stability, and self-crystallization.

Although prior task reactions and future performance expectations are often correlated, Bandura (1997) notes it is possible conceptually to have high self-efficacy about a capability that one does not particularly esteem, as well as in reverse. Pajares (2000) describes the distinction between self-efficacy and self-esteem in the following manner: Self-efficacy is a judgment of capability to perform a task or engage in an activity, whereas self-esteem is a personal evaluation of one’s self that includes the feelings of self-worth that accompany that evaluation. In other words, self-efficacy is a judgment of one’s own confidence; self-esteem is a judgment of self-value. Because self-esteem involves evaluations of self-worth, it is particularly dependent on how a culture or social structure values the attributes on which the individual bases those feelings of self-worth. Pajares
further notes that there is no fixed relationship between one's beliefs about what one can or cannot do and whether one feels positively or negatively about oneself. For example, one could surmise that skilled soldiers in war may possess strong efficacy beliefs about their professional capabilities but take no pride in performing them well, plagued as they may well be by the emotional stress that accompanies the rendition of their skills. A student may feel highly efficacious in mathematics but without the corresponding positive feelings of self-worth, in part because s/he may take no pride in accomplishments in this area.

Self-concept theorists view as particular troubling the loss in practical utility that results from the microanalytic assessments of a particularized judgment matched directly to a criterial task. As has been mentioned previously, general measures of self-efficacy insensitive to context are weak predictors of academic performance. However, to be practically useful and predictive, the level of specificity of an efficacy assessment should depend on the complexity of the performance criteria with which it is compared. Judgments of competence need not be so microscopically operationalized that their assessment loses all sense of practical utility. Lent et al. (1993) showed how efficacy judgments can be tailored to varying levels of academic outcomes and still remain highly predictive. They compared students' confidence to succeed in math-related courses with three career-related outcomes—intention to take the courses listed on the instrument, grades obtained in mathematics-related courses that students took during the subsequent term, and interest in mathematics courses listed on the instrument. Self-efficacy beliefs were predictive on each count.
Findings have consistently shown that self-concept is related to academic achievement and to other motivation constructs across domains (Hattie, 1992). Few researchers have explored the relationships among self-efficacy, self-concept, and academic performances, and results are inconsistent. Marsh et al. (1991) compared the direct effect of achievement on the mathematics self-concept and self-efficacy of fifth graders and reported a stronger direct effect on self-concept than on self-efficacy. Relich (1983) assessed mathematics self-concept, mathematics achievement, performance on a mathematical task, and self-efficacy for the task. Achievement correlated strongly with domain-specific self-efficacy and self-concept. Specific performance on the mathematical task was more strongly correlated with specifically assessed self-efficacy than with domain-specific self-concept.

Researchers assess self-efficacy beliefs by asking individuals to report the level, generality, and strength of their confidence to accomplish a task or succeed in a certain situation. In academic settings, self-efficacy instruments may ask students to rate their confidence in solving specific mathematics problems (Hackett & Betz, 1989), performing particular reading or writing tasks (Shell, Colvin, & Bruning, 1995), or engaging in certain self-regulatory strategies (Bandura, 1989). Assessments of other expectancy beliefs include asking students to report how well they expect to do in an academic subject (i.e., performance expectancies, Meece, Wigfield, & Eccles, 1990), whether they understand what they read (i.e., perceptions of competence, Harter, 1982), and whether they are good in an academic subject (i.e., academic domain-specific self-concept, Marsh, 1992; also ability perceptions, Meece et al., 1990).
In one sense, the issue centers around which types of questions, and the beliefs such questions tap, afford greater prediction and explanation of an individual's dispositions, behavioral intentions, and subsequent actions. Conversely, this is an issue of which types of questions individuals primarily ask themselves as they encounter new information and novel phenomena, engage in tasks, and sort out just what it is that they will or will not do.

**Predictive utility.** There is growing evidence that, although self-efficacy beliefs are correlated with domain-specific self-concepts, self-efficacy measures offer predictive advantages when a task is familiar and can be specified precisely. For example, Pajares and Miller (1994) used path analysis procedures to examine the predictive and mediational roles of these two constructs in mathematical problem solving by college students. Mathematics self-efficacy was more predictive of problem-solving performance than was mathematics concept or, for that matter, perceived usefulness of mathematics, prior experience with mathematics, or gender.

Pajares & Valiante (1997) demonstrated the predictive utility of self-efficacy for writing performance. In this study, 218 fifth-grade students completed measures for writing performance, efficacy, apprehension and perceived usefulness. Although aptitude had a powerful effect, self-efficacy independently contributed to the prediction of writing performance.

Williams (1994) investigated gender-related differences and the predictive quality of self-efficacy across four different domains. In this study, high school students completed measures in language arts, mathematics, reading and science achievement. In
addition, prior to each test the students rated their perceived self-efficacy for success. The majority of the students, both male and female, with high efficacy ratings performed at higher levels on the tests.

Shell, Bruning and Murphy (1989) demonstrated the predictive utility of self-efficacy across the domains of reading and writing. The study required 153 college students to complete assessments of efficacy, outcome expectations and achievement for reading and writing tasks. Regression analysis results demonstrated that self-efficacy and outcome expectancy were significant predictors of reading achievement with self-efficacy being the stronger predictor. Interestingly, self-efficacy alone accounted for the variance in writing achievement.

These findings seem to suggest that the traditional distinction between self-concept and self-efficacy may have been overstated in the literature. Social cognitive theorists propose that self-concept and self-efficacy act as common mechanisms of personal agency in the sense that both types of self-beliefs help mediate the influence of other determinants on subsequent behavior and that both “contribute in their own way to the quality of human life” (Bandura, 1986, p. 410).

**Perceived Control**

The correlation between self-efficacy and perceived control has been well documented. In early research with phobics, Bandura (1982) described self-efficacy as an individual’s judgment of their ability to maintain control of their performance during an emotionally distressing situation. In turn, he postulated that self-efficacy was a component of personal control. Skinner, Wellborn, and Connell (1990) found that a student’s
perceived control over academic outcomes is an important contributor to school achievement. That is, when students believe they can control academic achievement they perform at higher levels on cognitive tasks (Skinner et al., 1990).

The effect of perceived control on performance outcomes is complex. Bandura (1982) contends that the effects of perceived control indirectly influence achievement through motivation. In support, others state that perceived control directly influences the amount of effort students expend during a task which promotes or impairs academic performance (Skinner et al., 1990). In this way, student engagement mediates between perceived control and actual performance outcome.

The relationship between performance outcomes and perceived control is described as cyclic and bi-directional (Scott, 1996; Skinner et al., 1990). According to researchers, the cycle begins with perceived control over outcomes, which results in enhanced performance. In turn, a successful performance reinforces the student’s perception of control, and enhances self-efficacy. This results in increased motivation and renewal of the cycle (Scott, 1996; Skinner et al., 1990).

Locus of control theory is based on an individual's tendency to perceive of control over outcomes as either internal or external (Rotter, 1966; Schunk, 1991). For example, some individuals hold the belief that outcomes are related to their actions (internal control) and yet, others may believe that outcomes are due to circumstances out of their control, such as luck (external control). According to Scott (1996), efficacious students believe they have control over achievement and that their actions have a primary
impact on achievement. However, ineffectual students believe their actions have a limited effect on achievement and that they have little power to change their achievement outcomes.

Research has shown that control beliefs are related to self-efficacy perceptions and the student’s engagement in school. Skinner et al. (1990) developed a model of perceived control based on three sets of beliefs: strategy beliefs, which refer to the effectiveness of certain actions in producing outcomes; capacity beliefs, which refer to whether the individual is capable of acquiring effective actions; and control beliefs, which concern producing the desired outcome without reference to specific actions or causes. In regards to this theory, self-efficacy seems most clearly aligned with capacity beliefs. Skinner et al. (1990) found those children with high strategy and capacity beliefs for effort had the highest level of engagement, but children with low capacity beliefs for ability, teachers, and luck showed the lowest levels of engagement. With respect to effort, these findings suggest that strategy beliefs in effort must also be accompanied by the capacity belief of producing the necessary level of effort. Furthermore, engagement in school is predicted by capacity beliefs that are similar to self-efficacy judgments.

**Academic Motivation**

Self-efficacy beliefs have also shown convergent validity in influencing such key indices of academic motivation as choice of activities, level of effort, persistence, attributions, and emotional reactions. There is evidence (Bandura, 1997; Schunk 1996) that self-efficacious students participate more readily, work harder, persist longer, and
have fewer adverse emotional reactions when they encounter difficulties than do those who doubt their own capabilities.

**Choice of activities.** In terms of choice of activities, self-efficacious students undertake difficult and challenging tasks more readily than do inefficacious students. Bandura and Schunk (1981) found that students' mathematical self-efficacy beliefs were predictive of their choice of engaging in subtraction problems rather than in a different type of task: The higher the children's sense of efficacy, the greater their preference for the arithmetic activity. Zimmerman and Kitsantas (1997, 1999) also found self-efficacy to be highly correlated with students' intrinsic interest in a motoric learning task as well as in a writing revision task.

Another major area of inquiry has been the link between efficacy beliefs and college major and career choices and success in coursework, particularly in the areas of science and mathematics (e.g., Bores-Rangel, Church, Szendre, & Reeves, 1990; Brown, Lent, & Larkin, 1989; Farmer, Wardrop, Anderson, & Risinger, 1995; Lent, Brown, & Larkin, 1986). Researchers have reported that the mathematical self-efficacy of college undergraduates is more predictive of their mathematics interest and choice of math-related courses and majors than either their prior mathematics achievement or mathematics outcome expectations and that male undergraduates report higher mathematics self-efficacy than do female undergraduates (Hackett, 1985; Hackett & Betz, 1989; Lent, Lopez, & Bieschke, 1991, 1993; Pajares & Miller, 1994, 1995b). This line of inquiry has important implications for counseling and vocational psychology theory and practice,
given that findings have provided insights into the career development of young men and women and can be used to develop career intervention strategies.

**Level of effort.** The amount of effort a student invests in a task is related to his/her perceived level of self-efficacy. Bandura (1982) contends that during task performance high self-efficacy allows the student to apply effort optimally in the absence of interfering self-doubts. Self-efficacy beliefs are predictive of two measures of students’ effort: rate of performance and expenditure of energy. For example, Schunk and colleagues found that self-efficacy for learning correlates positively with students’ rate of solution of arithmetic problems (Schunk & Hanson, 1985; Schunk, Hanson, & Cox, 1987). Conversely, students with low self-efficacy are beleaguered by self-doubt, which interferes with the effective deployment of effort.

Nonetheless, some self-doubt in terms of task challenge and not ability enhances preparatory effort during learning. If the task is seen as unchallenging by a highly self-efficacious student, a minimum amount of effort will be invested in the undertaking and achievement is lowered. In support, Solomon (1984) has found that self-efficacy is positively related to self-rated mental effort and achievement during students’ learning from text material that was perceived as difficult.

**Persistence.** Regarding the effects of perceived self-efficacy on persistence, path analyses have shown that self-efficacy influences students’ skill acquisition both directly and indirectly by increasing persistence (Schunk, 1981). The direct effect indicates that self-efficacy influences students’ methods of learning as well as their motivational processes. These results validate the mediational role that self-efficacy plays in motivating
persistence and academic achievement. In a meta-analytic review of nearly 70 studies of persistence and rate measures of motivation, Multon, Brown, and Lent (1991) found a significant positive effect size of students’ self-efficacy beliefs.

Findings also support Bandura’s (1986) contention that efficacy beliefs mediate the effect of skill or other self-beliefs on subsequent performance by influencing effort, persistence, and perseverance (Bandura & Schunk, 1981; Bouffard & Bouchard, 1990; Lent, Brown, & Larkin, 1984; Schunk & Hanson, 1985). Collins (1982) identified children of low, middle, and high mathematics ability who had, within each ability level, either high or low mathematical self-efficacy. After instruction, the children were given new problems to solve and an opportunity to rework those they missed. Collins reported that ability was related to performance but that, regardless of ability level, children with high self-efficacy completed more problems correctly and reworked more of the ones they missed. Bourrard & Bouschar, Parent, and Larivee (1991) found that students with high self-efficacy engaged in more effective self-regulatory strategies at each level of ability.

Self-efficacy also enhances students’ memory performance by enhancing persistence (Berry, 1987). In studies of college students who pursue science and engineering courses, high self-efficacy has been demonstrated to influence the academic persistence necessary to maintain high academic achievement (Lent et al., 1984, 1986).

However, Schunk (1991) reminds us that choice, effort and persistence are the only appropriate indexes of motivation for previously learned tasks. The relationship between self-efficacy and these indexes of motivation (choice, effort, and persistence) must be altered when applied to a context where learning is taking place (Schunk, 1991).
According to Schunk (1989), choice is not an effective index of academic motivation because students have little choice about participating in learning activities that are dictated by teachers. Likewise, according to Corno and Mandinach, students do not choose to persist in tasks but are influenced by their teachers to keep working (as cited by Schunk, 1989). However, it has been found that cognitive effort is considered an appropriate index of academic motivation.

**Attribution.** Attribution is defined as the assignment of responsibility to psychological or situational factors in an attempt to explain behavior (Campbell, 1996). Attributions enable people to explain the reasons for important events in their life, such as a grade on a mathematics test. In learning situations, students attribute success or failure to different causal factors such as effort, ability, or luck (Schunk, 1991).

Weiner (1979, 1986) postulates that differences in effort expenditure by students of similar age can be explained by differences in how the students explain their school-based successes and failures. As Weiner and his colleagues (Weiner et al., 1972; Weiner and Kukla, 1970) have shown, successful students explain successful achievement outcomes in terms of ability and effort. They explain failure by lack of effort or unstable external factors. Ability is an internal, stable, uncontrollable factor. Effort is an internal, unstable, controllable factor. Attributing successful outcomes to ability and effort brings with it feelings of pride and continued expectations for success in school. Attributing academic failures to lack of effort permits students to maintain their views of themselves as competent students because level of effort expenditure is under control of the students. Students who fail and explain their failure by lack of interest in the task or by limited time
to devote to the task (i.e., the value assigned to successful completion of the task is low) can maintain their views of themselves as competent, because they could have been successful if they had been interested in the task and expended the necessary effort.

Individuals use these attributions as cues to appraise their self-efficacy. As an example, Scott (1996) states that students with high self-efficacy tend to attribute their failure to lack of effort, and students with low self-efficacy tend to attribute their failure to lack of ability. Likewise, students use attribution information to develop expectations for future performances (Schunk, 1989). For example, if students attribute past failures to stable factors (e.g. ability) they will tend to have lower expectations for future success. Conversely, students who ascribe past effort to unstable factors (effort) will tend to have higher expectations.

It has been found that educators can utilize effort-attribution feedback to increase self-efficacy and motivation in students. According to Schunk (1989), "effort feedback can be a persuasive source of self-efficacy information" (p. 179). For example, students can be motivated to complete a task if they are told they can succeed through hard work. This is motivating because it implies that the students are capable of successfully performing the task. It also encourages self-efficacy perceptions and enhances perceptions of skill improvement.

**Emotional control.** Students’ beliefs about their efficacy to manage academic task demands can also influence them *emotionally* by decreasing their stress, anxiety, and depression (Bandura, 1997). For example, Pajares and Kranzler (1995) have studied the relationship between self-efficacy and students’ anxiety reactions regarding mathematics.
Although the two measures were negatively correlated, only self-efficacy was predictive of mathematics performance when compared in a joint path analysis. There is also evidence that students' performance in academically threatening situations depends more on efficacy beliefs than on anxiety arousal. Siegel, Galassi, and Ware (1985) found that self-efficacy beliefs are more predictive of mathematics performance than is math anxiety. The strength of efficacy beliefs accounted for more than 13% of the variance in their final mathematics grades, whereas math anxiety did not prove to be a significant predictor. These studies provide clear evidence of the discriminant and predictive validity of self-efficacy measures, and they suggest particular benefit if educators focus on fostering a positive sense of personal efficacy rather than merely diminishing scholastic anxiety.

**Self-Efficacy and the Present Study**

In this section, the construct of self-efficacy is discussed and was compared to other related beliefs such as outcome expectations, self-concept, perceived control, and motivation. Each of these constructs were found to be correlated to self-efficacy in a variety of domains, including math-related areas. Most of the studies discussed here are quantitative in nature, with limited reference to qualitative work in the field of self-efficacy. Much of the math-related discussions centered on elementary, middle, and high school levels, especially with respect to intervention techniques. Those studies related to the college level, in particular the field of mathematics focused more heavily on college major and career choices. The importance of self-efficacy in college-level mathematics is clear when it has been determined that mathematical self-efficacy of college
undergraduates is more predictive of their mathematics interest and choice of math-related courses and major.

The present study differs from the previous study in that an intervention technique is directed at the college level population. Secondly, although not denying the importance of the predictive power of self-efficacy with respect to college and career choices, the present study did not use self-efficacy as a predictive utility, but instead focused on the participant’s current curriculum itself. Thirdly, the study itself is qualitative in nature. Schunk (1995) addresses the importance of the current study when he notes that with respect to self-efficacy, there is a need for alternate forms of data collection (e.g., case studies, oral histories). Although this study included fewer subjects than the majority of the studies in the literature review it was assumed, and also noted by Schunk, that studies such as the present one should yield rich data.

**Self-Regulated Learning**

Self-regulation is defined as an individual’s ability to regulate his or her own behavior (Hallahan & Kaufman, 1997). Self-regulating students actively employ strategies in order to improve skills in learning situations. For example, if given the task to memorize a list of words, self-regulating students will spontaneously utilize the strategy of rehearsal. Self-regulated learning according to Corno, involves student's metacognitive strategies for planning, monitoring, and modifying their own cognition (as cited by Pintrich & De Groot, 1990). Metacognition refers to a student's awareness of what strategies are required to execute a task and the ability to use self-regulating strategies (Hallahan & Kaufman, 1997).
The relationship between self-efficacy and self-regulated learning is well documented. According to Zimmerman and Martinez-Pons (1990), the utilization of strategies depends on a student's academic self-efficacy. For example, if a student performs poorly on a task, his/her self-efficacy will be affected and this will in turn affect motivation and choice in strategies. In support, Schunk stated that "self-efficacy for learning sustains motivation and leads students to use effective self-regulatory strategies" (1996, p. 14). In addition, self-efficacy is promoted when a student is taught to apply learning strategies because it instills a sense of personal control over performance outcomes (Schunk, 1989).

Self-efficacy beliefs provide students with a sense of agency to motivate their learning through such self-regulatory processes as goal setting, self-monitoring, self-evaluation, and strategy use. For example, there is evidence (Zimmerman, Bandura, & Martinez-Pons, 1992) that the more capable students judge themselves to be, the more challenging the goals they embrace.

**Goal Setting**

It has been hypothesized that goal setting is beneficial to student motivation and self-efficacy (Bandura, 1986). Goal setting has been described as "a form of self-motivation in which persons compare present performance with internal standards" (Schunk, 1983, p.77). According to Locke and Latham, goals impel students to focus on activities related to goal acquisition, to exert effort, and to stay on task (as cited by Schunk, 1991). Students who attain their goals experience a sense of self-efficacy that sustains motivation (Scott, 1996). In contrast, students without goals have limited...
motivation and self-efficacy, "because they lack standards against which to gauge learning" (Schunk & Swartz, 1991, p. 4). Interestingly, Malpass (1996) found that self-regulated learners are characteristically goal directed because they actively set goals, use strategies to reach goals and monitor their progress during learning tasks.

Researchers have proposed that the motivational effects of goals are determined by three properties: proximity, specificity, and difficulty (Bandura, 1982; Schunk, 1991). Proximal and specific goals enable the students to stay in control and monitor steps in the learning process. Interestingly, Schunk (1991) recommends the use of easy goals in the initial stages of skill acquisition and the use of difficult goals in the later stages. It seems that difficult goals offer more information about the student’s capabilities.

When self-efficacy and personal goal setting from the beginning of a school term were used jointly to predict final course grades in high school social studies, they increased prediction by 31% over a measure of prior grades in social studies. Similarly, when self-efficacy and personal goal setting were compared with the verbal subscale of the Scholastic Aptitude Test, there was an increase of 35% in predicting college students’ final grades in a writing course (Zimmerman & Bandura, 1994). Although prior course grades and general measures of ability are considered exemplary predictors of achievement, these studies demonstrated that self-efficacy beliefs and goal setting add significantly to the predictiveness of these measures.

In addition, goal orientation has been shown to affect self-efficacy and motivation. Of particular interest are performance and learning goal orientations. Performance goals refer to task completion and product creation (Scott, 1996). On the
other hand, learning goals involve the acquisition of strategies and knowledge (Scott, 1996). Research has demonstrated that students with a learning goal orientation tend to view obstacles as cues to increase effort or alter strategies (Dweck, 1986). Schunk and Swartz (1991) demonstrated that providing students with the goal of learning a strategy enhances self-efficacy more than strategy instruction or progress feedback alone.

Research has demonstrated that goal orientation is also related to individual characteristics. Students oriented to performance goals, according to Schunk (1996), are merely concerned with solving the problem and tend to compare themselves with peers. In contrast, students oriented to learning goals are interested in learning how to solve the problem and are more focused on process, mastery and effort (Dweck, 1986; Schunk, 1996). Dweck (1986) has suggested that students who perceive of intelligence as a stable factor orient towards performance goals. On the other hand, students who view intelligence as a changeable factor tend to orient towards learning goals. It has been hypothesized that a learning goal orientation is characteristic of self-regulated students (Malpass, 1996).

**Self-Monitoring and Self-Evaluation**

The effects of efficacy beliefs on students’ *self-monitoring* were studied during concept learning (Bouffard-Bouchard, Parent, & Larivee, 1991). Efficacious students were better at monitoring their working time, more persistent, less likely to reject correct hypotheses prematurely, and better at solving conceptual problems than inefficacious students of equal ability. Self-efficacy beliefs also affect the *self-evaluation* standards students use to judge the outcomes of their self-monitoring. In a path analytic study
Zimmerman and Bandura (1994) found self-efficacy for writing beliefs significantly predicted college students’ personal standards for the quality of writing considered self-satisfying as well as their goal setting and writing proficiency.

**Strategy Use**

Self-efficacy beliefs also motivate students’ use of *learning strategies*. Zimmerman and Martinez-Pons (1990) investigated the relationship of grade, sex, and giftedness to self-efficacy and strategy use. Ninety boys and girls from the 5th, 8th, and 11th grades in regular education and gifted programs were asked to report on their use of self-regulated learning strategies, as well as their verbal and mathematical efficacy. The study revealed that self-efficacy and use of self-regulated strategies increases as students progress through school, with gifted students displaying increases before regular education students. Zimmerman and Martinez-Pons (1990) also found that student perceptions of verbal and mathematical efficacy were positively related to self-regulating strategies across all domains. In regards to sex differences, the findings were controversial, with girls exhibiting a greater use of strategies but reporting lower self-efficacy.

There is also growing evidence that self-efficacy plays a central role in accounting for *academic performance* (Pajares & Valiente, 1997; Shell, Bruning, & Murphy, 1989; Williams, 1994). The greater motivation and self-regulation of learning of self-efficacious students produces high *academic achievement* based on numerous studies.
Self-Regulated Learning and the Present Study

Self-regulated learning becomes a key component of this study. For the individuals in this study to successfully use CHAMP, each must be able to regulate their own learning by being self-monitoring and self-evaluative. As mentioned in the literature review, to be able to regulate one’s learning, one must be able to set realistic goals for oneself. The H component of CHAMP deals with this very issue.

As will also be addressed later in this chapter, non-traditional students actually learn differently from their traditional counterparts and therefore need to be taught differently. From the current discussion, few techniques are suggested for aiding non-traditional students in the development of self-regulatory techniques. Through their participation in this study, the individuals within the study will be exposed to some useful techniques.

Academic Performances and Achievement

Pintrich, Roeser and De Groot (1994) examined the relationship of classroom and individual differences on motivation and self-regulated learning. The participants, 100 seventh graders, completed a questionnaire that assessed student motivation, cognitive strategy use, and self-regulation. Motivational beliefs in this study were comprised of self-efficacy, intrinsic value, and anxiety. Pintrich et al. (1994) found that positive motivational beliefs were related to self-regulated learning. Self-efficacy and self-regulated learning were influenced by individual and classroom characteristics. Initial levels of self-efficacy and self-regulation predicted both constructs. In regards to classroom features,
collaborative work, choice of task, interest, productivity and good explanations promoted the use of self-regulating strategies and a sense of self-efficacy.

**Academic Self-Efficacy**

Zimmerman and his associates have been instrumental in tracing the relationships among self-efficacy perceptions, self-efficacy for self-regulation, academic self-regulatory processes, and academic achievement (Risemberg & Zimmerman, 1992; Zimmerman & Ringle, 1981; Zimmerman, 1989, 1990, 1994, 1995; Zimmerman & Bandura, 1994; Zimmerman & Martinez-Pons, 1990). Zimmerman, Bandura, and Marinez-Pons (1992) used path analysis to demonstrate that academic self-efficacy mediated the influence of self-efficacy for self-regulated learning on academic achievement. Academic self-efficacy influenced achievement directly as well as indirectly by raising students' grade goals. Other researchers have found that self-efficacy is related to self-regulated learning variables (e.g., Feather, 1988; Pintrich & Schrauben, 1992; Pokay & Blumenfeld, 1990). Findings in this area suggest that students who believe they are capable of performing academic tasks use more cognitive and metacognitive strategies and persist longer than those who do not (Pintrich & Garcia, 1991). Pintrich and De Groot (1990) reported a positive correlation between global academic self-efficacy and both cognitive strategy use and self-regulation through use of metacognitive strategies. In addition, academic self-efficacy correlated positively with academic performances such as semester and final year grades, in-class seatwork and homework, exams and quizzes, and essays and reports. Perceived importance of academic achievement was positively associated with the outcome variables but was not a significant predictor. Pintrich and De Groot concluded
that self-efficacy played a mediational or “facilitative” role in relation to cognitive
ingagement, that improving self-efficacy might lead to increased use of cognitive
strategies and thereby higher performance.

One line of inquiry has looked at judgments of self-efficacy in terms of
particularized self-perceptions of competence highly consistent with the criterial task being
assessed. This microanalytic assessment requires that if the criterial task involves solving
specific mathematics problems, then the efficacy assessment asks students to provide
judgments of confidence to solve similar problems (Konstanopolous, 1996; Pajares &
Miller, 1994, and their colleagues).

Schunk and his associates have reported on numerous studies that have examined
the role of particularized self-efficacy beliefs in various academic contexts (Schunk,
1996a, 1996b; Schunk & Cox, 1986; Schunk & Gunn, 1985; Schunk & Hanson, 1988).
For example, Schunk (1981) used path analysis to show that modeling treatments
increased persistence and accuracy on division problems by raising children’s self-efficacy,
which had a direct effect on skill. He later demonstrated that effort attributional feedback
of prior performance (e.g., “You’ve been working hard”) raised the self-efficacy
expectations of elementary school children, and this increase was in part responsible for
increased skill in performance of subtraction problems (Schunk, 1982a). In subsequent
experiments, he found that ability feedback (e.g., “You’re good at this”) had a stronger
effect on self-efficacy and performance (Schunk, 1983a; Schunk & Gunn, 1986). Relich,
Debus, and Walker (1986) also reported that self-efficacy mediated the role of skill
training and attributional feedback and had a direct effect on the performance of division
problems of learned helpless sixth graders. Attributional feedback showed a moderate
direct effect on performance and a stronger indirect effect mediated by self-efficacy. In
another study, Schunk (1984b) reports that mathematical self-efficacy influenced
mathematics performance both directly and indirectly through persistence. Results of these
investigations demonstrate that acquisition of cognitive skills, modeling effects,
attributional feedback, and goal setting influence the development of self-efficacy beliefs
and these beliefs, in turn, influence academic performances. Students with similar
previous performance attainments and cognitive skills may differ in subsequent
performance as a result of differing self-efficacy perceptions because these perceptions
mediate between prior attainments and academic performances. As a consequence, such
performances are generally better predicted by self-efficacy than by prior attainments.

Other researchers have attempted to discover whether prediction is increased when
particularized efficacy and performance assessments directly correspond. Pajares and
Miller (1994) report that mathematical self-efficacy had stronger direct effects on
mathematics problem solving than did self-concept, perceived usefulness, and problem-
solving performance.

**General Mental Ability**

Pajares and Kranzler (1994, 1995a, 1995b) constructed path models that included
mathematical self-efficacy, general mental ability, mathematics self-concept, math anxiety,
self-efficacy for self-regulation, previous grades in mathematics, and gender. The most
substantive effort to extend previous findings involved the inclusion in the model of a
measure of general mental ability, or psychometric g, rather than a math-related aptitude
assessment. The researchers chose an assessment of psychometric g because domain-related aptitude assessments as controls in studies of self-efficacy are confounded with the influence of self-beliefs that influence these assessments (Hackett & Betz, 1989). As a consequence, if the prior influence of the self-beliefs is not partialed out, their effect is artificially lessened. Moreover, g accounts for the single largest component underlying individual differences in mental ability and is acknowledged to be a strong predictor of academic performance (Thorndike, 1986). The key finding from these studies was that the direct effect of self-efficacy on performance was as strong as the effect of ability. The nonsignificant direct effect of anxiety (Pajares & Kranzle, 1995b) and the reduced effect of self-concept (Pajares & Kranzler, 1994, 1995a) on performance, as well as the influence of self-efficacy on anxiety and self-concept, supported previous findings that the influence of these determinants on academic performances diminishes when self-efficacy is included in the model.

**Mathematical Performance**

Pajares (1996b) examined the interplay between self-efficacy judgments and the mathematical problem solving of middle school students mainstreamed in algebra classes. Mathematics self-efficacy made an independent contribution to the problem-solving performance of regular education students and of gifted students in a path model that controlled for the effects of math anxiety, cognitive ability, mathematics grades, self-efficacy for self-regulatory learning, and gender. Pajares also reported that girls expressed lower confidence than boys when performance scores did not warrant it and similar confidence when performance scores warranted greater confidence. Although most
students were biased toward overconfidence, girls were less biased in that direction, and
gifted girls were biased toward underconfidence. Consistent with the findings of Hackett,
Meece, and their colleagues, these results suggest that factors are still at work in
negatively affecting the mathematical self-beliefs of girls.

What this line of inquiry has demonstrated is that when self-efficacy closely
corresponds to the criterial tasks with which it is compared, prediction is enhanced.
Multon et al. (1991) found 36 studies written between 1977 and 1988 on the relationship
between self-efficacy and academic performance or persistence that met their criteria for
inclusion in a meta-analysis: containing a measure of self-efficacy and academic
performance and providing sufficient information to calculate effect size estimates. They
computed that efficacy beliefs were related to performance and accounted for
approximately 14% of the variance in academic performance. However, effect sizes
depended on specific characteristics of the studies, notably on the types of efficacy and
performance measures used. Researchers who compared specific efficacy judgments with
basic cognitive skill measures of performance, developed highly concordant self-
efficacy/performance indexes, and administered them at the same time obtained the
strongest effects.

Correlations between self-efficacy and academic performances in investigations in
which self-efficacy is microanalytically analyzed and closely corresponds to the criterial
task have ranged from $r = .49$ to $r = .70$; direct effects in path analytic studies ranged from
$\beta = .349$ to $\beta = .545$. Results tend to be higher in studies of mathematics than of other
academic areas such as reading or writing, but even in these areas relationships are
considerably higher than previously obtained if the criteria by which students rate their self-efficacy judgments are used as the criteria for scoring essays or assessing reading comprehension.

As noted by Multon et al. (1991), self-efficacy researchers have sometimes used generalized, global, or multiple-scale self-efficacy measures to predict academic performance. For example, researchers have often operationalized mathematics self-efficacy as the composite score of individuals’ judgments of their capabilities to solve mathematics problems, perform math-related tasks, and succeed in math-related courses—the three subscales of the Mathematics Self-Efficacy Scale (MSES; Betz & Hackett, 1983).

Pajares and Miller (1995b) argued that the mathematical judgments assessed by the MSES are substantively different and tap differing math-related beliefs. Although they have in common that all are mathematically related, their predictive value should largely depend on the nature of the criterial tasks with which they are compared. Consequently, students’ judgments of their ability to solve mathematics problems should be more strongly predictive of their ability to solve those problems than should their confidence in their ability to perform other math-related tasks or succeed in math-related courses. Similarly, their judgments of their ability to succeed in math-related courses should be more strongly predictive of their choice to enroll in such courses than should their confidence in their ability to solve specific problems or perform mathematics tasks. Pajares and Miller compared these judgments of capability with two outcome measures; ability to solve the problems on which self-efficacy was assessed and mathematics
relatedness of academic majors. Results confirmed that Bandura's (1986) cautions regarding specificity of self-efficacy and performance assessment are well founded. Students' confidence in their ability to solve mathematics problems was a more powerful predictor of their ability to solve those problems than was their confidence in their ability to perform math-related tasks or their confidence in their ability to earn As or Bs in math-related courses.

Recall that significant relationships are obtained even with generalized domain specific self-perceptions, provided that they assess skills and performances in related domains (Multon et al., 1991). Pajares and Miller (1995b) found this phenomenon as well. Each subscale, as well as the full scale, showed a significant positive correlation with each performance task. Such relationships attest to the generalizability of self-efficacy perceptions within a domain, but prediction is enhanced as self-efficacy and performance more closely match.

Studies that report a lack of relationship between self-efficacy and performance often suffer from problems either in specificity or correspondence. Benson (1989) found that the path from mathematical self-efficacy to performance was not significant. Self-efficacy was assessed with three global items dealing with expected success in statistics class (e.g., "No matter how hard I study, I will not do well in this class"); performance was the midterm exam grade in a statistics course. Cooper and Robinson (1991) compared scores for the courses subscale of the MSES with scores on a performance measure that consisted of solving problems from the Missouri Mathematics Placement Test and reported a low but significant correlation between mathematics self-efficacy and
performance. A regression model with math anxiety, the quantitative score on the American College Test (ACT - Q), and prior mathematics experience revealed that self-efficacy did not account for a significant portion of the variance in mathematics performance.

**Academic Performance and the Present Study**

Findings on self-efficacy coincide on two points: When efficacy beliefs are globally assessed and/or do not correspond with the criterial tasks with which they are compared, their predictive value is diminished or can even be nullified; and when efficacy assessments are tailored to the criterial task, prediction is enhanced. In general, there is ample reason to believe that self-efficacy is a powerful motivational construct that works well to predict academic self-beliefs and performances at varying levels, but works best when theoretical guidelines and procedures regarding specificity and correspondence are adhered to.

Beyond supporting the hypothesized predictive and mediational role of self-efficacy, results from self-efficacy investigations generally show that, as Bandura (1986) theorized, particularized judgments of capability are better predictors of related outcomes than are more generalized self-beliefs. This can be viewed as begging the question of practical utility, given that many criterial tasks of interest in the motivational and academic arenas cannot be assessed with the specificity afforded by a performance as particularized as the solution of, say, mathematics problems. Research findings demonstrating that more generalized self-efficacy perceptions are also good predictors of more generalized performance such as obtained grades, choice of academic majors, and intention to enroll in
math-related courses speak to the practical utility both of self-efficacy and of expectancy beliefs in general.

One key result demonstrated within this portion of the literature review is that when self-efficacy assessments are tied to the criterial task, prediction is enhanced. That is, particularized judgments of capability are better predictors of related outcomes than are more generalized self-beliefs. By directly relating the techniques of CHAMP to critical tasks, the participants in the study further focused on short-term goals and incremental improvement as opposed to final grade outcomes, thus enhancing the influence that improved self-efficacy might have on performance.

**Strength and Accuracy of Self-Perceptions**

Past findings suggest that most students are overconfident about their academic capabilities (Hackett & Betz, 1989; Pajares, 1996b; Pajares & Miller, 1994). Bandura (1986) argues that successful functioning is best served by reasonably accurate efficacy appraisals, although the most functional efficacy judgments are those that slightly exceed what one can actually accomplish, for this overestimation serves to increase effort and persistence. But how much confidence is too much confidence, when can overconfidence be characterized as excessive and maladaptive in an academic enterprise, and what factors help create inaccurate self-perceptions? Bandura argues that the stronger the self-efficacy, the more likely are persons to select challenging tasks, persist at them, and perform them successfully. Researchers will have to determine to what degree high self-efficacy demonstrated in the face of low personal attainments ultimately results in benefits. Efforts to lower students’ efficacy precepts or interventions designed to raise already
overconfident beliefs should be discouraged, but improving students’ calibration, the accuracy of their self-perceptions, will require helping them to better understand what they know and do not know so that they may more effectively deploy appropriate cognitive strategies as they perform a task. The challenge is to accomplish this without lowering confidence and optimism.

On the other end of the efficacy continuum, students who lack confidence in skills they possess are less likely to engage in tasks in which those skills are required, and they may more quickly give up in the face of difficulty. In some studies, researchers have reported that girls perform as capably as boys in varied academic tasks but nonetheless report lower self-efficacy, particularly at higher academic levels (Pajares & Johnson, 1996; Pajares & Miller, 1994, 1995b). In one study, gifted girls were found to be biased toward underconfidence, although most students are generally biased toward overconfidence (Pajares, 1996b). Exploring the nature of the relationship between efficacy judgments, calibration, performance attainments, and the hypothesized effects of self-efficacy (choice, persistence, and perseverance) continues to be a promising avenue of inquiry (Pajares, 1996c).

**Instructional and Social Influences on Self-Efficacy Beliefs**

In contrast to trait measures of self-perceptions, self-efficacy indices focus on cognitive beliefs that are readily influenced by four types of experience: enactive attainment, vicarious experience, verbal persuasion, and physiological states. Unlike self-beliefs assumed to have trait-like stability across time and setting, self-efficacy is assumed to be responsive to changes in personal context and outcomes, whether experienced
directly, vicariously, verbally, or physiologically. As a result of this sensitivity, self-efficacy beliefs are studied as indicators of change during instructional interventions as well as indicators of initial individual differences.

To facilitate improvements in perceived efficacy, researchers have trained students with learning and motivational deficiencies by modeling specific self-regulatory techniques, describing their form, and providing enactive feedback regarding their impact. For example, youngsters who observed an adult modeling the use of a cognitive strategy had significantly higher levels of perceived efficacy and academic skills than youngsters who received didactic instruction (Schunk, 1981). Asking students to set short-term goals enhanced self-efficacy and skill development more effectively than asking them to set long-term goals because the short-term attainments provide evidence of growing capability (Bandura & Schunk, 1981). Verbally encouraging students to set their own goals improved not only their efficacy beliefs and achievement but also their commitment to attaining goals (Schenk, 1985). The frequency and immediacy of enactive feedback also created high perceptions of personal efficacy (Schunk, 1993). When students were taught to attribute their enactive feedback to effort, they perceived greater progress, maintained higher motivation, and reported greater efficacy for further learning (Schunk, 1987). In these investigations, Schunk and his colleagues demonstrate the sensitivity of efficacy beliefs in explaining changes in learners’ self-regulation and achievement outcomes (Berry, 1987; Schunk, 1981). Self-efficacy beliefs increased prediction of academic outcomes by as much as 25% of the variance above instructional influences.
Schunk and Swartz (1991) found that progress feedback enhanced self-efficacy perception, especially when in combination with learning goals. Research has demonstrated that progress feedback is especially beneficial "when students have difficulty determining how well they are learning and whether strategy use is improving their work" (Schunk & Swartz, 1991, p.7).

It has also been hypothesized that modeling is an important source of self-efficacy information (Bandura, 1977, 1986, 1997; Schunk & Hanson, 1985). According to Schunk (1991), students who watch others succeed tend to believe they too are capable, which can motivate them to attempt the task. On the other hand, observing a failed attempt may dissuade a student from attempting the task.

Students can gauge their progress and self-efficacy by observing similar others attain a goal. Schunk (1983) investigated the relationship between goal setting, social comparative information and self-efficacy. This study found that providing low achieving mathematics students with specific, proximal goals and social comparative information was a successful method of fostering skill acquisition and self-efficacy. Schunk (1983) states that goals alone do not tell the student how difficult it will be to acquire the set goal. On the other hand, social comparative information vicariously implies how difficult or easy it will be to attain the set goal.

**Non-Traditional Adult Learners**

The participants in this study each would fall under the classification of non-traditional students (all were 25 years or older and each had been out of school for a period of eight or more years prior to entering college). Adults older than 25 years of age
are now a powerful segment of the undergraduate population and are dramatically changing the nature of higher education today. They make up about 40% to 45% of the students enrolled as undergraduates in higher education (The National Center for Educational Statistics, 1998). Despite these trends, most of the insights about the undergraduate experience are drawn from the past two decades of research on young adults (under 25 years of age) and their development (Astin, 1977, 1993; Chickering & Gamson, 1987; Kuy, 1993; Pace, 1979; Terenzini & Pascarella, 1994) and are in many ways limited to explaining how young adults learn and develop in college.

There is ample research demonstrating that college has a significant impact on the students who enroll. Furthermore, the effects are more pronounced for students who actively participate in the college environment. Probably the most comprehensive work in this area was done by Pascarella and Terenzini (1991), who analyzed the results of more than 2,500 studies to provide an overall picture of the impact of college. From their analyses, they found that college attendance was associated with significant increases in several domains, including verbal, quantitative, cognitive growth, self-concept, self-esteem, moral development, attitude, and value changes. Their research also pointed out the significant role of the college culture and the nature of the students' personal experiences. In fact, they suggested that the students' experiences during college have more impact on the students than the nature of the colleges or universities themselves (Pascarella & Terenzini, 1991; Terenzini & Pascarella, 1994).

Astin's (1993) research efforts in this area provide evidence on the significance of the students' level of involvement in college and the nature of their interactions with the
college culture. Terenzini, Pascarella, and Blimling (1996) have further documented the importance of out-of-class experiences. Kuh (1992) noted several conditions that enhance the impact of college, such as involvement in social and academic life, interactions with peers whose values match those of the institution, and how students were connected to the campus environment.

In these and other studies, involvement was defined in traditional ways for traditional-age students who interacted in a peer culture that shaped their values, habits, and knowledge. Although there is considerable evidence of the benefits of involvement and the value of both the student-student and the faculty-student interactions for traditional-age students, it is often difficult to involve adult learners in the campus environment due to their conflicting life roles. Adults often enroll in college to address work or life transitions, reasons that are different from those of traditional-age students. Frequently, adults report rusty study skills, low self-confidence, or fears about returning to college (Cupp, 1991; Kasworm, 1995, 1997; Shere, 1988). Yet somehow, adults generally compensate for this lack of campus involvement. Kuh (1993) found adults reported benefits similar to those articulated by traditional-age students. Numerous other studies found that adults report outcomes similar to younger college students across a wide array of areas (Graham, 1998; Graham & Donaldson, 1996, 1999; Graham & Long, 1998).

There are several theories developed from previous research that might explain why older adults report significant progress from their academic endeavors. First, older adults have complex and rich mental schemas that might make learning more personally
meaningful to them. According to the work of several researchers (Cervero, 1988; Kasworm, 1997; Kasworm & Blowers, 1994; Merriam & Caffarella, 1991, 1999), older adults integrate new learning by making connections to existing knowledge schema. They reflect on rich, personal experiences and draw on their previous knowledge and wisdom to make meaning of new material and to understand it in a way that transforms their own previous understandings.

Second, in many instances, older adults make connections to other real-life activities and then apply this learning immediately in real-life contexts (Hughes & Graham, 1990; Kasworm, 1997). As a result, they achieve a new, more “authentic involvement” that addresses their comprehensive community and life roles and which is not limited to the classroom or to experiences in college clubs or organizations (Graham & Donaldson, 1996; Kasworm, 1995, 1997).

Another plausible explanation is that older adults use the classroom differently than do traditional students. They may use the classroom as a stage to intensify their learning and enhance their interactions with peers and instructors to achieve additional benefits (Bean & Metzner, 1985; Donaldson, 1991; Kasworm, 1997; Kasworm & Blowers, 1994). Finally, research by Cupp (1991), Frost (1991), and Kasworm (1995) suggests that adults are more intent on learning, hope to gain something they can apply to their work, approach their college experiences with a clearer purpose in mind, and take the advice of instructors more seriously.

Looking at the various relationships between these possible explanations and the work of Kasworm, 1995, 1997); Kasworm and Blowers (1994), and several others,
Donaldson and Graham (1999) developed a framework for understanding the college outcomes for adult learners. The model takes into account the learner’s history and the interaction of various processes over time that influence learning. The model consists of six components: (a) prior experience and personal biographies; (b) psychosocial and value orientations; (c) adult cognition; (d) the connecting classroom as the central avenue for social engagement on campus; (e) life-world environment (the different contexts in which adults live, defined by the roles they occupy in their various work, family, and community settings); and (f) college outcomes (different types of outcomes such as learning new content to finish a course, to really understand it, to apply it to authentic settings, and to use it to improve the lives of others). The variations within each of the components and the interactions among them highlight the important dynamics associated with adult development in college.

**Prior Experience and Personal Biographies**

Adults come to the collegiate experience with rich personal biographies. These personal biographies are influenced by prior experiences in the real world, ranging from experiences in formal schooling, to the social and cultural contexts of adult life in which adults participate as workers, family, and community members. These experiences and their assessment of their performance, as well as the assessments of others, influence the adults’ initial interactions with the college environment as they return to college (Kasworm, 1995, 1997; Merriam & Caffarella, 1999). These prior experiences and personal biographies influence the knowledge structures or the adult cognition component, including those related to self, education, and the classroom. They also influence learners’
motivations, self-esteem, self-confidence, self-efficacy, responsibility, and intent, as well as the value systems or the psychosocial and value orientations component with which learners approach their education.

**Psychosocial and Value Orientations**

Prior experience leads adults to evaluate themselves across a number of social and psychological dimensions that affect their collegiate experiences. These dimensions are the various social conditions, the values, and the psychological motivations that influence adults’ abilities to learn and remain in college. As one example, adults’ evaluations of themselves as learners influence their participation behaviors (Cross, 1981). Other psychosocial elements such as concerns associated with a “fear of being too old” and a lack of confidence in academic abilities have also been reported by adult undergraduates as they begin or reinitiate their college careers (Carp, Peterson, & Roelfs, 1974; Chartrand, 1990; Novak & Thacker, 1991). Another value dimension that influences persistence and achievement in college is the extent of the adults’ commitment to the student role (Cross, 1981). This is especially important given the competing life roles with which most adults must contend. Supportive family and friends, possessing adequate study skills, and having clear purposes for participation, have also been connected with the nature of adults’ collegiate experience and their retention (Chartrand, 1992; Dill & Henley, 1998).

Nonetheless, the role expectations of adults can also serve to make them more serious students. There is evidence that adult learners compensate for any initial lack of confidence or rusty skills by working harder than the traditional-age students (Cupp, 1991; Donohue & Wong, 1997; Nun, 1994), by attending college with a clear purpose in mind,
or by taking the advice of their professors or advisers more seriously than younger students (Frost, 1991; Kasworm, 1995). Other research has demonstrated that adult students are more concerned than younger students with the cognitive and quality aspects of their education, whereas younger students tend to value the social aspects (Kasworm & Blowers, 1994; Wolfgang & Dowling, 1981).

**The Connecting Classroom**

The connecting classroom addresses the ways that adults use the classroom and their interactions with students and faculty as a springboard for their learning. Because adults generally spend less time on campus, they may be forced to find ways to use the classroom as the focal point for their learning experiences. Cupp (1991), Graham and Donaldson (1996, 1999) and Kuh (1993) have reported that adult learners were much less involved in extracurricular activities on campus than their traditional counterparts due to time constraints, lack of money, and/or the multiple life roles they must play.

Kasworm and Blowers (1994) found that part-time students attribute the relationships they develop with faculty members and their in-class learning experiences as more meaningful to them than for their traditional-age peers. Additionally, research on adults’ perceptions of exemplary collegiate instruction for adults suggests that the social aspects of instruction (i.e., development of a community of learners within classes and having a respectful, caring instructor) are critical factors for adult students (Donaldson, 1991; Donaldson, Flannery, & Ross-Gordon, 1993). Graham and Long (1998) reported that the adult students’ overall satisfaction with the college’s academic climate (e.g. faculty concern for students, faculty accessibility, quality of instruction) played a more
significant role in the students' learning outcomes than did their involvement in campus activities, suggesting the centrality of the classroom in these adult students' experience. A number of other researchers have also offered evidence that for adults, the classroom is the center stage for their learning (Dill & Henley, 1998; Donaldson, 1991; Kasworm, 1997; Kasworm & Blowers, 1994). For example, Kasworm (1997) found that adults perceived the classroom as the “main stage for the creation and negotiation of meaning for learning, for being a student and for defining the collegiate experience” (p. 7).

One explanation of how adults compensate for their time restrictions is that their class-related learning and their relationships with faculty and other students become the most powerful influences on their campus experiences. Due to this limited interaction time, they may instead gain support from sources outside the college, like family, friends, or co-workers. This is in contrast with traditional-age students in which the primary impact comes from their involvement with peers and in peer-related activities—primarily outside of class (Kasworm & Blowers, 1994; Kasworm & Pike, 1994).

**Adult Cognition**

The adult cognition component encompasses three discrete forms of cognition: (a) declarative and procedural knowledge structures, (b) metacognitive or self-regulatory processes, and (c) cognitive operations through which knowledge structures develop (Anderson, 1993; Bruer, 1993; Rummelhart & Norman, 1978). In brief, adults have complex cognitive schema, rich with previous knowledge and experience. This generally allows them to connect new information to something that they have already experienced. Furthermore, through life experiences and their previous successes and failures, adults
have developed metacognitive skills that allow them to monitor their learning approaches, study habits, motivation levels, and personal resources. Finally, adults make concrete connections to the real world, often seeing new knowledge in the context of how it can be used.

The knowledge structures developed as a result of prior experience relate to conceptions (i.e. declarative structures) of self, education, and the classroom, as well as the know-how (i.e., procedural knowledge) learners employ in their study habits and work responsibilities. For example, as beliefs, these knowledge structures influence how learners use the classroom as a venue for negotiating and making meaning. Furthermore, they affect their social and psychological relationships with instructors that range from viewing instructors as authorities to viewing them as co-learners with peers (Kasworm, 1997). Research has also demonstrated that as a consequence of prior experiences, adults often make better use of time management strategies than do traditional-age students (Kasworm, 1997) and have developed study skills as adequate as those of traditional-age learners (Richardson & King, 1998). They often take a serious approach to studying and learning and attempt to comprehend the meaning of material rather than taking a superficial approach of merely being able to reproduce material for purposes of academic assessment (Harper & Kember, 1986; Kasworm, 1997; Richardson, 1994, 1995). Adult learners also employ complex metacognitive decisions about their approaches to study, learning, and balancing the many demands on their time (Kasworm, 1997).

Once adults begin their collegiate careers, interactions between the life-world environment and connecting classroom components influence their cognition. Kasworm

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and Blowers (1994) found that the adult life context both influenced learning and served as an avenue for adults to express their learning.

In addition, Kasworm and Blowers's (1994) findings suggested that adult students made clear distinctions between the academic world and the real world and the knowledge and learning strategies needed for them. For example, adults suggested that they learned expert knowledge by using either a hierarchical building block or a networking approach to connect the existing knowledge to the unfamiliar new knowledge. Kasworm and Blowers also found that in some instances, adults used real-life experiences to forge meaningful learning connections to link academic and real-world knowledge, whereas in other situations, they memorized class-based expert knowledge that did not connect to their life experiences.

Adult learners often employ metacognitive processes to monitor and regulate their work, learning, and personal life roles as well as complex strategies and beliefs about how to combine their study methods, their interactions with instructors, and their classroom experiences. Once in college, they struggle to connect their present and emerging life-world knowledge structures to their academic knowledge structures. The extent to which they are able to make these connections influences the value of their college experiences.

**Life-World Environment**

The life-world environment component refers to the different contexts in which adults work and live and are defined by the roles they occupy in their various work, family, and community settings. This component includes social settings outside the collegiate environment and the people adults depend on for outside support for their
collegiate learning activities. The concept of setting is used here as sociocultural theorists use the term to depict a subjectively perceived context in which adults participate with others to frame and develop communities of practice (Brown & Duguid, 1991; Lave & Wenger, 1991; Wilson, 1993). These settings offer places where adults construct meaning for what they are learning in their classrooms. For example, Kasworm (1995) noted that involvement in co-curricular activities for adults means engagement in work, family, and "self-directed learning projects outside the confines of the college setting and beyond particular course assignments" (p. 24).

Other elements of the life-world environment component are the reinforcing agents, or individuals within the out-of-class social settings that support adults' return to higher education. These reinforcing agents include family members, co-workers, supervisors, and community members with whom adults interact on a consistent basis. These individuals either provide psychological and social support for adults to return to pursue their collegiate studies or undermine their efforts (Chartrand, 1992; Ross, 1989; Schlossberg, 1987). In addition, Merriam and Heuer (1996) found that support from others can help adults foster meaning from their experiences as part of their continued development.

**College Outcomes for Adults**

Most studies of college outcomes focus on measures that tap the traditional academic definitions of expected outcomes from college, such as cognitive, intellectual, and emotional development. However, the Donaldson and Graham (1999) model suggests that adults may really be seeking, and in many cases achieving, different levels of
outcomes related to their college experiences and learning. For example, some research suggests that adults differentiate between learning that (a) is required to pass an academic test; (b) actually increases their knowledge and understanding of the world; (c) can be applied directly at work, in their families, or in other life situations; or (d) can be used to help the larger community or for the benefit of society (Donaldson & Graham, 1999; Kasworm, 1995, 1997).

Research in the arena of college outcomes has demonstrated that using conventional measures, adults experience equal or greater outcomes as those achieved by traditional-age students. For example, using a national sample of 28,000 undergraduate students, Graham and Donaldson (1999) found that adults reported slightly higher levels of growth than did the younger students on most academic and intellectual items, even though they were much less involved in campus activities. In addition, the greater the satisfaction with the colleges’ climate for learning, the greater the reported growth on outcomes for both adults and traditional-age students.

Cupp (1991) reported that postsecondary education served as a stimulus for changes in attitudes and values among adults. For many, it stimulated new aspirations and interests and helped them realize these enhanced goals. In another study of 9,400 undergraduate students, Graham and Donaldson (1996) created an index to measure “personal growth attributed to college attendance” and reported that colleges had a “tangible impact” on 29 of the 36 personal and social areas. Additionally, the adults’ reported growth was comparable to that of the younger students.
As noted above, these conventional definitions of outcomes are recognized in the model. However, the model also acknowledges different forms and levels of outcomes as defined by adult learners themselves that go beyond those defined by the academic community. For example, Kasworm (1995, 1997) found that traditional academic outcomes were not freestanding but instead were related to the adults’ perceptions of how they integrated academic and life-world knowledge structures.

By expanding the definitions of potential college outcomes, this component of the model addresses a number of issues. For example, it draws into question the relationship between different forms of involvement in adults’ life-world environments versus the conventional forms of on-campus involvement and the possibility of different outcomes. It also questions whether adults distinguish between success in their learning and success in college (e.g., getting good grades, playing the “academic game,” getting a degree) that is predicated on achieving outcomes defined by the institution and its faculty, a possibility suggested by Kasworm’s findings. Also, the model considers outcomes influenced by multiple factors, such as the collegiate experience, life-world experiences, and adult cognitive processes, and not simply what learners experience on campus.

Donaldson and Graham (1999) note that this model was presented in part as a way to explain how adults do as well in college as traditional-age students, despite the unique ways they engage in higher education. But it does not assume that there is homogeneity in the level of outcomes experienced by adults. Rather, the level of outcomes achieved varies for adults, as it does for traditional-age students. Therefore, the model, by providing multiple components composed of several different variables, also helps explain
the variations in experiences for adults. As noted earlier, the model draws attention to the need to explore alternate definitions of outcomes for adult learners rather than assuming that those identified for traditional-age students naturally apply equally well to adults (Kasworm, 1997). Traditional-age students continue to change their nature of engagement with institutions of higher education by attending part-time more, working more while in school, and engaging in life-world activities with other adult learners. Donaldson and Graham (1999) note that the model may very well serve as a better way to explain the experiences of all students than the models historically used to explore the college experience of the traditional population.

**Teaching Adults**

The above model suggests that adult learning and traditional-age learning is different. This implies that possibly different methods of teaching should be incorporated when teaching adults as compared to teaching traditional-age students.

The adult education literature generally supports the idea that teaching adults should be approached in a different way than teaching children and adolescents. The assumption that teachers of adults should use a different style of teaching is based on the widely espoused theory of andragogy, which suggests that “adults expect learner-centered settings where they can set their own goals and organize their own learning around their present life needs” (Donaldson, Flannery, and Ross-Gordon, 1993, p. 148).

The question of whether teaching adults is different remains ambiguous. For example, research summarized in an ERIC Digest (Imel, 1989) has shown that even those
educators who say they believe in using an andragogical approach do not necessarily use a
different style when teaching adults.

Drawing upon the work of Habermas and Mizirow, Cranton (1994) classified adult
learning into three categories: subject-oriented learning, consumer-oriented learning, and
emancipatory adult learning.

In adult learning contexts that are *subject oriented*, the primary goal is to acquire
content. The educator “speaks of covering the material, and the learners see themselves as
gaining knowledge or skills” (Cranton, 1994, p. 10).

The goal of *consumer-oriented* learning is to fulfill the expressed needs of learners.
Learners set their learning goals, identify objectives, select relevant resources, and so
forth. The educator acts as a facilitator or resource person, “and does not engage in
challenging or questioning what learners say about their needs” (Cranton, 1994, p. 12).

The goal of *emancipatory* learning is to free learners from the forces that limit
their options and control over their lives, forces that they have taken for granted or see as
beyond their control. Emancipatory learning results in transformations of learner
perspectives through critical reflection (Mezirow, 1991). The educator plays an active
role in fostering critical reflection by challenging learners to consider why they hold certain
assumptions, values, and beliefs (Cranton, 1994).

Of the three types of adult learning, only emancipatory has been described as
unique to adulthood, but even that claim has been challenged (Merriam and Caffarella,
1991). Subject-oriented learning is the most common form of learning engaged in by
youth. Collaborative and cooperative learning and other types of experiential learning that
are more consumer oriented are also found in youth classrooms. However, according to Mezirow (1981), emancipatory learning, with its emphasis upon learner transformation, can take place only in adulthood because, “it is only in late adolescence and in adulthood that a person can recognize being caught in his/her own history and reliving it” (p. 11).

In adulthood, “rather than merely adapting to changing circumstances by more diligently applying old ways of knowing, individuals discover a need to acquire new perspectives in order to gain a more complete understanding of changing events and a higher degree of control over their lives. The formative learning of childhood becomes transformative learning in adulthood” (Mezirow, 1991, p. 3). As a result of the research and theory-building efforts of Mezirow -- fully described in Transformative Dimensions of Adult Learning (1991) -- emancipatory adult learning has become more commonly known as transformative learning.

It is not clear through research as to the need for teaching approaches that are geared specifically to adults. What is clear however, is that transformative learning requires that learners address problems through critical reflection (Cranton, 1994; Mizirow, 1991). Some strategies used to facilitate transformative learning, such as journal writing and experiential methods, are used in other types of learning as well.

What is clear is that fostering transformative learning demands a different approach by the educator. Although learners must decide on their own to engage in transformative learning, educators who wish to promote transformative learning have the responsibility to set the stage and provide opportunities for critical reflection (Cranton, 1994). When educators are operating in the domain of transformative learning, they help learners
examine their beliefs and how they have acquired them by creating situations in which they can debate how their values, assumptions, ideologies, and beliefs have come to be constructed (Newman, 1993).

**Significance of Present Study**

As a whole, research has shown that self-efficacy is an important predictor of student motivation and academic achievement. Individual differences, such as effort attribution, perceived control, and self-regulation could influence self-efficacy. Such individual differences are valuable in explaining learning and performance of cognitive skills. Likewise, variables associated with learning contexts can affect student self-efficacy: progress and attribution feedback, strategy instruction, social comparative information, goal setting and classroom goal orientation. These situational variables act as cues that students can utilize to evaluate their self-efficacy. Research has demonstrated that the modification of learning context variables can enhance individual self-efficacy perceptions which can in turn increase motivation and skill performance. By creating self-regulated learners who perceive internal control and attribute achievement to effort we will attain an important goal; students who believe they are capable of learning and improving their academic skills.

One goal for this study was that by modifying self-efficacy perceptions, the reverse pattern would take place. That is, by creating students who believed they were capable of learning and improving their academic skills in mathematics, the result would be the creation of self-regulated learners who perceive internal control and who attribute achievement to effort.
CHAPTER 3

RESEARCH DESIGN, METHODS, AND PROCEDURES

This case profile investigation was designed to train non-traditional developmental mathematics students in the techniques contained in CHAMP and to assess the extent to which these modification techniques enhance mathematical self-efficacy, as well as the extent to which these students are able to continue to apply these techniques on their own. The study was conducted from June 1998 to February 1999 with Amy, Mark, and Melanie—students from the researcher’s previous developmental mathematics class, who were now enrolled in college algebra courses at a large midwestern university (see pp. 114 – 115).

This study was conducted using qualitative measures. These qualitative measures included individual interviews, direct observations, a focus group interview, as well as documents such as researcher and participant journals, and copies of completed tests and quizzes from courses in which each participant was enrolled during the training portion of the study. A 20-question mathematical self-efficacy scale was also used as an aid in determining each participant’s initial mathematical self-efficacy as well as a prompt in the first interview.

Case profiles for the three participants were developed documenting each subject’s initial mathematical self-efficacy, the training process, each subject’s growth in
mathematical self-efficacy, and his/her ability to internalize the techniques of CHAMP through its use during the training quarter (Summer 1998) and the follow-up quarter (Autumn 1998).

Research Questions

The current investigation began during the summer of 1998. The primary research questions that were used to guide the investigation follow:

1. What changes in mathematical self-efficacy occurred during the application of the CHAMP toolkit?
2. To what extent did the students seem to internalize the techniques of CHAMP?
3. To what extent did the participants begin to use these techniques themselves?

Case Studies

A case study is a “detailed examination of one setting, or a single subject, a single depository of documents, or one particular event” (Merriam, 1988). As Stake (1995) explains, a “case study is the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances” (xi). Elsewhere, Stake (1994) defines the case study as “both the process of learning about the case and the product of our learning” (p.237) and he identifies three types of case studies: the intrinsic, where the case itself is of interest; the instrumental, where a particular case is examined to provide insight into an issue or refinement of a theory; and the collective study, where the researcher studies a number of cases jointly in order to inquire into the phenomenon, population, or general condition (p.237). Significantly, Stake views these categories as “more heuristic than functional” because researchers, the researched, and research reports rarely fit neatly into categories (p.237). In the present investigation, the case studies are
a combination of the aforementioned types. At certain points, the case study is guided more directly by intrinsic inquiry than instrumental; at other times, the questions focus on instrumental issues rather than emphasizing its collective design, and so on.

**Case Study Samples**

Case studies focus on the particular; hence, research samples are small. Patton (1990) notes the great impact studies with small samples have had in the social and behavioral sciences, listing the works of Piaget, Freud, and Bandler & Grinder as examples (p. 185). He claims "the validity, meaningfulness, and insights generated from qualitative inquiry have more to do with the information-richness of the cases selected and the observational/analytical capabilities of the researcher than with sample size" (p. 185). Nevertheless, case study methodology has suffered because many researchers do not see them as important as studies that obtain generalizability pertaining to the population of cases. Stake (1994) contends that "researchers such as Denzin (1989); Glaser & Strauss (1967); Herriot & Firestone (1983); and Yin (1984)" have emphasized case study as a typification of other cases leading up to generalization-building studies, or an occasional early step in theory building" (p. 238). Disagreeing with this approach, Stake acknowledges that while single cases are not as strong a base for generalizing to a population of cases as other research designs, people can learn much that is general from single cases. As he puts it:

They do that partly because they are familiar with other cases and they add this one in, thus making a slightly new group from which to generalize, a new opportunity to modify old generalizations. People learn by receiving generalizations, explicated generalizations from others, regularly from authors, teachers, authorities. People also form generalizations from their experience. (Stake, 1995, p. 85).
Furthermore, Stake (1994) claims case studies teach us both prepositional (or explicated) and experiential knowledge as he elaborates in the following:

Certain descriptions and assertions are assimilated by readers into memory. When the researcher’s narrative provides opportunity for vicarious experience, readers extend their memories of happenings. Naturalistic, ethnographic case materials, to some extent, parallel actual experience, feeding into the most fundamental understanding. (p. 240).

Finally, in his collaborative piece with Trumbull (1982), Stake coins the term naturalistic generalizations to refer to generalizations people form from experiential knowledge:

The reader comes to know some things told, as if he or she had experienced them. Enduring meanings come from encounter, and are modified and reinforced by repeated encounter...Knowledge is socially constructed—we constructivists believe—and thus case study researchers assist readers in the construction of knowledge. (cited in Stake, 1994, p. 240)

Case studies give an awareness and understanding of experiences, processes, phenomena, and behavior that we may not be able to experience firsthand, but only vicariously. As Donmoyer (1990) states, “Case studies can take us to places where most of us would not have an opportunity to go... ; they allow us to look at the world through the researcher’s eyes and, in the process, to see things we otherwise might not have seen” (pp. 192-196). The quality of my case studies depends largely on the extent to which readers are able to vicariously experience my experience, and the degree to which they are able to draw naturalistic generalizations, thus expanding and extending what they already know about what students do.
Data-Collcction Methods

Wolcott (1994) says, “Everything has the potential to be data, but nothing becomes data without the intervention of a researcher who takes note—and often makes note—of some things to the exclusion of others” (p. 3). He purports, “In the very act of constructing data out of experience, the qualitative researcher singles out some things as worthy of note and relegates others to the background” (p. 13). In addition, Wolcott identifies three major modes through which qualitative researchers gather their data: “participant observation (experiencing), interviewing (enquiring), and studying materials prepared by others (examining)” (p. 10).

Data collection for the current investigation was accomplished via five methods including participant observation, interviewing, focus group, documents, and questionnaires.

Participant Observation

Patton (1990) explains the purpose of observational data is to “describe the setting that was observed, the activities that took place in that setting, the people who participated in those activities, and the meanings of what was observed from the perspective of those observed” (p. 202). These descriptions must be “factual, accurate, and thorough without being cluttered by irrelevant minutiae and trivia” (p. 202). The basic criterion to apply in judging a recorded observation is “whether the observation permits the reader to enter into and understand the situation described” (p. 202). Finally, in participant observation, “the extent of participation is a continuum that varies from
complete immersion in the setting as full participant to complete separation from the setting as spectator” (p. 206).

Two points on the continuum are discussed by Glesne and Peshkin (1992), who view a difference between “observer as participant” and “participant as observer” (p. 40). The former remains primarily an observer with some interaction with the study participants, and the latter, which best describes my participation with each subject, is primarily a participant who may risk “losing the eye of the uninvolved outsider,” yet has a “opportunity to learn” (p. 40).

**Qualitative Interviewing**

An emergent research design and emphasis on interaction with the researched make participant observation and interviewing two effective, generative, and ideal means for gathering rich data. Seidman (1991) explains the purpose of in-depth interviewing in the following:

The purpose of in-depth interviewing is not to get answers to questions, nor to test hypotheses, and not to “evaluate” as the term is normally used. At the root of in-depth interviewing is an interest in understanding the experience of other people and the meaning they make of that experience (p. 3).

Kvale (1996) agrees, maintaining “if you want to know how people understand their world and their life, why not talk with them?” (p. 1). In his description of the qualitative research interview as a “construction site of knowledge...and interchange of views between two persons conversing about a theme of mutual interest” (p. 2), Kvale touches on the ontological and epistemological undercurrents of this study—my ontological assumption that reality is constructed through human interactions, and my
epistemological position that understanding (or coming to know) someone’s reality is discovered by finding out how people name their reality.

Participants were interviewed informally (and often) using an informal conversational interview approach. The informal conversational interview is described by Patton (1990) as “the most open-ended approach to interviewing” whereby the conversational interviewer “wants to maintain maximum flexibility to be able to pursue information in whatever direction appears to be appropriate, depending on what emerges from observing a particular setting or from talking to one or more individuals in that setting” (p. 281). This approach was utilized throughout the study and was found to be particularly helpful during the CHAMP training and practice sessions. In addition, this method proved useful for starting relationships, particularly getting to know the research participants as individuals and developing trust and rapport between us. Negotiating a research relationship is not easy. As Maxwell (1996) suggests, “Your relationship with those you study is a complex and changing entity…the researcher is the instrument of the research, and the research relationship is the means by which the research gets done” (p. 66).

Conversational interview questions were individualized “to establish in-depth communication with the person being interviewed and [made] use of the immediate surroundings and situations to increase the concreteness and immediacy of the interview questions and responses” (p. 282). Although complete audiotaped versions of these conversational interviews were obtained, the gist of the interviews was often recorded in the form of fieldnotes and later in more detailed notes and reflections in a reflective journal. Since the open-ended approach could not guarantee asking the same questions of
the participants, they were interviewed more formally at times using the *general guided interview approach* (Patton, 1990) where “an interview guide is prepared in order to make sure that basically the same information is obtained from a number of people by covering the same material” (p. 283). This method proved to be more streamlined than *informal conversational interviews* as I was able to “provide topics or subject areas within which [I would be] free to explore, probe, and ask questions that [would] elucidate and illuminate particular subject(s)” (p. 283). Guided interviews made it easier to analyze data and to generalize internally among this group of research participants. Maxwell (1996) describes *internal generalizability* as “generalizability of a conclusion within the setting or group studied...the descriptive, interpretive, and theoretical validity of the conclusions depend on their internal generalizability to the case as a whole” (p. 97).

The general guided interview approach was used during the initial interview as well as during the final group interview. This approach was also used when following up on comments made during a previous session. In most cases, these questions were directed at the particular participant. That is, individual questions for the participant were prepared prior to the next meeting as a “member check” of a previous comment or comments. On a few occasions, a particularly insightful experience with one participant would allow for the development of a general question that would be directed to each participant during the next session. For example, when Mark first coined the phrase “toolkit” as a means of describing CHAMP, the other two participants were asked if they too viewed CHAMP in this way.
Focus Group Interview

The comparative advantage of focus groups as an interview technique lies in their ability to observe interaction on a topic. According to Morgan (1988),

The hallmark of focus groups is the explicit use of the group interaction to produce data and insights that would be less accessible without the interaction found in a group (p. 12).

Group discussions provide direct evidence about similarities and differences in the participants’ opinions and experiences as opposed to reaching such conclusions from post hoc analyses of separate statements from each interviewee.

The group interview has the advantages of being data rich, flexible, stimulating to respondents, recall aiding, and cumulative and elaborative, over and above individual responses. Some disadvantages of a group interview are that one person may dominate the group, the group format makes it difficult to research sensitive topics, and the requirements for interviewing skills are greater because of the group dynamics.

To some extent, each of these advantages and disadvantages appeared at various points throughout the interview. The participants were highly engaged and able to elaborate on items previously mentioned on an individual basis. In many cases, a comment by one participant would aid in recalling a similar experience by another participant. There were times within the conversation that one or two of the individuals dominated the conversation. One participant, Melanie, was much “quieter” in this setting as compared to individual conversations. Whereas the other participants jumped into the conversation, Melanie in particular had to be asked her feelings. She was not as open in revealing herself as the other participants.
The group interview approach was implemented one time, in February 1999. This allowed for one quarter of elapsed time between the actual CHAMP training period (Summer 1998) and the interview. In this way, autumn quarter allowed the participants time to use the techniques of CHAMP in a subsequent mathematics course. Prior to the group interview, each participant had met individually with the researcher. Numerous attempts had been made to try to get these individuals together for the training sessions, but each person’s schedule was so different that this became an impossibility.

**Documents**

Lincoln and Cuba (1985) distinguish documents and records on the basis of whether the text was prepared to attest to some formal transaction. Thus, records include marriage certificates, driving licenses, and official grades. Documents, on the other hand, are prepared for personal rather than official reasons and include diaries, memos, letters, field notes, and so on.

Glesne and Peshkin (1992) suggest documents are the source of data that “corroborate your observations and interviews and thus make your findings more trustworthy.... they may raise questions about your hunches and thereby shape new directions for observations and interviews”(p. 52). Numerous documents were collected and analyzed throughout the study. These came in a variety of forms. Some were formal, while others were not. Some were participant generated; others were researcher generated.

Documents supplied by each participant included his/her attempted and/or completed combination problems, both those performed in the presence of the researcher and those completed outside the class; attempted formulation of cue words developed
from the completion of the combination problems; copies of quizzes and tests; participant journal entries; and the completion of more formal documents such as the *Performance Review List* (Appendix A) and the *Positive Frame of Mind* (Appendix A).

Practice tests were developed with participant input as a means to prepare for upcoming tests. Since each was involved in this process, the creation of the tests allowed each participant to be reflective regarding their test preparations as well as the ability to map out a "game plan" with respect to that preparation. Actual copies of test from their exams were used to analyze past performances and as a means for establishing goals for future tests and test preparation.

Additional documents were also created by the researcher. First of all, although the tape was constantly rolling during the individual sessions as well as the group interview, numerous notes were taken, especially if something enlightening took place, like, the day that Mark first used the phrase "toolkit" as a means of describing his vision of CHAMP. It also became important to have a pad of paper handy during phone conversations due to the fact that each participant usually said something highly "quotable" during these discussions. In addition to notes taken during sessions or conversations, an ongoing journal containing reflections, reminders, appointments, disappointments, and revelations was maintained.

**Questionnaires**

Fetterman (1989) explains that in "filling out a questionnaire, the respondent completes the researcher's form without any verbal exchange or clarification"; thus, "knowing whether the researcher and the respondent are on the same wavelength, sharing common assumptions and understandings about the questions, is difficult—perhaps
impossible" (p. 65). Despite this limitation, he states, “questionnaires are an excellent way to ask questions dealing with representativeness” (p. 66).

The main use of questionnaires in this research occurred at the very beginning and at the very end. During my first meeting with the participants, they were asked to complete a **Background Questionnaire**. This was used to determine general information regarding age, college major, and previous high school and college mathematics experience. Participants were also asked to pick a pseudoname (first and last name) at this time. A copy of this questionnaire appears in Appendix B.

The other questionnaire that was incorporated at the very end of the study was the **Post Group Interview Writing Request** (Appendix B). This open-ended questionnaire allowed the participants to either elaborate on and/or add additional comments regarding anything that was said during the final group interview.

**Additional Means of Data Collection**

As mentioned previously, all sessions were audiotaped using a rolling tape approach. Portions of some sessions were also videotaped. In these sessions, students were taped working combination (e.g., mixture, coin, interest) problems at the board. These videos were later used as evaluation tools that allowed the participants to critique their own work. The videos further served the purpose of forming a basis for practice in the area of mental recall. By reviewing the tape, each was able to create a mental image of solving the combination problems. With practice, each was able to visualize himself/herself solving the problems. This created a positive image to refer back to when needed.
Researcher Roles, Responsibilities, and Relationships

Each of the participants in the current investigation had previously been enrolled in a section of a developmental mathematics class at The Ohio State University I taught during the spring of 1998. Each student was enrolled in a college-level mathematics course (Amy in Math 075; Mark and Melanie, in different sections of Math 104) during summer 1998, when training in CHAMP was conducted. I was not the instructor for either course.

From the onset of this study, I felt extremely comfortable with each of these participants and they equally with me. Having already taught these students in a previous class, and being the type of teacher who has a keen interest in my students both inside and outside of the classroom, had allowed me to have numerous non-math related conversations with these students.

In essence several types of relationships had already been established prior to the formal data collection process. For example, the students considered me a competent college instructor. At the same time, they also identified with me in the role as a doctoral student struggling for academic success. Moreover, since each of us had the identity of "the learner" in the project, this strengthened the reciprocal nature of the relationships, as the participants developed a sense of empowerment and equality throughout the project.

As the work with each of these participants began, a great sense of responsibility grew within me and within each participant. I wanted the work being done together to be beneficial to each of them, and they wanted the study to be successful for me.

The overall stress related to doing all the things each participant was attempting to do provoked an ongoing discussion with the participants. Melanie worked full-time at a
bank, went to school at night and had made numerous trips to Cleveland to help prepare for her best friend’s wedding. And there was Amy, who between her work schedule, school schedule, and keeping up with her 16-year-old son, somehow found time to fit this investigation in. Mark was not only going to school and working at OSU Medical Center, but was also in the process of renovating a newly purchased home and playing in an up-and-coming band in the area. Yet each of these people gave the impression that they were “honored” to be a part of the study and would do whatever it took to continue their help. I too felt honored for being able to work with each of the participants.

**Procedures**

**Subject Selection**

The participants in the study were students in the researcher’s section of a developmental mathematics course during the Spring Quarter, 1998 at a large midwestern university. Near the end of this quarter, I used a portion of one class period to describe the focus of the research. A few students were already aware of my plans from previous individual discussions. Two students in particular, Amy and Mark, expressed a keen interest in learning more about this work.

Each individual interested in participating in the study was asked to fill out a “preliminary consent form.” This preliminary consent form (Appendix D) asked for general demographic information such as name, address, and phone number, and supplied each potential participant a tentative outline of his/her responsibilities. Eight potential subjects submitted preliminary consent forms.

At the end of a two-week period, each individual was contacted by phone. A total of five students eventually agreed to participate in the study. This group consisted of two...
males and three females. Four of the five were non-traditional students. Three of these students were enrolled in a mathematics course during the Summer 1998 quarter and two were not taking any courses during the summer quarter. Initial appointments were made and Phase I of the data collection commenced.

**Data Collection**

Data collection took place over three quarters, Summer 1998 to Winter 1999. The researcher met with each participant individually, with the exception of the final group interview. The length of each individual session varied, but generally ranged in length from one to two hours. For this investigation, data collection occurred in three phases: initial data collection, training sessions, and a follow up phase.

**Phase I: Initial Data Collection**

The first session with each participant took place the second week of the Summer 1998 quarter. At the time of the first meeting, each participant was given an abstract of the proposed study which included the purpose for the study, the research questions, an overview of CHAMP, the participant's role in the study, and what the study would require of the participant. A participant consent form documenting what the participant could expect as a study participant, their right to stop participating in the project at any time, and my reassurance that confidentiality would be maintained through the use of pseudonames and the storage of all data in a locked file.

**Background questionnaire.** Each participant was asked to fill out a brief questionnaire (found in Appendix B) regarding mathematics preparation and career plans, such as intended major, current class standing, previous mathematics course information
(high school and college), and approximate average grade in mathematics courses taken in high school and college.

**Mathematics Self-Efficacy Scale.** A mathematics self-efficacy scale, influenced by Betz and Hacket (1993) and Dowling (1978), was devised by the researcher which includes examples of twenty of the most common types of problems encountered in the two courses in which these students were either currently enrolled or would be enrolled in the fall. By careful inspection of the textbooks, as well as past examinations for these courses, it was determined that each course stressed similar types of problems, as well as similar methods for solving these problems. For example, in the case of mixture, motion, and interest problems, each of these courses emphasized the use of a two-variable approach as compared to the one-variable approach the subjects encountered in the developmental course. For this instrument, students did not solve the problems, but instead indicated how confident they were in their ability to solve the question. A 5-point scale ranging from no confidence at all to complete confidence was utilized. A copy of the Mathematics Self-Efficacy Scale can be found in Appendix E.

The scale included different levels of tasks, ranging from the lower level of mathematical calculations and simple solving techniques to the higher level of solving word problems and writing literal equations. Respondents were directed to “Indicate how confident you are in your ability to solve the problem by circling the letter according to the following 5-point confidence scale.”

**Initial Interview.** Upon completion of the background questionnaire and the Mathematical Self-Efficacy Scale, an individual interview was conducted. A protocol for the interview is contained in Appendix C. The initial interview probed into the reasons
each subject used to determine the initial rankings on the self-efficacy scale and obtained a more detailed history of each participant’s experience with respect to mathematics—to create a mathematical autobiography of each participant.

How each student had come to his/her current level of self-efficacy was of interest for a variety of reasons. First of all, for some of these students, the level of confidence they had in performing mathematics had little to do with mathematics itself, but had more to do with other issues surrounding the learning of mathematics (e.g., a poor teacher, time constraints, etc.) or feelings of inadequacy formulated over time or by a single event in the subject’s past. Cultural, familial, and gender issues also played a role in their entry level of self-efficacy.

The developmental influences that led to each subject’s current level of self-efficacy determined the most appropriate course of action within the CHAMP model. For example, if an emotional block of some sort existed, greater emphasis was placed on arousal control. However, if a conceptual block existed, greater time was spent initially developing the concept. If there was some cultural or gender block, activities were directed in each of these areas.
Phase II: The Training Sessions

Each participant was introduced to the components of CHAMP during training sessions. The components of CHAMP are:

C: cue words
H: here and now (defining and achieving controllable goals)
A: arousal control
M: modeling and mental imagery
P: praise, verbal persuasion, and positive self-talk

For a complete description of each of these components, please refer to Chapter 1. A representative table, found on the following pages, was constructed outlining the goals of a given session, the CHAMP technique(s) addressed during the given session, specific procedures used, specific problems used, and comments. Since each student worked through these at a slightly different pace, the table should be read as a reasonable representation of the actual training order and content.
<table>
<thead>
<tr>
<th>Session 1</th>
<th>Goal(s)</th>
<th>CHAMP Technique</th>
<th>Procedures Used</th>
<th>Problem(s) Used</th>
<th>Details</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>To determine current level of mathematical self-efficacy with respect to problems contained in Math 075 and Math 104</td>
<td>NA</td>
<td>1.1 Administer Mathematical Self-Efficacy Scale (MSES)</td>
<td>NA</td>
<td>1.1.1 No problems solved</td>
<td>Problems chosen from Math 075 and Math 104</td>
</tr>
<tr>
<td>2</td>
<td>To determine reasoning behind self-efficacy rankings and to determine developmental issues contributing to self-efficacy perception</td>
<td>NA</td>
<td>2.1 Conduct initial interview</td>
<td>NA</td>
<td>2.1.1 Initial interview protocol in Appendix C;</td>
<td>Important to know entry-level self-efficacy and possible developmental influences (familial, peer, education, etc.) and sources of self-efficacy that contributed to entry level so as to individualize CHAMP techniques</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>2.1.2 Subjects asked to comment on reasoning for low versus high self-efficacy rankings on selected problems from MSES</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>2.1.3 Typewritten transcripts will be obtained from interview;</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td>2.1.4 Analyze for development issues and connection to current level of self-efficacy.</td>
<td></td>
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</tr>
</tbody>
</table>

Table 3.1: CHAMP Training Sessions
### Table 3.1: Continued

<table>
<thead>
<tr>
<th>Step</th>
<th>Goal(s)</th>
<th>CHAMP Techniques</th>
<th>Procedures Used</th>
<th>Problem(s) Used</th>
<th>Details</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.1</td>
<td>Problem 1: A chemist has one solution that is 50% acid and a second that is 25% acid. How much of each should he use to make 10 L of a 40%-acid solution?</td>
<td>3.1.1</td>
<td>Model using 2-colored chips</td>
</tr>
<tr>
<td></td>
<td>To begin introduction to CHAMP</td>
<td>Modeling Positive self-talk Arousal control</td>
<td>3.1.2</td>
<td>Complete explanation including chart set-up, necessary equations, and the solving of equations</td>
<td>3.1.2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>3.2</td>
<td>Problem 2: A chemist has two solutions, each containing a certain percentage of acid. If solution A is 5% and solution B is 15% acid, how much of each should be mixed to obtain 20 liters of a solution that is 12% acid?</td>
<td>3.2.1</td>
<td>Subject writes while researcher supplies information</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.3</td>
<td>Problem 3: How many gallons of a 15% salt solution needs to be mixed with 50 gallons of a 20% salt solution to form an 18% solution?</td>
<td>3.3.1</td>
<td>Researcher listens for key words that indicate either positive or negative thought process; high/low levels of arousal;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.3.2</td>
<td>Researcher offers verbal persuasion as a means to focus on positive</td>
<td>3.3.2</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>3.3.3</td>
<td>Participants encouraged to focus on positive self-talk</td>
<td>3.3.3</td>
<td></td>
</tr>
</tbody>
</table>
Table 3.1: Continued

Prior to Session 2

<table>
<thead>
<tr>
<th>Step</th>
<th>Goal(s)</th>
<th>CHAMP Technique</th>
<th>Procedures Used</th>
<th>Problem(s) Used</th>
<th>Details</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>To develop cue words</td>
<td>CHAMP Technique</td>
<td>4.1 Subject analyzes 3 performed mixture problems and creates cue words to aid in solving</td>
<td>NA</td>
<td>4.1.1 Participants analyze 3 completed problems;</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
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<td></td>
<td>4.1.2 Subjects write down generic steps in own words</td>
<td></td>
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<td></td>
<td>4.1.3 Subjects analyze written steps, narrowing down to a few (≤ 5) cue words</td>
<td></td>
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<td></td>
<td></td>
<td>4.1.4 Cue words placed on notecards.</td>
<td></td>
</tr>
</tbody>
</table>

5  To internalize cue words

<table>
<thead>
<tr>
<th>Procedures Used</th>
<th>Problem(s) Used</th>
<th>Details</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Subject completes combination problem other than mixture problem using cue cards (Problem 4)</td>
<td>5.1.1 Subject makes any adjustment in order and/or content of cue cards</td>
<td>Coin and ticket problems will be used by participants as well;</td>
</tr>
<tr>
<td>5.2</td>
<td>Subject performs combination problem without use of cue cards. (Problem 5)</td>
<td>5.1.2 Subject reviews cue cards and internalizes</td>
<td></td>
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<tr>
<td></td>
<td>Problem 4: Abby invested $2000 for one year in two separate savings accounts. One account paid 8% simple interest and the other 9% simple interest. How much was invested in each account if the total interest from both was $175?</td>
<td>5.2.1 Subject verbalizes cue words</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Problem 5: The total interest earned on a sum of money invested for one year was $183. If $500 more was invested at 10% simple interest than was invested at 9% simple interest, how much was invested at each rate?</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Step</th>
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<th>Problem(s) Used</th>
<th>Details</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>To continue work with analysis related to cue words</td>
<td></td>
<td>Discussion of cue words developed prior to session 2</td>
<td>How many grams of pure silver must a silversmith mix with a 45% silver alloy to produce 200 grams of a 50% alloy?</td>
<td>Researcher and subject discuss/analyze resulting cue words</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.1</td>
<td>Variety of other problems used.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Cue words</td>
<td>6.2</td>
<td>Subject performs two additional mixture problem(s); recorded on video</td>
<td>Subject performs steps of each problem on black board verbalizing cue words;</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>6.2.1</td>
<td>As student performs steps, is video tape recorded.</td>
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<td></td>
<td>6.2.3</td>
<td>Prior to next session subject analyzes performances using Performance Review List (completes list for each performance);</td>
<td>Performance Review List allows student to reflectively note good and bad points regarding performance. (Appendix A)</td>
<td></td>
</tr>
</tbody>
</table>

(Continued)
Table 3.1: Continued

<table>
<thead>
<tr>
<th>Session 3</th>
<th>Step</th>
<th>Goal(s)</th>
<th>CHAMP Techniques</th>
<th>Procedures Used</th>
<th>Problem(s) Used</th>
<th>Details</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td></td>
<td>To evaluate videotaped work</td>
<td>Cue words Mental imagery Positive self-talk</td>
<td>7.1 Video played back for participant</td>
<td>NA</td>
<td>7.1.1 Subject chooses which previous video would like to critique further</td>
<td>Video used here as a means to critique own work and as a means to introduce mental recall techniques</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To introduce mental imagery</td>
<td></td>
<td>7.2 Replay of video to introduce mental recall</td>
<td></td>
<td>7.1.2 As video plays, subject critiques work</td>
<td>Guidelines and procedures adapted from The Mindset for Winning (Curtis, 1988)</td>
</tr>
<tr>
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<td>7.1.3 Compare to Performance Review List created prior to viewing video.</td>
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<td></td>
<td>7.1.4 Researcher and subject discuss good and bad points; how bad points can be changed to good points.</td>
<td>Prior to next session, practice use of cue words, mental recall, and positive self-talk with mixture and/or additional combination problems;</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>7.2.1 As subject watches video, asked to form a mental image of performance;</td>
<td>Subject keeps a log of practices.</td>
</tr>
<tr>
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<td></td>
<td>7.2.2 Discuss techniques involved with mental recall;</td>
<td>(Continued)</td>
</tr>
</tbody>
</table>
Table 3.1: Continued

<table>
<thead>
<tr>
<th>Session 4</th>
<th>Step 8</th>
<th>Goal(s)</th>
<th>CHAMP Technique</th>
<th>Procedures Used</th>
<th>Problem(s) Used</th>
<th>Details</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>To practice mental recall using real-life event</td>
<td>Mental Imagery</td>
<td>8.1 Subjects discussed a real-life event as a means to practice mental recall</td>
<td>NA</td>
<td>8.1.1 Each participant was asked to recall a real-life event that stands out in their minds. 8.1.2 Researcher assists by asking questions in order to formulate details of event</td>
<td>Some students were having difficulty with the mathematically based recall, so to expand practice, a real-life event was also included. Student continues practice of mathematical recall and real-life recall, along with positive self-talk.</td>
</tr>
</tbody>
</table>

| Session 5  | Step 9 | To outline key elements of goal setting | Here and now | 9.1 Subjects will be instructed on guidelines of goal setting. | NA          | 9.11 Goals should be specific, attainable, and written. 9.21 Copy appears in Appendix A. | To become adept at mental rehearsal, one needs to establish goals. |

(Continued)
<table>
<thead>
<tr>
<th>Step</th>
<th>Goal(s)</th>
<th>CHAMP Techniques</th>
<th>Procedures Used</th>
<th>Problem(s) Used</th>
<th>Details</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>To introduce subjects to mental rehearsal</td>
<td>Here and now</td>
<td>10.1 Introduce subject to concepts of mental rehearsal</td>
<td>10.1.1 Discuss guidelines regarding mental rehearsal.</td>
<td>By repeatedly visualizing positive upcoming event, mental rehearsal can strengthen the self-efficacy base laid by mental recall.</td>
<td>Guidelines and procedures adapted from <em>The Mindset for Winning</em> (Curtis, 1988)</td>
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<td></td>
<td></td>
<td>Arousal control</td>
<td>10.2 Discussed with participants past (math or non-math related) occurrences of mental rehearsal</td>
<td>10.2.1 Students tell stories of when they have used mental rehearsal in the past or when they currently use it.</td>
<td>Students created a script for upcoming test including visualizing walking to the test, after entering the test, during review session that accompanied each test, when test first passed out, etc.</td>
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<td>Mental imagery</td>
<td>10.3 Began to develop test preparation techniques as a means of mental rehearsal</td>
<td>10.3.1 Discussed upcoming tests</td>
<td></td>
<td>Students created a script for upcoming test including visualizing walking to the test, after entering the test, during review session that accompanied each test, when test first passed out, etc.</td>
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<td>Positive self-talk</td>
<td>10.4 Included further discussion of arousal control</td>
<td>10.4.1 Refocused arousal control on testing situations.</td>
<td></td>
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<tr>
<td>Session 7+ Step</td>
<td>Goal(s)</td>
<td>CHAMP Techniques</td>
<td>Procedures Used</td>
<td>Problem(s) Used</td>
<td>Details</td>
<td>Comments</td>
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<tr>
<td>11</td>
<td>To review and practice all elements of CHAMP</td>
<td>All components</td>
<td>11.1 Discussed components of CHAMP within ongoing courses</td>
<td></td>
<td>11.1.1 Subjects practice CHAMP on material within classes (Math 075 and Math 104); Additional sessions linked to tutoring can be incorporated in consultation with subject;</td>
<td>Subjects practice all components of CHAMP; Keep log of practice.</td>
</tr>
</tbody>
</table>
The initial goal was to introduce the various components over a two-week, three-
session period of time. As was soon discovered, keeping on the same schedule with each
individual became a difficult, if not impossible task. It was therefore necessary to become
more flexible.

Two circumstances necessitated expanding the training format beyond the
original design of three sessions. First of all, after the initial data collection phase had
taken place, two of the five subjects indicated that it was necessary for them to stop their
participation in the study. The three remaining subjects (Amy, Melanie, and Mark), all
non-traditional students, noted that they were interested in placing a "practice" session or
sessions between each of the training sessions. Each also felt it would be beneficial not
to try to “cram in” so much in each session. Due to the limited number of participants,
increasing the number of sessions was feasible. Therefore, although not specifically
represented in the table, the reader should assume that practice sessions were sprinkled
throughout.

Although all portions of CHAMP were utilized throughout the study, certain
components were emphasized for each student, due to the nature of the techniques. Some
techniques (e.g., cue words), for developmental reasons, needed to be introduced in a
predetermined sequence. Other techniques, such as verbal persuasion, were called upon
as needed. Still others, such as positive self-talk were discussed and assessed throughout
the study. Background information and training session responses from each individual
helped to determine the type and the strength of intervention at any given time.

Combination problems (e.g., mixture, investment, coin, ticket) were chosen to
introduce the components of CHAMP. First of all, these types of problems generally
result in lower self-efficacy for most students. Giving the students the opportunity to become successful with this type of problem bodes well for problems in which students are more efficacious to begin with. Secondly, combination problems offer real-life applications, therefore emphasizing the importance of mathematics in general.

Due to the multidimensional nature of these problems, the use of cue words had a marked impact. These problems also offered the best introduction to the use of modeling and mental imagery. The active nature of say, mixture problems, offers the added visualization of seeing themselves actually mixing chemicals or dry goods. This visualization aids in the development of mental recall as well as mental rehearsal.

Emotionally, it is these types of problems that have a tendency to create the most anxiety. Therefore, it seems appropriate to develop anxiety reduction and negative thought-stopping techniques using these types of problems. Goal setting in trying feared math-related behaviors and reinforcement in meeting these goals were also are well adapted to this setting.

**Phase III: Follow Up**

**Autumn 1998.** Initially, this phase of the study was to be a detailed follow-up of each of the subjects in the study as they moved on to their next mathematics class the following quarter. The original plan was to have the students keep a journal and to meet with each at least three times during the quarter. Due to time constraints and time conflicts, these meetings became numerous phone conversations.
One participant, Melanie, dropped her mathematics class at the beginning of Autumn Quarter 1998 due to some health issues. Although the researcher was unable to obtain direct follow-up during fall quarter, Melanie was willing to be involved during Winter Quarter. Initially, what could be perceived as a hindrance to the study, in reality became a benefit. Melanie’s need to take the quarter off from mathematics provided the opportunity to determine whether she was able to continue to use the CHAMP toolkit even with one quarter absence from mathematics.

**Focus group interview.** A final focus group interview with the three participants was conducted in February 1999 to elicit overall merits of techniques employed and to offer suggestions for the improvement of these techniques. The intention of the group interview was to produce data and insights that would be less accessible without the interaction found in a group. A copy of the interview protocol can be found in Appendix C.

**Validity Concerns**

The believability and trustworthiness of the data in any qualitative investigation are directly related to the methodological and analytical processes of the project. Four methods for increasing the trustworthiness of the data gathered and reported in the current investigation are discussed here – triangulation, member checking, peer debriefing, and prolonged engagement.

**Triangulation**

Patton (1990) defines triangulation as “the combination of methodologies in the study of the same phenomena or programs” (p. 187). He says several kinds of methods or data, including using both quantitative and qualitative approaches can be used in
triangulation. Denzin (1989) asserts the logic of triangulation is based on the premise that "no single method ever adequately solves the problem of rival causal factors. Because method reveals different aspects of empirical reality, multiple methods of observations must be employed" (p. 28). Marshall and Rossman (1995) describe triangulation in the following manner:

The act of bringing more than one source of data to bear on a single point...designing a study in which multiple cases, multiple informants, or more than one gathering method are used can greatly strengthen the study’s usefulness for other settings. (p. 144)

In the current investigation there was a concern that the data collected during the student interviews were untrustworthy because, as revealed by Winne, Hadwin, Stockly and Nesbit (1997), students’ perceptions of their own strategies may be inaccurate. In an attempt to address this issue, and as a way of increasing the trustworthiness of the data, information collected during the student interviews was triangulated whenever possible. Observational data, questionnaires and documents were used to substantiate students’ interview responses.

**Member Checking**

The student participants were given the opportunity to either confirm or negotiate the interpretations and conclusions of the current investigation. This process—known as member checking—contributed to the face validity of the research, which is “operationalized by recycling descriptions, emerging analysis, and conclusions back through at least a subsample of the respondents” (Lather, 1986, p. 271). A portion of each session was set aside to discuss various statements made previously, as well as any ongoing analysis and/or conclusions that had been tentatively reached.
**Peer Debriefing**

One of my colleagues reviewed several of the recorded interviews with me to discuss my responses and the possible effects of those responses on the interviewees. This colleague pointed out, for example, that I tended to talk too much in some cases and that I had the tendency to sometimes lose the focus of the particular discussion under consideration. I attempted to refrain from talking too much and to keep the focus of the conversation in subsequent interviews. This method of increasing trustworthiness is known as peer debriefing. In addition, my preliminary coding themes were discussed with colleagues in order to verify that I was not just “seeing what I wanted to see.”

**Prolonged Engagement**

A final method used to increase the trustworthiness of the data in the current investigation was prolonged engagement. I worked with the three central participants for nearly one year (from March 1998 to February 1999).

**Reciprocity**

The three students involved in the investigation from Summer 1998 to Winter 1999 gave generously of their time. Compensation was offered in the following forms:

- An offer of free mathematics tutoring during quarters of involvement and throughout their academic career at Ohio State.
- A total sum of $100 for their participation in the study.
- Unlimited beverages during our meetings together.
- Continental breakfast served during the final group interview.
Rolling Pilot

Interview protocols and other researcher-designed instruments, as well as training techniques, were tested prior to use. A former developmental mathematics student from Winter 1998 (Kaylynn), who was not one of the three participants in the current investigation, met with me regularly during Spring 1998 for the purpose of refining interview questions, researcher-designed instruments, and training techniques. She continued to work with me into Summer 1998. Her work preceded the work of the current investigation participants by approximately five weeks. With the exception of the continental breakfast, this participant was offered the same compensation as the three current participants.

Data Analysis Strategies

Hammersley and Atkinson (1983) remind us data analysis is not a distinct stage of research and “it begins with the pre-fieldwork phase, in the formulation and clarification of research problems, and continues into the writing up” (p. 174).

Several data analysis methods were used before, during, and after data collection including the following: (1) writing detailed descriptive and reflective journal entries based on interviews, events, documents, and other contacts with research participants; (2) exploring literature during fieldwork that stimulated my thinking and enhanced analysis; (3) transcribing all interviews, permitting the formulation of questions for future interviews; (4) and reviewing printed data, marking it up with large, descriptive, preliminary categories.

Seidman’s (1991) method for managing and sharing in-depth interview data was especially useful. He explains the process as “one way to solve the problem the
interviewer has of how to share what he or she has learned from the interviews” (pp. 92-93). Seidman (1991) explains his process in the following:

First, I have developed profiles of individual participants and grouped them in categories that make sense. Second, I have marked individual passages, grouped these in categories, and then studied the categories for thematic connections within and among them. (p. 91)

This method was especially appealing and appropriate because crafting a profile in the participant’s own words allowed the interviewer to use these words “to reflect the person’s consciousness...the narrative form of the profile allows the interviewer to transform this learning into telling a story” (pp. 91-92). As a rationale for crafting profiles, Seidman (1991) cites Mishler’s (1986) work, which describes narrative as a way of knowing. However, he notes his purposes derived from someone else:

I found crafting profiles, however, to be a way to find and display coherence in the constitutive events of a participant’s experience, to share the coherence the participant expressed, and to link the individual’s experience to the social and organizational context within which he or she operates. (p. 91)

**Data Presentation**

The presentation of the data was arranged into four components — the initial profiles of each of the three participants, followed by the presentation of data that supported each of the three research questions. In each case, three to four themes were identified and presented.

A summary narrative approach was incorporated to display the various themes present. Narrative tables were used extensively throughout the data presentation. The use of narrative tables allowed the researcher to present the data, the majority of which consisted of illustrative quotes, in the form of a concise visual that “tells the story” at a glance.
CHAPTER 4

FINDINGS

This chapter will discuss the key findings of the current research. These findings will be presented in four sections. The first section, Initial Profiles, introduces the reader to each of the three participants in the study prior to his/her introduction to CHAMP. The remaining three sections each answer one of the research questions posed by the researcher: the second section notes indicated changes in each participant’s mathematical self-efficacy; the third section offers evidence as to how each participant internalized CHAMP; and the fourth section discusses how each participant began to use CHAMP on his/her own.

The majority of the data presented here is in the form of quotes obtained through individual training and interview sessions as well as through a final focus group interview. When possible, narrative tables were used to organize this data.

Initial Profiles

In this section, the reader will be introduced to each of the three co-researchers in this study. Information gleaned from a Background Questionnaire, the Mathematics Self-Efficacy Scale, the Initial Interview and the researcher’s reflective journal was used to create these initial profiles of the co-researchers. In this section, the reader will meet each co-researcher prior to each being introduced to CHAMP. The reader will find
general information regarding each participant, a discussion of each participant’s early experiences in mathematics, each participant’s general view of mathematics, and follow-up questions related specifically to the Mathematics Self-Efficacy Scale.

**General Information**

**Amy Jenkins** is a 44-year-old college senior who is attending college for the second time. Her first experience with college was 26 years ago and lasted three quarters. Amy is an Elementary Education major and is seeking a minor in Women’s Studies. She is divorced and has a 17-year-old son. Amy has a bubbly personality, yet is strong-willed and is not afraid to state what is on her mind. The phrase “whoa hoo” was an ongoing component of Amy’s speech and used whenever she was excited about something in general, or when she understood something for the first time. In the second case, it acted as a sort of verbal light bulb. Amy currently works for a local company that installs and services elevators. Due to her hectic schedule, many of the meetings between the researcher and Amy took place during lunchtime at her place of business.

**Melanie Lake** is 26 years old and grew up in northeastern Ohio. She has been out of high school for 8 years, but has not had a formal mathematics class since she was a sophomore in high school. Melanie took two courses at a Community College in northeastern Ohio prior to transferring to Ohio State. Summer 1998 represents her second quarter at OSU. Melanie is currently majoring in Business. She also notes that some day she would like to become certified as an American Sign Language interpreter. Melanie currently is a full-time student and maintains a full-time job working at a local bank.
Mark Tanner is a 25 year-old Industrial Design major. He is entering college for the first time since graduating from a local high school 8 years ago. Mark works on the janitorial staff at local hospital. He says he decided to go back to college because “you can’t get a real job without an education.” (Initial Interview, June 30, 1998) On top of working and going to school full time, Mark is also currently renovating a home he and his wife recently purchased.

**Mathematical Autobiographies**

For this research, it was important to know the students’ experience in mathematics so that a better understanding of how they accounted for mathematical situations from their past in their own words. It was important to know how they pieced together the fragments of their experience.

According to the constructivist perspective on learning mathematics, students are not passive receivers of information but active sense makers of their world and their mathematical experiences (Mason, 1989). Mason suggest that students do this by “assembling fragments of their experience into some sort of story” (1989, p. 153).

Mason (1989) described what he learned from students’ stories in the form of observations, two of which are particularly interesting here.

**Observation 3**: Experience is fragmentary. We piece together bits of explanatory stories that we hear or construct, in and attempt to organize experience. We constantly probe our past experience to look for similar situations, and that similarity comprises the structures of our understanding.

**Observation 4**: The result of making sense seems generally to consist of two elements, [one of which is] articulate stories that explain or account for a variety of situations (p. 156).

These participants enter the study with mathematical histories. Most students have a warehouse of stories about mathematics teachers and incidents from their first
days of school. Collecting and analyzing the stories of the participants is one source of insight into their beliefs and attitudes, in particular, offers a glimpse into the development of their current level of mathematical self-efficacy.

In the next few pages, the reader will have the opportunity to meet the mathematical side of each participant, not purely through the researcher’s words, but through the words of the participants.

Amy Jenkins. When asked during the initial interview to contribute stories regarding her previous experience in mathematics, Amy’s first recollection was a positive memory regarding junior high:

My first memory was with my 7th grade biology teacher. And the only way I passed biology was because he would spend time helping me with the equations and stuff. (Interview I, July 1, 1998)

Amy further explains that it was necessary for her to repeat the seventh grade. This circumstance was not at the request of any of her teachers, but at the request of her mother.

I was asking [my social studies teacher] for help. My mom found out and held me back for a year. That’s where a lot of my trouble started because the kids made fun of me. So from that point on I just existed in school. (Interview I, July 1, 1998)

Here we see that Amy’s mother assumed she wasn’t capable of doing the work and held her back for a year. From that moment on, she felt nervous about asking for help from her teachers, especially in class. This behavior was further reinforced when Amy got to high school.

When I got to high school, because I was so heavy, I didn’t fit in the chair and the teacher told me to sit in the back of the room because I would take up too much aisle space. So I went to the back of the room and so when I went to meet with him after school he said, “Well, you’re too dumb and ugly...you probably won’t
make anything out of yourself, so he said don’t worry about it.” He said, “If you just show up and try, I’ll give you a D.” So that’s how I got my D in algebra. And then, because I did OK in high school biology, I didn’t have to take anymore science or math.

The reduced self esteem, the low level of achievement, the mental suffering that I endured was so painful, and yet, no one cared. No one in the school system cared that I could do math. I was actually labeled fat, dumb and ugly, a label which followed me around at home, school, and throughout my life, until I lost weight and later went back to school. (Interview I, July 1, 1998)

In an attempt to right a wrong, Amy describes in a journal reflection an incident which occurred as part of her cross-district FEEP (Freshman Early Experience Program) experience. Amy had been working quite closely with a little girl who was struggling in math. Amy writes about a dialogue between herself and another FEEP student.

My cross-district FEEP student went outside at that the end of the day and said this [to me]. Man, you spend a lot of time with so and so. I used to do that but she’s not very smart, if she would just lose weight she’d have more friends and she would probably get smarter. I was literally [upset] and I literally seized this moment to let her have it. How dare she use or imply stereotypes in a classroom. How dare she use analogies as unscientific as her’s to state what this girl might or might not be able to accomplish in math because of her weight? How dare she think that her teacher skills are so refined to make such a comment to me or anyone? How dare she do to this little girl what all my teachers did to me growing up? Does she not realize the implications that this would have on her for the rest of her life? (Reflective journal entry, September 15, 1998)

This early experience in mathematics has affected Amy in everyday life, even with respect to finances.

The actual thought of using math frightened me that I have avoided checking accounts for years. A simple passbook savings account has served me just fine. I literally have paid bills and debts with money orders for so long, that it has become my way of life. (Interview I, July 1, 1998)

Amy’s experiences with mathematics also played havoc with how she viewed herself academically. Amy attended college the summer after graduating from high school. As she notes, “I only went to college to get some information and had
no intention of getting a degree.” (Interview I, July 1, 1998) Due to some issues she had when growing up, Amy decided to take some courses related to domestic violence and black studies. Even after earning 2 A’s and a B that summer, she still was not convinced she had the ability to continue on in college.

The lack of faith she had in her own abilities can be felt in the following excerpts from the initial interview.

And when my teachers told me I had potential, it shocked me to death. One of my teachers asked me what I was majoring in on an evaluation form and I told her I wasn’t going back to school. Then midway through the quarter she said you really should do something with writing. Because she said, the way that you write and perceive things is different. And she said you’d be a natural. So I said ok, thank you very much and I basically excused it.

In these excerpts we can see that even though others were offering encouragement, Amy herself was not confident in her own abilities. Amy continued to harbor an ongoing fear and mistrust of mathematics until reaching college.

As a member of the researcher’s Math 050 class, Amy was somewhat tentative. She did ask questions but most of the time these questions were asked prior to the beginning of class or after class. Rarely did she ask questions within class. From this, it appears that she was still harboring some of those same feelings instilled in her when her mother held her back in seventh grade.

Whereas Amy took a survivor role with respect to mathematics, Melanie lists mathematics as one of her favorite subject. The fact that she has not had a mathematics course for ten years has however taken a toll on her level of confidence.

**Melanie Lake.** Melanie began her mathematical history discussion by noting that she does not remember a great deal about her mathematical experiences prior to seventh
grade. Similar to Amy, her first recollection really had nothing to do with mathematics, but again focused on the matter of the teacher. She explained.

Seventh grade math class, I had a really mean teacher. I got a swat because I was late for class. She was really mean. I was always late to her class because it was after lunch. (Interview I, July 1, 1998)

What seemingly could have had a negative affect on Melanie's effort, actually had a positive affect.

I probably worked a little harder in her class just because she was so determined that I wasn't going to do as well as a student. If someone tells me I can't do something, I have to prove them wrong. That's the type of person I am. (Interview I, July 1, 1998)

She went on to earn an A in that particular math class. Melanie further noted that she cannot remember ever getting a grade other than A in a math class, that is until she got to college.

Her next recollection of mathematics was in high school. She really enjoyed the mathematics teacher she had in the ninth and the tenth grade. His help and encouragement even allowed her to tutor mathematics for a time.

In high school, ninth grade, I took prealgebra. I had a wonderful teacher. He worked with me and helped me through some of my problems. He was a really great guy and so I ended up, I had him again my sophomore year for algebra...and I also did some tutoring in the tutor room --- just like prealgebra and basic math and stuff like that for him. (Interview I, July 1, 1998)

Melanie also took some bookkeeping classes in high school. She thought these classes were more interesting than regular mathematics classes.

I also took business math, very interesting class. I liked that, like I liked bookkeeping...something different than just standing up there and putting numbers on the board and solving these problems. I guess bookkeeping is different because you have to keep record of things. I'm very good with the checkbook. I'm very good at writing everything down and balancing it. (Interview I, July 1, 1998)
Here we see a reverse connection to Amy's discussion with respect to her checkbook. Whereas Amy makes every attempt to avoid the use of a checkbook and checking account, Melanie takes great pride in making sure everything is complete and accurate in her checking account.

Both Amy and Melanie could pinpoint exact points in time to begin their mathematical histories. Amy actually began with a positive occurrence, which rapidly turned negative. The negative high school experience had a seemingly negative affect on parts of Amy's life, but in the same sense created a positive situation when she came to the defense of a little girl in FEEP. Melanie began with a negative situation, although she was able to use that negative situation as a motivational factor. Whereas Amy and Melanie focused on specific occurrences, Mark focused on an extended time frame. One thing that becomes clear is that Mark never acquired any level of fondness for mathematics.

Mark Tanner. Mark's early recollections of mathematics focused on a strong dislike of mathematics. Mark had no strong recollections of mathematics with respect to elementary or middle school, other than in many cases he didn't "see the point."

In high school I did pretty poorly—had a lot of focus problems and a lot of things on my mind. Math was my particularly weak subject -- with the math and history. I didn't take very high math courses, although I did take really high physics courses which was kind of a contradiction. I was the only person ever allowed into honors physics without any of the math --- most of the people in there were taking precalc[culus] and stuff like that. I managed to get a C in the class despite the lack of math. I feel I can understand some complex problems, but when it actually comes to staring at them in mathematical form, I just kind of freak out if I don't know what exactly I'm supposed to do. (Interview I, June 30, 1998)

The previous excerpt allows a glimpse of what will become an ongoing theme for Mark. The theme that will continue to emerge is that of application and understanding.
When mathematics is applied, as is the case of physics, Mark was able to better see the importance of mathematics and thus further understand it. When doing mathematics for the sake of doing mathematics (e.g., evaluating or simplifying mathematical expressions, or solving algebraic equations), Mark had a tendency to lose focus.

This lack of focus contributed to Mark needing to retake prealgebra in high school.

I took prealgebra 3 times in high school, finally passing it in summer school. I also failed Algebra I and barely passed Geometry.

When you completely fail a course, when you completely flunk it, you get nothing out of it. I didn’t get anything out of the first two prealgebra courses at all—nothing. I didn’t retain anything except acquiring the understanding that they were going to start putting letters in with numbers.

You reach a certain point, if you are in a class for one or two chapters and you’re failing already, you never catch up. You might as well just pack it in right there and quit. (Interview I, June 30, 1998)

Mark has observed this same situation in his college level classes.

I’ve observed this with some students in [Math] 050. If you didn’t fully understand a particular step and you didn’t ask how or why, and you didn’t even bother to get it, though and say, oh, I’ll just get it eventually, then you are done. (Interview I, June 30, 1998)

Mark ended up taking the prealgebra class in summer school. He felt this to be a better experience for him. Much of that depended on the teacher.

He wanted everybody to pass; he wanted everybody to understand what was going on and why they failed it and what they could do to stay on top of it. (Interview I, June 30, 1998)

Upon reflection, Mark came to the general conclusion regarding mathematics that many students do.

I literally took the attitude that I just don’t understand math and I never will. Everybody has weak points. (Interview I, June 30, 1998)
What is confusing to Mark is why he feels that way, because from his own admonition, he doesn’t think that his mind is un-mathematical.

I approach things like creative writing with a very logical sensitivity. Logic is paramount to any course for me. To me, you have to see the logic behind Shakespeare in order to understand it. And there’s a lot of creativity in math, really, there’s a lot of interesting stuff that someone had to sit down and put a lot of thought in and come up with to make the stuff work. I think it is an impressive language. I wish I could maintain a better level of understanding of it. (Interview I, June 30, 1998)

The key to having confidence in his ability to do mathematics has a great deal to do with his ability to understand it.

To Be Successful in Mathematics

A question of concern to understanding how the co-researchers were approaching this study had to do with how each viewed success in mathematics? For these students, was success tied to unstable factors such as grades or luck? Or was success tied to stable factors such as effort and/or improvement. The following discussion will focus on how each of the three participants looked upon success in mathematics.

Mark. Mark was very consistent on this point. Just as he tied his confidence in his ability to his ability to understand mathematics, so too did Mark tie this understanding to his success in mathematics.

To successfully perform mathematics, the best definition on earth is to understand what you are doing, not necessarily getting the right answer. Because if you understand what you are doing and you make an error then that’s going to affect the ultimate answer, but then you have a way to go back and figure out what you did wrong—cause you already understand the concept of what you are doing. (Interview I, June 30, 1998)

Mark goes on to further clarify this with a specific example from Math 050.
I remember one problem in particular on a take-home quiz. I got the right answer, but I had no freakin’ clue how I got the right answer. I got the right answer, but if you asked me to repeat it, I have no idea how.

So I didn’t learn anything from it by doing it and getting the right answer. Now problems I missed that I know how to do—I walked away feeling good about that. If I looked at a test and missed 8 questions and they were all simple mathematical screw-ups or I’ve simply forgot a step, I’m OK with that. If I missed 8 questions because I didn’t know how to begin them and ....this is high school, and was completely clueless, then you feel like a failure.

So yeah, to me success is understanding it, not necessarily getting it right.

(Interview I, June 30, 1998)

Similar to Mark, Melanie’s thoughts on being successful in mathematics also did not focus on obtaining correct answers.

**Melanie.** For Melanie, to be successful in mathematics means to put forth an effort.

As long as you try, you may not get the right answer every time, but as long as you try and your trying to figure out stuff, or you’re seeking help wherever you can, I don’t think you have to be able to answer the question the first time you sit down and read it....and I don’t think all your answers have to be correct to be successful. And I think that just in general in life, as long as you try and you give it what you have, I think that is important. (Interview I, July 1, 1998)

Grades for Melanie represent a way of determining progress and a way of learning. She is not focused on a grade as a final outcome, but as a means of determining what she knows and doesn’t know.

I learn more from my mistakes and stuff. I don’t look at my grades and tests and say, gosh, I only got a 71. That’s not what it is. It’s what I learned and where my mistakes were on my tests and where I can go from there so I don’t ever make that mistake again. Grades are all about getting through and learning from my mistakes. (Interview I, July 1, 1998)

Amy has a similar line of reasoning when it comes to grades.
Amy. Grades for Amy represent a record of what she was learning and also a
measure of progress and improvement.

Grades are an evaluation of what I was really learning. They represent a sort of
barometer for me. Also, they offer me a goal to work for. Each time I raise the
benchmark that adds to my confidence. Like in 050, I was pretty stressed out
about the first midterm, but when I got a 72, I knew that was a C and that is all I
expected. But it also told me I could do better. Then when the grade went higher
on the second midterm, I knew that maybe I could do better than a C, so I set my
goal to be a C+. Then after the third midterm, a B was possible. So each time,
the grade acted as a motivational factor. (Interview I, July 1, 1998).

All three do however admit that although grades may not mean as much as the
progress they are making, that grades do have impact in other areas, namely in the areas
of financial aid and graduate school.

For Amy, she does have to focus on grades somewhat because she is “scholarship
driven.”

My scholarships will drop off if they’re not a certain point hour. And in education,
any class you take that isn’t B or better...because of how graduate school is set
up, you have to take another class again. (Interview I, July 1, 1998)

For Mark, in order to continue getting paid to go to college, he must maintain
good grades.

The only real concern is that I can’t fail the course. ‘Cause if I fail the course, I
have to pay for it. Since OSU pays for my school, you have to at least get a D. I
don’t want to have to pay for any of these courses. Also, OSU has started giving
me additional money as long as I maintain a certain grade point average. So even
though I go to school for free, now if I get a 3.5 and up or 3.7 and up, I get some
money each quarter. (Interview I, June 30, 1998)

Melanie must obtain certain grades each quarter for the bank she works for to help
her with the financial side of college.

The bank I work for pays for my school. They have a nice tuition reimbursement
program. However, for me to continue to get this help, I have to maintain a C
average. So to some extent, grades do have an impact. (Interview I, July 1, 1998)
**Interpretation of Scale Directions**

The general focus on stable factors such as effort and improvement and less on the ability to obtain correct answers is also seen in the interpretation of the directions for the developed Mathematics Self-Efficacy Scale. One additional concern the researcher had in the development of the scale had to do with the interpretation of the instructions. Would the participants interpret the direction “Indicate how confident you are in your ability to solve the problem by circling the letter according to the following 5-point confidence scale,” as a judgment of capability (*Can* you solve the problem?) or one of intention (*Will* you solve the problem?)?

Amy did not focus on whether she could get it right, but focused more so on whether she could set it up.

I was looking at it as a process-oriented statement. I felt that if I knew how to set it up, I could get an answer. I didn’t look at it like well, I know what the answer is already because I don’t, but I knew that if I could set it up that I could go back and check and get that. (Interview I, July 1, 1998)

Melanie was somewhat defensive when this question was posed to her during the initial interview. She questioned as to whether or not she had read the question appropriately or whether she had read the question as it was intended. That defensiveness in her tone shows some lack of confidence in her interpretation. Although there was no right or wrong interpretation of the question, she felt she had incorrectly interpreted the intention of the question.

I was answering them that I could, that I knew, that I knew how to try to get the right answer, how to solve them. Why? Isn’t that how I was supposed to answer them? You know, I didn’t even try to solve them or to even look for the right answer. (Interview I, July 1, 1998)
Much like the Amy and Melanie, Mark focused on the process rather than whether or not he could find the correct answer. He questioned whether he had the tools to answer the question and also the complexity of the problem.

I was trying to scan over each question and trying to determine what they were asking for. Well, given my memory bank, do I know how to do that type of problem. I look at it like I would a household repair—if it’s electrical, I’ve never done electrical work. I know right away I’ve got very little confidence with that. I could maybe figure it out if it’s not too complicated. (Interview I, June 30, 1998)

Each of these non-traditional students viewed the question in virtually the same way. Their focus was on the process and as to whether they felt that they had the appropriate tools to begin to answer the question. None of the three specifically focused on the answer or their ability to acquire the correct answer. Similar to the “being successful in mathematics” line of questioning, the focus here again was on the learning or the process, and not on the outcome (correct answer).

**Comments Regarding Current Instructor and Course**

Each of the participants noted occurrences in their early mathematical careers that had an impact on their mathematical self-efficacy. For each, and for Amy in particular, these early memories were still having an effect on the confidence each had in their own mathematical abilities. Mark goes on to summarize the importance of a teacher’s confidence and interest and the effect it can have on a student’s confidence.

I’m not too confident if I don’t feel confident in the person teaching the course. I’ve had some bad teachers….teachers that didn’t seem to care about what they were teaching. It’s like, if you’re not excited about it, then I’m not going to do as well. You have to be excited for me to stay interested, otherwise I’m just here watching a seminar every day of the week. Nobody really likes to sit still for an hour and have somebody talk at ‘em---it had better be interesting or else you are going to start to wonder, you know drift off. (Interview I, June 30, 1998)
This thread of worry is already creeping into the current course for each of the participants. Each has mentioned happenings that have occurred within the first week of class that has made them anxious at certain levels and created somewhat of a lack of confidence in their current instructor.

**Melanie**

He’s a spurt guy. Like at the beginning, we started out with story problems, then we went, right now, we’re into slopes and graphing and stuff like that…and he hates a particular section in graphing so we kind of just skipped over that. He’s a very quick person. He’s like if you ask him a question, he’ll go “NO” and it’s like OK. And I’m a little intimidated by him.

The teacher I have right now is big on steps, and his steps. And that’s the way they need to be. That’s not how I solve everything. (Interview I, July 1, 1998)

**Amy**

I can tell you what happened. the other night in class. I had missed the first week of all my classes because I participated in that K - 12 teacher’s conference. So I went in Monday, and we already had a quiz and everything and so I was six units behind. So I took Wednesday off and spent almost 11 hours on math, between Monday night and this quiz Wednesday. And I was so frazzled and frustrated by our quiz time that I just didn’t know what was going on…because when we entered class he reviewed our homework from the night before, then he covered all the new material, and he rushed through that so we’d have time to take the quiz. So I thought that was totally inappropriate, so I asked him if we could discuss classroom procedures, and he said there was no democracy in his class—I’m the teacher. (Interview I, July 1, 1998)

**Mark**

I did really well in Math 050, so you show up [for Math 104] and you’re feeling really good ‘cause you just did your first college math course. You know for a person that always viewed himself as always being awful in math, just terrible in math—and you had a great experience in your first one so you’re thinking this is good. But then again, there is this little stigma, like 050. Everybody tells me, everyone’s like—Oh, 050 that’s stuff they are learning in third grade now. That’s kidstuff. That’s worthless. So now you’re in 104 and you’re thinking, oh well, maybe this will be a lot harder—maybe 050 was just a lot easier. But most of 050 I hadn’t seen before. I mean I had never taken enough math in high school to have ever seen it. So, you dive into 104 … and your teacher [stinks].
I mean she is just the absolute worst you can possibly imagine.

You’d go to class and it was supposed to be a two-hour, a two-and-one-half-hour class and you’re done in 40 minutes.

And then you are like...this is insane. I mean she’s using stuff like try to explain to us like that variables aren’t important—it doesn’t matter what symbols you use. So I’ll use smiley faces and hearts. So I’m like doing math with smiley faces as numbers.

So you are going to try to divide out diamonds and fractional numbers involving smiley faces and stars and clovers. It was a mathematical Lucky Charms.

And she doesn’t care about anything at all. Like you go up and ask her a question, she is combative with you because you don’t understand.

One time I went up to show her a problem. I felt like I knew what I was doing, but I went out of kilter here. I mean that is the only way I can learn in math. Ok, where did I make my mistake. And you would think someone would be able to say, Oh well, right here, you can’t do that. And you go oh, well what do I do? And then you say you divide this out here and bring it to the other side...then you say, oh great, no problem, now I can do this right? Well her answer to that would be something like...you were doing fine here and then I don’t know what you did here? So I would start over from where you were here, and then that’s your answer.

And I even had her walk away from me a few times in class. So, I’m like [in trouble]. I’m thinkin’ like oh man, I’ve been in this class like two days and I’m already in trouble. (Interview I, June 29, 1998)

In response to these initial concerns regarding their current mathematics course, the researcher wrote the following personal reflection.

Each of these students came out of Math 050 feeling pretty good about their college mathematics experience thus far. Melanie’s highlight from 050 was the final exam, which had taken place just three weeks prior. Mark finished 050 with an A and was feeling pretty good about getting through that first math class. Amy had exceeded her goals for 050, starting with a goal of a C and finally earning a B. From first impressions, each has some negativity toward their current teacher. Each has dropped down somewhat from their ending level of confidence to where it is now. It is amazing how fragile self-efficacy can be. Don’t these teachers realize how fragile self-efficacy can be? Don’t they realize how simple actions and words can be misconstrued as lack of caring on the part of the teacher? A couple of the teachers don’t seem to care much at all about the concerns of their
students. The issue of dealing with the teachers will be something each of them could very well have to deal with on a daily basis. The impact of the teachers could be detrimental if the students are not able to overcome these differences in method. In the opposite sense, by overcoming these through various portions of CHAMP, this could represent added support for its effectiveness. Time will tell. (Researcher Journal, July 3, 1998)

**Evidence of Non-Mathematical Self-Efficacy**

Within the initial phase of data collection, each participant was able to document efficacious life occurrences. These are important to the research because the researcher will use these non-mathematical occurrences as a means to aid in the promotion and development of certain components of CHAMP, most notably in the areas of mental recall and mental rehearsal.

*Amy* was the owner of her own business, Herbiatage and Basketry for 11 years. During that time she wrote a book that “sold 1800 copies in three months” and she presented many lectures.

One such lecture entitled *The Victorian Uses of Herbs through the Vinegar and Culinary and Ornamental Aspects* was for 842 people. That led to a lecture series with a renowned children’s illustrator/artist, who at the time was deeply involved in Natural Herb Society of America. Due to this involvement I was later asked to be the educational director of the Society, a position I held for 2 years. (Interview I, July 1, 1998)

*Melanie* lists her moving down here on her own from northeastern Ohio and her need to continually try new things as points of reference for her non-mathematical efficacious occurrences.

I moved down here...I needed to change my life. And my family was shocked. My whole family is there. I picked up, moved all my stuff. They didn’t think I’d do it.

I like to try different things. I have my hair license. I am a beautician. I’m afraid of heights, so I’ve bungy jumped. My next thing is to jump out of an airplane. I figure [by doing these things] I’ll overcome my fear of heights. (Interview I, July 1, 1998).
Mark has recently purchased a home and is completely renovating it, from redoing bathrooms, to redoing the electricity, to redoing the plumbing. He admits for the most part, "I have never done any of this before, but feel I can do it." Mark is also a member of an up-and-coming local rock band. He walks on stage two times a week and notes that on most nights, he has a slight case of stage fright.

There are some nights it takes everything I have just to get up on that stage. But each night we play I am able to conquer those fears and step up on stage and do my thing. (Interview I, June 30, 1998)

These discussions led the researcher to write the following reflective entry.

It is interesting to me that each of the participants has, in their past history, demonstrated considerable amounts of confidence in their abilities to do a variety of things. For example, Amy ran her own company and gave speeches in front of large crowds...something she thrived in doing. I would be extremely nervous in that circumstance. Melanie had the confidence in herself to leave home when everybody close to her doubted she could or would do it. She says she is a daring person and takes on her fears. She is afraid of heights, so she overcomes this fear by bungy jumping and says "she will jump out of an airplane." Mark has recently bought a house and is remodeling it on his own. A huge undertaking, but freely admits he is willing to try things he has never attempted before. Not to mention he is a member of a rock band.

And even with all this demonstrated confidence in their own abilities, each has limited confidence in their ability to do math. What will be needed is a way to draw upon their competencies in other areas and bring them into the math settings. This could be accomplished by asking them to create a recall experience that is not only math related, but one that is also non-math related.

(Researcher Journal, July 5, 1998)

**Mathematical Self-Efficacy Scale Results**

The Mathematical Self-Efficacy Scale was administered during the first session with each participant. The scale consisted of 20 problems that could be found in either of the two courses in which students would enroll beyond Math 050. The participants were to indicate how confident they were in their ability to solve each question by choosing a
letter from 5-point confidence scale. The scale ranged from (A) No confidence at all to (E) Complete Confidence. A sample of the scale can be found in Appendix E. The following table represents the results for the three participants with respect to each question.

<table>
<thead>
<tr>
<th>Question</th>
<th>Amy</th>
<th>Melanie</th>
<th>Mark</th>
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<tr>
<td>1</td>
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<td>C</td>
<td>A</td>
<td>E</td>
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Table 4.1: Results from Mathematical Self-Efficacy Scale

As part of the initial interview, follow-up questions were asked to focus on the participants' reasoning for rankings. The researcher was primarily interested in their reasoning related to 1) high rankings, 2) low rankings, and 3) word problems. Word problems were of keen interest to the researcher due to the fact that word problems would be used as the primary focus for the initial training sessions.
**High Rankings**

From the list above it can be seen that for problems such as 1, 4, 5, 6, 13, and 14 the participants rank these as having either much confidence (D) or complete confidence (E). Within the initial interview, the participants noted that the major reason each ranked these at the upper end of the scale had a lot to do with the fact that they had either experienced the specific problem previously or had at least experienced a similar problem.

[I ranked number 5 high] because I know that if that problem was put in front of me, that I would know how to solve it and I don’t think I would have to go back into notes or something like that to figure it out. It is basically coming from past experience. I have seen that problem before. (Melanie, Interview I, July 1, 1998).

The things I ranked the highest on this were, you know, the ones I had seen or done before.... And there was one word problem on there that figured grades [17], that is what I tried to do to figure out my grade for this class [050]. So I felt like even though it was a word problem, I had much confidence coming up with an answer for her because that’s how I came up with how many points I could get on my final and still get a B. (Amy, July 1, 1998)

You have to consider that some of these I looked at were very similar to something I had done—and in format they look like things I’ve already done. (Mark, Interview I, June 30, 1998)

At the upper end of the scale, each participant had a unique way of clarifying distinctions between D and E. For Melanie, the distinction had to do with how much time she had to work on a particular problem as well as whether she could or could not use notes or other resources.

I think [the ones ranked as D] are a little more detailed to me. I would have to work on them a little bit longer. I would maybe have to check briefly on my notes or something like that, rather than if you put that in front of me I could, like number 5, if you put that in front of me, I could literally just start solving it. On numbers 1 and 2 I would have to concentrate a little bit more on exactly where everything needs to go. (Melanie, Interview I, July 1, 1998)
Mark had a similar argument with respect to the time issue, but focused more so on instruction as the primary resource that could adjust a D to an E.

Bear in mind that looking at them quickly and trying to decide whether or not I would do them differently than actually sitting there and pondering them for a little while, actually thinking about the solution, the confidence scale would probably slide a little bit in either direction. Like with number 9 [solving a system of equations], on first glance I thought yeah, you know, no problem. But on second glance now I kind of look at it like, well, I have some skills involving that, but precisely how to solve it, maybe not. It doesn’t mean I can’t.

But then again, in all honestly, as an overall confidence, looking at the majority of those I would say that I think it would take me very little instruction on each one to be able to mark down, I would say, by going over those for one day I could mark down complete confidence on all of those [currently marked D]. (Mark, Interview I, June 30, 1998)

Amy’s distinction between a D and an E more directly related to her own understanding of herself and the confidence she had in her own ability.

Ok, on #1, I circled D versus E because I knew I could have theoretically circled E, but I didn’t know if I’d make a mistake on my signs—cause I’d always do that. So allowing for the negative factor to go in and not subtracting that or doing that right, I figured until I check my work I would have “much confidence.” If it would have all been positives, I would have circled “complete confidence.” So because of the negative factor, I just stepped back a little. On #2, because I could read that and I knew the formula, I had “much confidence,” but since it’s a partial word problem, I actually backed down a bit in case I would misread how I would plug everything in. (Amy, Interview I, July 1, 1998)

**Low Rankings**

The three collectively lowest ranked problems were problems 19, 10 and 15.

Question #19 represented the simplification of a square root problem. Each freely admitted that the major reason that #19 received such a low ranking had to do with each participant’s unfamiliarity with this problem. This type of problem is not addressed in Math 050 and is first introduced in Math 075 or Math 104.
I mean I know somewhat what the answer would be, because we briefly discussed square roots [in Math 050] in terms of something like “you may see something like this later.” So I said, exactly not knowing what that totally means, I better just go low because I’m not sure how to figure the rest out.

(Amy, Interview I, July 1, 1998)

I don’t know what I’m doing. I don’t know...I don’t even know. I wouldn’t even begin to even know how to solve that. Maybe I could guess on 19, but...I don’t know anything about it, so I guess lack of experience is the reason. I haven’t seen it. And if I did, it was 10 years ago. (Melanie, Interview I, July 1, 1998).

Number 19 was ranked “no confidence at all” because we never actually, and I’ve never personally discussed anything that involved the actual square root symbol. I saw that there was a squared number and I saw that 27 was in there, but then I saw the x-cubed and I thought I don’t know how to square out a cube. So I think again I probably have some of the tools to get there already, but I’ve never really seen the actual format. (Mark, Interview I, June 30, 1998).

The remaining two problems that were ranked the lowest were both word problems. Each problem could be classified as a combination problem. Problem 10 represents a motion problem and problem 15 represents a mixture problem. The fact that these problems rated the lowest is an important issue, for it is these types of problems that will be used for training purposes.

Melanie listed both as having little confidence. She confides that she does not really know why she has such little confidence in these types of problems

That mixture one, it throws me...I don’t know why. I don’t know if it’s putting it into... I mean I can put it into...obviously...where it needs to go. I don’t know, mixture problems just throw me a little bit. Well, 12 and 15 are similar problems. I mean they’re set up pretty much the same --- it’s dealing with two things here and I’m dealing with three things here. There’s just something about those. I’m not fully confident, I’m not. I have some confidence, but I don’t have that --- “Yeah I could do those, throw ‘em at me.” I’m not there yet. (Interview I, July 1, 1998)

Melanie goes so far as comparing the solving of mixture problems to standing in front of an audience and delivering a speech. In both cases she feels a certain level of nervousness.

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Like if I would have to stand up in front of the class and talk—I’m not a good public speaker. So I’d be nervous and I’d sit and I’d probably scrunch more down in my chair. It wouldn’t be something like “Yes, I know what I am doing.” It’s not that I don’t know what I’m doing, it’s just something that takes a little more thought to get myself grinding. (Interview I, July 1, 1998)

Amy too had a strong reaction to the solving of word problems. But in Amy’s case, the type of word problem made a difference as to her level of confidence in her abilities.

If the problems are more like #7, which is mostly a direct translation, then I’ve got some confidence. Or like the rectangular one [#20], yeah, because that is totally formula driven. So I could do that. But like where you start adding in formulas to....accountants, a chemist, or running, it’s like how do I take out and cross out all the words that don’t mean anything to it and just leave the words there.

It is the setting up. Where you can look at another problem and you can immediately go, ok that’s going to be an area, or that’s going to be a perimeter...with this [#15] you have to think in terms of choices and understand more about the process. (Amy, Interview I, July 1, 1998)

Although Mark did rank this low on the scale, again his reason had more for his dislike of them rather than his trust in his own ability.

I never really had a big problem with word problems. I mean I really never had a big fear of them. I just don’t like ‘em. With a math problem, you are all numbers. But with word problems you have to actually take the words, put them into concepts, and create the equation. With mixture problems, I hate mixture problems, but I always thought they were neat because it had a practical application, but for me the difficulty was being able to put them into mathematical terms. (Mark, Interview I, June 30, 1998)

**Summary**

This section of the *Findings* chapter was used to introduce the reader to each of the participants in the study. In this way, the reader can better understand how each participant entered the study with respect to his/her mathematical “upbringing,” as well
as understand the role each participant’s mathematical history played in their entry-level mathematical self-efficacy.

Two additional issues that will be addressed throughout the study and the discussion of the findings are the real-life references each participant made initially and each student’s comments regarding his/her current instructor. The real-life references acted not only as a tool to aid in building each student’s mathematical self-efficacy, but also acted as a gauge as to each participant’s ability to use CHAMP on his/her own. The policies and actions of current instructors also had a bearing on each participant’s mathematical self-efficacy as the study progressed, becoming an ongoing line of discussion throughout the study.
Changes in Mathematical Self-Efficacy

Changes in mathematical self-efficacy with respect to each participant could be seen in three distinct ways throughout the study. These three distinct changes are the following:

1) Changes in participation
2) Changes in preparation
3) Changes in how students view word problems

In the section entitled Changes in Participation, the researcher will discuss changes that occurred within each student’s participation within the classroom setting. In previous mathematical experiences, each of the participants was quiet and reserved. In most cases, when these students had questions regarding the class, these questions were asked at a later time, normally before or after class. Prior to beginning the study, none of the three participants considered themselves the type to help others, nor did they consider themselves the type that others would seek out for help. In this section, it will be demonstrated that not only did the participants begin to help others in class, but that others looked to the participants for assistance.

Each of the participants also demonstrated changes in the way each prepared for class and in particular for tests within their math classes. In the section labeled Changes in Preparation, the researcher will highlight evidence pertaining to how each student mentally prepared for their mathematical experiences. In preparing for tests students reached a point where they “knew what they didn’t know.” By focusing their attention on what they didn’t know as opposed to studying everything, the students were able to establish a much more efficient use of time and abilities. In their initial profiles each
student spoke to the fact that each of their teachers preferred to review prior to each quiz and test. In all cases, this early one proved to be a detriment to their confidence. In this preparation section the researcher will also discuss how each student overcame this review complication and in turn used it to their advantage.

This study was conducted using word problems. The basic assumption from the researcher was that by using word problems in the training process was that if a student could become highly efficacious with respect to word problems, generally the nemesis of mathematics students at this level, then this should have some level of carry-over effect in their overall mathematics self-efficacy. Therefore, in the last section, Changes in How Students View Word Problems, each participant’s change in their ability to perform word problems will be discussed.

**Changes in Participation**

Each of these students was a member of the researcher’s previous Math 050 course at The Ohio State University. As a general observation with respect to their participation within that course, each student would clearly be labeled as quiet. Although each had demonstrated the ability to do the mathematics, each was unwilling to freely participate in class. Any questions these students had with respect to a particular problem or concept were saved for before- and/or after-class one-on-one discussions. When asked to work with other students, these students were generally the passive ones within the group. This demonstrated passivity had to do with the confidence they had in their own ability to do mathematics. Prior to the study, each felt as though they could not possible have anything creative and/or constructive to say to the class.
The changes in participation each student demonstrated throughout the study will be addressed in three areas:

1) Interaction with other students
2) Interaction with the instructor
3) Comparison of self to others

The changes in each area will be addressed through the use of a narrative table. In this table, each participant’s own words will act as the data representing each change.

**Interaction with students.** When placed into a mathematical setting prior to this study, the participants never considered themselves as leaders within a class. Each had taken the attitude that I am in this alone and only alone can I learn the material. Previous to the study none felt confident enough in their own abilities to offer their services to other students in their classes. None of the students considered themselves the type of mathematics student that others would ask questions of. As members of the researcher’s Math 050 class during the spring quarter, 1998, it was observed that little peer interaction took place.

Two indications of change with respect to how each student now interacted with other students could be seen. The first dealt with each participant’s willingness to help or work with one another. The second dealt with the willingness of others to seek out their help.

In the first case, if students are willing themselves to help others in the class, this demonstrates a higher level of mathematical self-efficacy. Someone with a lower level of self-efficacy is not going to be as willing to help another student with their mathematics. In the latter situation, for other students to seek out these students for
added assistance, the participants in some way demonstrated their competence and confidence in their own abilities to do mathematics.

The following table displays data in the form of quotes addressing the issue of how each had changed with respect to their interaction with other students.

<table>
<thead>
<tr>
<th>Indications of Change</th>
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<tbody>
<tr>
<td>1) Willingness to help/work with others</td>
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<td>2) Willingness of others to seek out their help</td>
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<tbody>
<tr>
<td>We could do our math together and it was really fun. It was nice to know that they had confidence in me to listen or that I would have something of value to contribute. (Focus Group, 2/13/99)</td>
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<tr>
<th>Mark</th>
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<tr>
<td>I would have never thought that I was the type of person that someone would ask questions of, but in a lot of people came to me and asked questions. And that felt kind of good, that improved my confidence. (Focus Group, 2/13/99)</td>
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<tr>
<td>In my other classes, I don't have a problem with people. I don't go out of my way to help, but if people come to me and say...Hey, do you know what's up with this?, I can usually figure it out. (Focus Group, 2/13/99)</td>
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<tr>
<td>I find now that working with somebody if they know their stuff, as least as much as I do, it is great. I can learn a lot from that. That is a big confidence boost. (8/25/98)</td>
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<tr>
<td>Before the midterm, that was kind of funny, I had three people come up to me in class and go, gee man, could you help me do this one? (Focus Group, 2/13/99)</td>
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<table>
<thead>
<tr>
<th>Melanie</th>
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<tr>
<td>There is one girl that sits behind me. Occasionally she will ask a question and I will help her answer her question. And then the girl that normally sits in this seat [pointing in front of her] is usually confused with some problems, she will usually ask me a question, so I will go over it with her. So that makes me feel good; that I have been able to help someone. It gives me a little added confidence to know I was able to explain something to someone that is going to be on the test. I've never really been in that position before. Up until now, no one every really looked to me as someone that could help them. So that is kind of cool. (8/24/98)</td>
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Table 4.2: Indications of change in participation: Interaction with other students
In the Table 4.2, all three participants mention situations where they have either worked with other students, helped other students, or have had other students approach them to aid in the answering of questions. All three give the impression that this was a relatively new development for them and almost seem perplexed by it all. They almost seem to be asking how is it possible for anyone to possibly think that they are capable of answering such questions. Statements such as “It was nice to know they had confidence in me,” “that felt good and improved my confidence,” “that is a big confidence boost,” and “it gives me a little added confidence to know I was able to explain something to someone” demonstrate that by helping other students, each was gaining back something in return—a sense of confidence in their own abilities. There still exists a feel of skepticism in their comments, but it can be seen that each is beginning to come to the realization that they are capable of doing the mathematics and in turn are viewed by their peers as being capable gives them a renewed sense of confidence.

A renewed sense of confidence in their own abilities was also found in the way each interacted with their instructor.

**Interaction with instructor.** As a previous instructor for each of these participants, I can verify that each was a responsible, conscientious student. When any of these students had a question, each was willing to ask their questions. For Melanie, her favorite time to ask questions was the half-hour prior to class. For Amy, her favorite time to ask questions was during the ten minutes of break. She also liked to ask questions in written form on her homework assignments. The written form was also her preferred method in relaying a message to her Math 075 instructor regarding her displeasure with his management techniques related to giving quizzes at the end of class as opposed to the
beginning of class. She commented that she felt “confident in her ability to get her point across in writing.” Mark would often stay after class to get in-depth one-on-one assistance.

As can be seen from these brief descriptions each of these students has at one time or another taken the initiative to have questions answered by the instructor. In Amy’s case, she has gone so far as to confront her teacher in writing. Each student is confident to ask questions in the privacy of an individual meeting or through means of writing. So what is in question here is not how or why the questions are asked, but more the case of when they are asked.

None of these students prior to the study felt confident in their own abilities to ask questions of the teacher in class. In the same sense, none were willing to answer questions asked by the teacher in class. None of these students would have ever considered confronting or correcting a teacher in class. The quotes in Table 4.3 demonstrate a change in mathematical efficacy, by demonstrating that these students no longer consider asking questions of their teacher as an isolated endeavor. Also the quotes will demonstrate the participants are now more willing to address the teacher in class regarding the correction of problems or even confronting them on policy issues.

The above quotes suggest that each of the participants has grown through their experience in that it can now be determined that these students are more willing to interact with the teacher in the classroom itself and not wait until a later time.
Indications of Change

1) Willingness to ask instructor questions in class
2) Willingness to answer teacher-initiated questions
3) Willingness to confront/correct instructor

Amy
Now I've gotten more confident in my classes and I'm not afraid to tell the teacher publicly I don't know something. Whereas before, I would always wait and make an appointment. And sometimes it would be two sessions later. Now I deal with it right in class. So I feel I am not worried about someone saying, "oh there she goes again." Or "oh man, she is stupid." Or "why can't she get that." Go ahead and say it, I'm still going to raise my hand. And I've gained respect for people around me for doing it because they were afraid too. (Focus Group, 2/13/99)

And I said to the teacher, I am tired of being told no by you, so I would like to know if I got my word problems right before I leave class. I want to know how I did on my word problems. And when he said I got them right I was like whoooo, hoooo. (8/14/98)

I told the instructor I had gotten news about my biopsy results. And I went in and talked to him about having to reschedule my midterm because they wanted to do my surgery the week of Thanksgiving. And he said don't worry about it, don't take the second midterm. And I actually freaked out. I said no you can't do that to me. He said what do you mean. And I said, if I don't take the midterm I'm not going to be able to measure my growth and what I could of known and didn't know and how to proceed to the third midterm. So he had to get departmental permission for me to take it after everybody would have it back. (Focus Group, 2/13/99)

Mark
Our teacher threw out a PRT=C problem at us in class. She couldn't even figure out to set it up. She didn't even have an equation. So as she is standing there fumbling around with it, I yelled out it is an interest problem. And she is like I know, now hang on. The girl next to me started throwing out some numbers. And then she goes to write them up there and she is like, I don't think that is going to work. And I am like yes it does and the answer is 412. She still doesn't accept that result and keeps fumbling around—thinking the number is too small. And she's like where did you get the 412 from? And so she finally gets it. (Focus Group, 2/13/99)

She was grading my midterm as I was about to leave. So I stuck around to watch. I didn't get a percentage, but I did see what I missed here and there. Two of them concerned me in particular. Because one I felt was completely right. On one my denominator was off one from what she had. I knew I had no problem in doing it. I thought I had nailed it. She acted as if I blew it completely. Two questions later she was about to say the same thing when I pointed out to her that her solution key was wrong. It was supposed to be 7 instead of 14. So she had to correct the answer key. I was right and she was wrong. So now I'm thinking we should go back and review that other one again. And sure enough. So everyone she had graded before me got the answers right or wrong depending on how they answered them. So I felt pretty good about that. (7/18/98)

Melanie
Our instructor has a policy that if we correct him in class while he is doing problems, we get 2 extra points if we notice it first. So far, I've gotten quite a few bonus points. (8/14)

But there are only about four of us in the class that actually answer questions. I answered his questions all the time. (Focus Group, 2/13/99)

Table 4.3: Indications of change in participation: Interaction with instructor(s)
Amy’s first quote speaks directly to her willingness to ask questions in class without the fear of ridicule she felt in the past. Her statements lead one to believe as in Amy’s case, it is her right to ask these questions and that now is the right time to ask the questions. She no longer fears the possible looks and or under-the-breath comments that at some stage led her to stop asking her questions in the first place. To remember where Amy began in the ninth grade, being told to sit in the back and “be quiet,” and to look where she is now represents a wonderful transition.

Amy’s remaining two comments point to her willingness to confront an instructor regarding two particular issues. The second quote relates to a situation where she felt so confident in her efforts on the word problem portion of a test that she wanted to know now how she had done. The key here is that in essence she already knew that she had done well and wanted that reinforcement not only for herself but also as a demonstration to her teacher that she could understand the mathematics in spite of the teacher’s perceived inability to teach.

The third quote references a situation that arose prior to the second midterm in her Math 104 class. Due to the need to have surgery she was going to need to adjust when she took the test. The instructor was trying to be sympathetic and in essence let her off the hook by suggesting that she not worry about taking the test. From Amy’s response, it can be seen that she was infuriated by this suggestion and demanded that she be given the test so that she would have “a measure of her own growth.”

Mark had become somewhat infuriated by his Math 104 instructor during Summer 1999. He had reached a point in the course where he had lost complete confidence in his teacher’s ability to teach the course and had therefore taken charge of
his own learning. In the first instance, the instructor was performing a word problem on
the board that he had complete confidence in solving, so much so he solved it in a matter
of seconds. He further demonstrates his confidence by stating what the correct solution
should be.

Mark’s second quote deals with his observation of the instructor grading his
midterm. In this case, Mark again confronts the teacher regarding what he perceives as
incorrect solutions on her part. Upon further review, Mark’s perceptions prove to be true.
He had so much confidence in his results he was willing to address these with the teacher.
Mark notes later that he had “never stood up to a math teacher like that before.” The fact
that he knew he was right and was able to point that out to his instructor not only added
to his confidence level, but it just felt good.

Melanie’s comments seem less dominant than those made by the other two
participants. However when they were delivered, the smile on her face and the sense of
pride she showed when delivering these lines exuded confidence. Melanie had shown
with pride in her ability to ask and answer questions in class. As she noted later in the
focus group interview, “It was probably the first time in a math class where I consistently
asked questions in class and was willing to answer questions also.”

Comparison of self to others. Recall that one key source of self-efficacy is
vicarious experience. By observing other students within the class, students can
persuade themselves that if others can do it, they too should be able to achieve at least
some improvement. In the same sense, observing others perceived to be similarly
competent fail despite their good efforts can lower the observers’ judgments of their own
capabilities.
In the case of the three participants in this study, a significant change occurred with respect to each regarding the vicarious source. Each student became more aware of those students around him or her. Each became more aware of others' successes and possible frustration. Each began to compare themselves to others as to how they felt they were doing with respect to others in the class. The reactions of others in some cases gave the participants an added boost.

In Table 4.4, representative samples of quotes with respect to this vicarious source of self-efficacy can be found.

Each of the participants in this study has become aware of other people in their math classes in a way that they had not previously. Each has begun to analyze actions and reactions of other students in their math classes. Each has come to realize that in many ways they are not unique in their highs and lows with respect to their mathematical setting.

Mark, in particular, credits CHAMP with allowing him to focus more on the other people in the class. His observations not only center on watching their reactions and the types of questions they asked, but also allows him to observe other student's expressed levels of confidence, or as the case might be, lack of confidence. Mark has learned that by watching others and judging his levels of arousal or frustration levels against theirs it in some ways has allowed him to feel more confident about his own abilities. When others are frustrated and he is not, it actually boosts his confidence level. Mark feels that if these other students were exposed to CHAMP that they too would understand the importance of remaining calm and instead of worrying about each individual step in a particular problem that each should focus on the big picture.
### Indication of Change

1) Awareness of confidence/lack of confidence when observing others

<table>
<thead>
<tr>
<th>Amy</th>
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<tr>
<td>We were all nervous. I was really nervous by that point. I knew I studied. And then I heard all this frustration going on around me. (8/26/98)</td>
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<th>Mark</th>
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<tr>
<td>Another thing that [CHAMP] helps with is recognizing in other people in your class and reading the class as a whole. And reading individual students and watching their reactions in class. And watching their outcome in class. And listening to the types of questions they ask. Seeing when they are frustrated, seeing when they are confident. (Focus Group, 2/13/99)</td>
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Without having done [CHAMP] I would have sat in a class like 050 and thought that I'm isolated. No one else here has a fit. They are all studying more than I am. And they're all doing better on their homework and getting better grades. I can recognize it in their body language, by their actions. And that actually makes me calmer and more confident because I am watching them freak out. But all the time I have taught myself that I will get it in the end. Even if it takes 18 steps, I will get the big picture. Everyone else is so focused on the individual steps that they lost it after the first 5 steps. If they would have had CHAMP, they would be sitting here like me—calm, confident I will get it in the end. (Focus Group, 2/13/99)

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<th>Melanie</th>
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<td>I went through that. I see people in my math class, they ask the same questions that I'm thinking in my head or that I've asked, you know like I will ask a question and there will be people all around me saying, “I was going to ask that same question.”</td>
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In 050 I had the fear that everyone had better grades than me, everybody else is studying more than me. But I see it as I'm going on, especially in 104. I mean I see the other people around me and I see like we have the same questions, we have the same reactions on our faces when he would put something on the board. (Focus Group, 2/13/99)

Table 4.4: Indications of change in participation: Comparison of self to other students

Through his observations Mark has determined that he is not really unique or isolated from others. Like Mark, Melanie's observations have led her to the same conclusion. She has discovered, comparatively speaking that she is really no different
than the other people in her class. They have the same questions, the same reactions that she does. This too has had a calming effect on Melanie.

**Changes in Preparation**

To be a successful participant within a classroom, one must be successful in their preparations outside the classroom. Numerous changes were noted in each participant in how they prepared for class and more explicitly how they prepared for quiz and test situation.

Any athlete will tell you that to be successful in competition one must be successful in preparing for the competition. It is during this preparation time that athletes hone their skills. It is also during this preparation time that they analyze their own progress toward meeting their goals. A good athlete is analytical regarding his/her preparation, constantly seeking out what he/she is doing correctly and incorrectly.

Within the preparation process, athletes will begin to focus their attention on those things needing improvement. This continual cycle of analysis, adjustment, and improvement raises the confidence level an athlete has regarding his/her own abilities.

Just as an athlete will pick up on their own tendencies through the preparation process, close analysis of an opponent will expose certain tendencies within that opponent. For example, an opposing football team might run only certain plays out of certain formations or a pitcher will usually throw a certain pitch when the ball and strike count is full. By analyzing an opponent and picking up on these tendencies, an athlete or a team can better prepare for those particular situations. Their game plan takes each tendency into consideration. In the same way, mathematics students can look for these tendencies in what the teacher says or does within the classroom, or from a previous test.
Better analysis of these tendencies leads to better preparation. This better preparation in turn leads to greater confidence in their own mathematical abilities. Therefore, in the establishment of their mathematical “game plan,” these items too can be taken into consideration.

The changes in preparation each student demonstrated through the study will be addressed in two ways:

1) Participants were more focused
2) Ability of the participants to control emotions

These changes will also be addressed through the use of narrative tables.

**Participants were more focused.** Just as athletes must hone their practice skills so too did these students begin to hone their practice skills. In the process of honing these skills, the participants began to analyze what they knew and what they did not know and in turn focused their attention on what they did not know. By focusing on what they did not know and making improvements in these areas, the students too became more confident in their abilities. In the process of focusing on what they knew and what they did not know, the students also became more aware of the common mistakes each often makes. The ability to focus their attention on those items that needed improvement created a much more efficient use of their time and effort. As a by-product of this preparation, the participants also began to analyze more carefully the actions and statements made by the instructor(s) of their given classes.

In the Table 4.5, quotes offering evidence of each student’s ability to focus are displayed.
<table>
<thead>
<tr>
<th>Indications of Change</th>
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<tr>
<td>1) More focused on what each knew/didn’t know</td>
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<tr>
<td>2) More aware of common mistakes</td>
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<tr>
<td>3) More focused on what instructor saying</td>
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**Amy**

It was being able to reappraise what was going on as we were studying it, it was elimination. And it was wonderful. Being able to take all the cues that they were giving and paying attention to it so you knew what to eliminate. (8/26/98)

With word problems, if we got tested on one I studied the remaining ones. And what we didn’t get tested on, I had to relearn it and relearn it. Not like relearn it, but review it over and over again until we were tested on it. And so my information base just grew. So it’s a game I love to play now. I love to go to class and pay attention to what that teacher is really saying, instead of what he is saying. (Focus Group, 2/13/99)

My preparation has become more efficient. I get down to what I don’t know. (8/26/98)

I decided in 075 I was going to concentrate on my signs, then math would be fine. So I gave myself permission to know that I can do math, but I have to pay attention to the details. (Focus Group, 2/13/99)

**Mark**

I am now more aware now of the particulars of what I need to look at. Like I know exactly what I don’t know. And that really makes what I need to work on and look at easy. (8/25/98)

Being able to take large sweeping areas of your notes and go, I don’t need these. I know how to do all of this. I won’t even need to study these five pages of notes. That’s a big confidence boost. Yeah, you’re minimizing it down into a smaller size area and you’re actually pinning down the stuff you don’t know. (Focus Group, 2/13/99)

**Melanie**

I want to be more prepared for this test than the last test. The instructor usually goes through easier review questions then puts more difficult ones on the test. Part of being prepared is looking through the more difficult problems throughout the book. Because the ones he put on the last test were not the ones he covered so well in class. (8/11/98)

I have really heightened my awareness with respect to signs. (8/24/98)

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Table 4.5: Indications of change in preparation: Participants were more focused

Each of the participants in this study has adjusted their focus. In the past each, by their own accounts would study everything over and over again when preparing for a quiz or a test. Now, instead of studying everything, each has learned to focus on what “they know and what they don’t know.”

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Mark clearly states in the representative quotes that this is now how he prepares for his classes. For him, having the capability to “pin down the stuff he doesn’t know” has created a confidence boost. For him, it has made the preparation for tests and quizzes manageable. Amy also supports this way of thinking and in so doing notes that her preparation for test has become much more “efficient.”

In these cases, each of the participants has analyzed their own preparation by looking at their own previous tendencies and making adjustments in those tendencies. In reading Amy and Melanie’s comments, we see that they also look at the tendencies of the instructor when preparing for their test or quizzes. Melanie has learned that she must look at some of the more difficult problems in her text and not simply rely on the “simpler” ones her instructor uses for review. She has learned from experience that his test questions have the tendency to represent the more difficult questions from the book.

Amy has taken this philosophy one step further. Although it may not be evident from these sample quotes, Amy has taken the establishment of teacher tendencies to a new level. She has discovered that by closely listening to what her instructor is telling her in class, she can judge as to what type(s) of word problems will appear on a given test. Beyond that, she has also discovered that once a particular type of word problem has appeared on a test, it will not reappear on another test. So once a particular type of problem has been tested, she knows in the future to focus her attention on other types of problems. To her, this has become a game.

Amy has discovered that cue cards and cue words have created a profound advantage in her ability to prepare for class, and in particular tests. Amy was using cue cards long before her introduction to CHAMP. In Math 050, she would write everything
on cue cards (definitions, sample problems, etc.). Upon completion of Math 050, based on her own estimation, Amy had in the neighborhood of 300 note cards. In stark contrast, by the time she was preparing to study for Math 104 final, she had narrowed the focus of her preparation to a mere 15 cards. She did this by constantly evaluating and re-evaluating what she knew and what she didn’t know. As she became confident in her ability to perform certain types of problems, she would eliminate the need for that particular card in her stack---if she was already confident in her ability to do a particular problem, it was not necessary to keep studying it over and over again.

Cue words have proved fruitful to Amy as well. She constantly struggled with her inability to remember to check her signs (positive or negative) within certain types of problems. Therefore, she created a cue word statement to “remember your signs.” Melanie had previously experienced similar problems with respect to her ability to handle signs. She also found the use of cue words helpful in reminding her to check her signs.

Often times it is not enough to focus purely on the tendencies that we have exposed in ourselves or in our opponent (in this case, the teacher). It is also important to focus on the emotional side of preparation. If an athlete is physically prepared for competition, but not mentally prepared for competition, performance will suffer.

**Ability to control emotions.** Each of the participants experienced various levels of anxiety with respect to his/her given class in general and with respect to testing in particular. Each was seeking out ways to reduce this anxiety if possible.

One particular issue created the most anxiety within all three participants. From the early stages of this study, each of the participants had addressed a key element in how the teacher conducted the class the night of a test or a quiz. In all cases the
instructor first continued with new material for the evening, then took some review time for the test or quiz, and finally ended the night with the quiz or test. In all cases, each of the participants was frustrated by this approach. Each felt this delay in testing created undo anxiety with respect to the testing process. Each would have preferred to take the quiz or test first without covering new material or reviewing. As was the case in all three situations, none of the teachers was willing to adjust this policy, so it was up to the individual participants to prepare for this inevitable situation.

From Table 4.6, it can be determined that both Amy and Melanie have demonstrated their ability to control their emotions with respect to test taking. In Melanie’s case, she has relied on creating a much more positive attitude regarding tests. In the past, she would often tell herself she was going to fail a particular test or that she hoped she did not fail the test. Rather than focusing on failing, she now focuses on doing the best she knows she has prepared herself to do. Positive affirmation statements have now become a part of Melanie’s vocabulary. Phrases such as “I can do this” and “I have worked hard and am prepared to take this test” have now replaced the more negative “possible failure” comments.

Amy has taken her positive attitude to a virtual arrogance stage. She has become so confident in her abilities in preparing for tests that she is somewhat overconfident in her thinking. This for some students can be dangerous. Some students are overconfident and therefore do not put the same effort into their preparation for a test. For Amy, however, she is confident because of her efforts in preparing for the test. She is hanging her confidence on an extremely stable factor—effort. Also in Amy’s case, she has formulated a personal competition between herself and her Math 075 instructor.
Indications of Change

1) Emotions with respect to class/tests
2) Mentally prepared for test review

Amy
I am no longer nervous when I take a test. My self-image now is one of arrogance. And I just sit there and take my test. I feel good. It is a cleansing moment. I feel better. (8/26/98)

We are still taking quizzes at the end of class. After we have learned new material, reviewed what we did in the class before, and now we are taking a quiz from two classes before that. I used to be totally confused, totally frustrated, mad. I feel that I have given myself the confidence to walk away, forget the frustration, start over, pick up the book, do it yourself, come to class, be as prepared as you can get, and I have been my own enforcer. So regardless of what stuff the teacher pulls, I am confident I am going to get it. (8/14/98)

Mark
Now I am pretty calm prior to and studying and all that stuff and being calm about going to take a test. It is almost laziness to a degree. In the same sense, I still can't get past that initial shaham of I'm here in my seat. It's time for the test and he won't pass out the test. In some cases I am still kind of jittery in that situation. But I know what is coming. I am prepared for it. (Focus Group, 2/13/99)

If I am getting it, I may study less—because I understand it. And when it comes time for the test, I sometimes take the approach that if I don't know it by now, then I'm not going to know it. That may sound negative or defeatist, but it isn't to me. It's more of a ... it's time to focus and take the test and stop worrying about preparing for the test ... it's a changeover. It's a mental gearshift. It's not that I'm going to forget between the review and now...and the review might actually help me to some degree, but I'd rather just go ahead and take it now because I have shifted gears. (2/13/99)

Melanie
I think I am more positive now than before. I mean I used to go into a test and I was like if I didn't know something, it was I am going to fail this test or something like that. I am trying to get that out of my mind and not say that and be more positive in that respect. (8/11/98)

The reviews before tests were always a pain. I just wanted to get in there and take the test. It seems that I was always getting confused if I listened to his explanations after I had already determined my own. So for the third test I worked on that too. Ok, I know what he is going to do. I envisioned it happening. I know this is something I had to overcome, so I mentally rehearsed before the test...saw him reviewing before the class. I even rehearsed questions I might ask him. That seemed to really help. (8/24/98)

But now I know they are going to ask questions before the test and I have pretty much prepared myself for that. But now I am starting to look at it as a positive. I just focus on answering his questions and looking at that as positive feedback. I don't feel as nervous about it anymore. (Focus Group, 2/13/99)

For the first two midterms if I went into the classroom and was unable to sit in the same area where I normally sat, I could not focus. I just could not do it. And I have gotten a lot better on that. I mean I can walk into a classroom and if I don't sit in the same seat, if I don't sit in the same section, it's a lot different now. It doesn't bother me as much. (Focus Group, 2/13/99)

Table 4.6: Indicated changes in preparation: Ability to control emotions
She has virtually taken the philosophy that if you are not going to teach me, then I am going to teach myself and I will show you what I can do.

For Mark, he has become extremely calm regarding testing and in his case there is the risk of becoming complacent because of it. He has on many occasions noted that as he is approaching a test, he reaches a point where “I just can’t cram any more in.” He reaches a point where his “preparation time” becomes “application time.” In Mark’s mind, once he has crossed into the application time mentality, there is no turning back—“you either know it or you don’t.” For Mark, once that mental gearshift has been engaged, he wants the test and he wants the test now. Because of this, he still harbors some displeasure with the fact the teacher would not pass out the test immediately. He notes that he is still “kind of jittery in these situations.”

Through numerous conversations, Mark has come to realize that with respect to competition, in this setting with respect to testing, some anxiety is a good thing. As discussed in Chapter 2, peak arousal represents a worthwhile aid in competition as well as test taking. It is when students have too little arousal (overconfidence or lack of caring) or too much (arousal becomes debilitating) that the most problems are created. The right amount of arousal can be extremely beneficial.

Melanie has decided to take a “if you can’t beat them, join them” philosophy to the review process before each test. Rather than focus on the negative aspect of the review, she has decided to focus on the positive aspect of the review. She has discovered that by actually answering the questions as part of the review offers her positive feedback to her preparation and in turn further instills confidence in the fact that she has prepared appropriately for the test and is indeed ready to take it. Mark also eventually took this
join in approach, but never quite reached the same level of comfort in this setting that Melanie did.

Melanie’s biggest fear continues to be whether or not she sits in the same seat for testing that she has sat in throughout class. When not given the opportunity to sit in the same seat, her “focus points” change. Her ability to recall things she has studied in class becomes somewhat muddled. As she progressed through the study this worry diminished and became less of one. She began to use mental rehearsal as an aid by visualizing what she would do if her regular seat were not available. Over time, this became less of an issue in Melanie’s mind.

**Changes in How Students Viewed Word Problems**

Through the training process, word problems-in particular, combination problems- became the focus. As each participant entered the study, each had some misgivings about word problems in general. Recall in their initial profiles how each participant rated word problems of these types low on the Mathematical Self-Efficacy Scale.

As each participant became familiar with these problems through the training experience and their use of these problems in their respective mathematics course (Math 075 or Math 104) a definite change in how they viewed word problems took place. There existed a definite change for the better in their level of self-efficacy with respect to word problems.

Representative samples of comments each participant had with respect to word problems can be found in Table 4.7.
### Indications of Change

1) **Confidence in ability to solve word problems**

2) **Began to enjoy solving word problems**

#### Amy

On the last test I was having a ball with word problems. I told myself the steps. I sat there and I giggled my way through those four problems. I sincerely had more fun going...the first equation is in the first sentence. Ok, the second equation is given. Ok, now the formula we are missing is in that third part. And then I would go, remember work the first one on the left, and the second on the... I mean I was treating myself like I was some two-year-old. But I was having a ball. (8/14/98)

I think if I hadn’t had CHAMP intertwined in with the word problem sessions that we had, that I wouldn’t have felt good about myself doing extra word problems on the side. Because it was like a dreaded process from beginning to end until I started gaining confidence. (Focus Group, 2/13/99)

In terms of math and how I use this, it became a game. I was able to like chart and it was really fun. (Focus Group, 2/13/99)

I am not inhibited anymore. Not at all. But I don’t think that if you would have just sat there and taught me how to do word problems, I don’t think that knowledge would have been as growth oriented as the whole process was. (Focus Group, 2/13/99)

#### Mark

In the last class we started to work on word problems similar to the ones we used in here. And I had a chart drawn and spit out an answer before she [the instructor] was even done writing it on the board, which I thought was kind of fun. And nobody else in the class drew a chart and nobody charted anything. The teacher does most of it in her head. I can’t begin to understand how anyone else understood what she was doing. To me, I’m just organized...and there is the equation. It felt good. (7/16/98)

CHAMP did boost my confidence in my ability to do word problems and I can tell you now I don’t worry about them as much. I guess I can find the math in them a heck of a lot easier now. (Focus Group, 2/13/99)

#### Melanie

I do all my story problems. I think I have gotten so much better on them alone. Just placing them where they need to go and looking at different ones. (7/22/98)

I think that is a big thing with a lot of people. I think word problems are honestly the hardest things. With a word problem setting it up is the hardest point to do it, is to try to find the equations from it ...and I know for a lot of people that is their biggest problem. But for me now, I look for them on the test. I do look forward to them. It is almost like, give me a word problem, I dare you. (7/22/98)

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**Table 4.7: Indicated changes in how students viewed word problems**
Word problems were a very important entity to this study. It was through word problems that the participants had the opportunity to be introduced to CHAMP. As mentioned previously, it is the philosophy of the researcher that by using word problems as a training device, there should exist a residual effect on mathematical self-efficacy. Melanie gives some added insight into this philosophy. She notes that she believes that word problems are the hardest things for students to understand. By allowing these participants to become successful in the one item that most students at this level find to be the most difficult, this should have a carry-over effect into other portions of mathematics and possibly into completely other areas.

From the comments listed above, it can be seen that each of the participants has a much greater confidence in his/her ability to solve word problems. What is equally important, at least for the purpose of this study, is that each of the participants to some degree attributes this newfound confidence to CHAMP.

Most students would say that the hardest part of doing word problems, especially those classified as combination problems, is the set-up of the problems. In each case, the participants has reached a point that they are so confident in their ability to do word problems that it has actually become fun. Phrases like “I was sincerely having fun,” “I was having a ball,” “It felt good,” and “I do look forward to them” are not typical comments one would normally associate with word problems. However, as the training period progressed, these were the types of phrases that became commonplace when these students described their experiences with word problems. As demonstrated earlier, especially in Mark’s case, word problems represented games to these students. Mark loved to challenge himself in the classroom and attempt to beat the teacher to the punch
when it came to word problems. It became a sort of a competition for him. Melanie reached a point where she actually looked forward to having them on tests and virtually dared anyone to put a word problem on a test that she could not answer.

Of all the changes mentioned here and the ones not mentioned here, the impact that CHAMP has had on each participants’ ability to do word problems might prove to be the most significant. If students can become proficient and confident in their own abilities to do what is generally considered to be the most difficult form of mathematics for students at this level, then that can only help to increase their confidence with respect to things that are not as difficult.

**Summary**

The changes discussed in this section occurred both in an outward fashion, as well as inward fashion. The discussion of changes in participation represented physical, outward signs that each student was becoming more confident in his/her own mathematical ability, especially in the ways that each began to interact differently with other students and the instructor.

In the area of preparation, both inward and outward signs were present. The way each participant physically prepared, especially for tests and quizzes, had changed. When studying for these tests and/or quizzes, each began to focus on those problems that each student knew he/she needed the most work with. This could only be accomplished by carefully analyzing what each student knew and did not know. This process of analysis involved a great deal of reflection, making it an inward process. This preparation also centered on each student’s ability to control his/her emotions and finding the correct level of arousal needed to be successful. In some cases, this had less to do
with the test and/quiz itself and more to do with the organization of the class around the test and/or quiz.

The ability of students to solve word problems generally constitutes one of the least efficacious activities students perform in mathematics. The ability of these three individuals to be able to confidently solve word problems helped to create a cycle of ongoing success and raised self-efficacy.
**Internalization**

[CHAMP] is engrained. And I don’t think about it. Sometimes I have to think about it in depth to actually realize that I am actually using it. (Mark, Focus Group, February 13, 1999)

I use all the components of CHAMP. I use more of them than I do other ones. I know there are some that I know I need to work on and stuff like that. (Melanie, Focus Group, February 13, 1999)

I had no idea I had learned all of that. I came up with this diagram to allow me to stay focused on cue words, on cue patterns, being able to control the arousal and keep going forward no matter what. Because it has been every quarter I seem to have one or two more classes that I actually come up with ways of making my life so much more tolerable [by using CHAMP]. (Amy, Focus Group, February 13, 1999)

In the previous discussion, each participant’s changes within mathematical self-efficacy were documented in his/her own words. As a researcher it was also important to focus on how each student came to understand CHAMP and make it his/her own. As is the case with any mathematical setting, each student brings a slightly different perspective to the mathematical setting and that perspective in turn helps determine how each student comes to understand the learning of mathematics. In the same way, each of these subjects came to the study with different perspectives. To truly come to grips with anything learned, students must internalize the information and understand it in their own terms. In this study, Amy, Melanie, and Mark each brought a unique perspective to his/her own understanding and subsequent use of CHAMP. That is, for each CHAMP had become engrained, but from slightly different perspectives and at slightly different levels.
In this discussion, three specific areas of demonstrated internalization of CHAMP will be discussed. In the initial section, each student’s own reflections of CHAMP will be addressed. In this section the discussion will center on each student’s awareness of the portions of CHAMP they were already using prior to the beginning of the study as well as the components of CHAMP each started to use consistently. The second section will look at the effectiveness of the use of the various portions of CHAMP. In this section, the researcher will demonstrate how each student began to use techniques of CHAMP naturally and effectively. As with mathematics, the greatest reinforcement of one’s own understanding of a particular topic is having the ability to teach or train someone else about that subject or topic. Each participant demonstrated at various times the ability to teach others regarding CHAMP. Therefore in the final section, each student’s ability to teach someone else regarding CHAMP will be documented.

**Reflection on CHAMP**

Throughout this study, the participants became extremely reflective regarding the techniques associated with CHAMP. As the study first began and throughout the initial stages to the training process, the participants were periodically asked to stop and reflect on their understanding of the various techniques of CHAMP. Questions directly centered on this were often asked within the early stages of the study. As time progressed, the natural conversations that took place between the subjects and the researcher resulted in the obtainment of this same information without prompting from the researcher. In other words, their ongoing reflections became non-solicited information.

Through these reflections it was possible to determine a few key outcomes that were taking place. First of all, each student became aware that he/she was already using...
certain techniques contained in CHAMP. It was also through this reflective process that each participant began to focus more heavily on certain components of CHAMP—those components each deemed more beneficial to their own situation. Through that focus, the concept associated with thinking of CHAMP as a toolkit rather than a kit became more and more evident.

Awareness of CHAMP Techniques Already Being Used

In the early stages of the training session regarding CHAMP, it became increasingly obvious that each of the participants had previously used components of CHAMP, but did not realize it until discussions regarding the technique(s) had taken place. Amy had extensively used note cards in the past, so this created a nice transition for her with respect to the cue cards. In Mark’s case, self-talk was something that he had used previously, but had not really thought about it. Mark also discovered that he had some previous experience with cue words and in the area of mental imagery, especially with regard to mental rehearsal. Melanie had previously been a swimmer and high school swimming coach. From her athletic and coaching experience, Melanie had previously been exposed to some of the techniques presented through CHAMP.

Amy Jenkins. As mentioned above, Amy had her greatest experience with the use of note cards. The following quote explains where she gained this previous experience.

When I started back to school I had Cultural Anthropology at Marion. [The instructor] had taught me, which had never known how to do before, how to use the flashcard and how to put a definition down that made sense to me, not what was in the book, but what made sense to me. In math, I knew I might have to do it like I did in Cultural Anthropology. So I was prepared. So when I left class I immediately started Xeroxing part of the book and cutting it up and putting the books terms in front of my terminology so I could get to the point where I could
separate the two card piles and I didn’t have to use the books words, I could learn just my own. (Interview I, July 1, 1998)

Amy’s previous exposure to the technique of creating flashcards as outlines representing her notes and information gleaned from the textbook became a launching pad for Amy with respect to the use of cue words. As will be discussed in greater detail later in this chapter, Amy was able to take the concept associated with the flashcards and analyze it using the conceptual understanding of cue words within CHAMP to create what turned out to be the most beneficial component for Amy. She used this concept to not only prepare for mathematics quizzes and tests, but also used these concepts in other classes and beyond. Amy truly took the concepts relating to cue words and attempted to find the practical application of them in virtually everything she did, both academically and outside the academic arena.

**Mark Tanner.** Throughout the study Mark had a unique perspective. He was extremely thoughtful regarding everything being discussed throughout this study. This might explain why Mark’s transcripted interviews represented approximately the same number of pages as the other two participants’ transcripted pages combined.

In Mark’s case, he was constantly noting situations where he had already been doing various components of CHAMP, but had not either thought about it in general or had not thought about it in the way it was discussed in this setting. In the following quotes, we see evidence that Mark was already aware of his previous ability to use self-talk, positive affirmations, and mental rehearsal.

Because I started looking at things and finding, ya know, gee that’s funny, I already do self-talk...I never thought about it before. I guess I already do and I didn’t even know it. And cue words...yeah, I’ve been using cue words for years and I never even realized I was using cue words. I mean I associate things I find difficult to remember with odd phrases. (July 28, 1998).
I dealt with the affirmation idea before. I can’t say I’ve ever been heavily involved in practicing it. I read somewhere about affirmation cards. Actually writing affirmations on index cards and reading them in the morning when you get up and reading them before you go to bed. I don’t think it is a bad idea. I don’t have any preconceived notions about affirmations...because I never really practiced them. (July 9, 1998)

A friend of mine who is a tennis instructor taught me [about mental rehearsal]. He never mentioned recalling previous experiences as successful, but he mentioned visualizing himself doing well and how you were going to do it and what it was going to be like and how wonderful it is going to be and how great to work out and you are going to then just go up there and do that. Do it the way you envisioned it. It actually works to a degree. (July 9, 1998)

I mean I’m aware of them and I’ve used them in the past, but I’ve never done it so regularly that I’m set in any kind of mode with it. I think that it is probably best to start from scratch with this type of thing. Besides there never was any science to what I did, I mean I just had [my tennis instructor] tell me, hey, why don’t you try this...this worked for me when I’m playing tennis. But this is obviously a little bit more thought out and there is a lot more information available to me so...this information would make it possible that this route might be more beneficial because I have more to base it on as opposed to just assuming what the heck he meant and just trying it. (July 14, 1998)

No, the rehearsal is what I was doing before I ever met up with you. So that is interesting. I didn’t foresee of us going toward that, so you kind of surprised me with that. I thought we were going to stick mainly with recall. So that’s cool because I’ve done that. (July 16, 1998)

Now somebody like myself have maybe thought of some of these ideas already. I was involved in sports and I don’t know if that is where that came from. And I’ve worked in a lot of artistic fields and I’ve taken a lot of jobs that require a lot of mental fortitude and physical fortitude. (July 16, 1998)

Mark, more than the other two participants was able to pinpoint his previous experience with respect to some of the components of CHAMP. Beyond his realization of his previous use of CHAMP, two items were of particular interest to the researcher. First was Mark’s realization that something he had experienced in the past in a non-mathematical setting could actually be tied to a mathematical setting. He felt that it was
"interesting" and "cool" that he already had some knowledge regarding these techniques, but it was also "interesting" and "cool" that they could be applied to mathematics.

Mark also became reflective regarding where he might have developed some of this pre-existing knowledge, and he attributed it to some previous experiences that took not only physical fortitude, but also more importantly mental fortitude. From this previous experience, he could see that although he had some familiarity with each of the aforementioned components, Mark saw the benefit of looking at these in a more formal "thought out" manner. From that perspective, Mark felt that more could be gained than simply "trying" something a friend mentioned in passing. As is always the case with Mark, the formalization of these techniques helped him to understand why these various techniques work.

**Melanie Lake.** Melanie too had developed some previous awareness regarding certain techniques associated with CHAMP. Much of Melanie's previous experience was associated with her swimming and coaching experience. Also, Melanie made trips to northeast Ohio at least two times a month. These trips allowed Melanie time to reflect on various assignments that were due and to some extent think through some of them in her head. In the quotes that follow, there exists pre-existing awareness regarding such CHAMP techniques as mental rehearsal and recall, focusing on the here and now (goal setting) and arousal control.

> When driving home to Cleveland I often will run through everything I have to do in my head. I do homework in my head. Think through different assignments that are due. (Melanie, August 5, 1998)
Like I try to see where it was on the board and what part of it that I understood. I am real big on focusing on where I saw it, like on the page. I know it was on this page and down at the bottom, in a little corner. I mean if I review something and that is what I focus on. (July 22, 1998)

I would work on a particular stroke that I think needs improvement. And I would mainly work on, I mean I had a very strong kick. So I worked more on my arms and the placement of my hands and literally bringing my thumbs and dragging them down my stomach just to make sure I am pulling all the way through.

Well I continued practicing that stroke, but than I went, just completing an entire practice and making all the send offs. And I swam with people that were faster than me and I think that pushed me a little bit more. And trying to, not needing to be as fast as them, but trying to keep up with them and each day trying to improve to where I could get to the wall and rest for two seconds before I would have to go again. And build it up until I got to that point. So I guess it was to complete the sets and to do my entire practice, and not miss a point of it. (August 24, 1998).

Something I learned from swimming was to take deep breaths to calm myself down before a competition. That was really how I tried to get myself through it. (July 22, 1998)

Melanie’s first two quotes are related to the two components of mental imagery. In the first quote, Melanie discusses her frequent trips to Cleveland. During those trips she often would think through her homework or different assignments that are due. This represents a form of mental rehearsal. Her second quote deals with mental recall. Melanie mentions that she has the ability to remember where she saw a problem, either in the text or on the chalkboard. By recalling where she saw the problem, she has the ability to better focus on that type of problem.

The final two quotes center on Melanie’s swimming experience. The first deals with her ability to establish goals for herself. Here, Melanie discusses various goals she had set for herself with respect to a particular practice she was describing. The goals mentioned here are in line with the concepts associated with the Here and Now aspect of CHAMP. In her description, she focuses on short-term, realistic goals (placement of
hands, making all send offs in a single practice, trying to keep up with the faster swimmers). Another important aspect of her statement is her focus on improvement. From this focus on improvement, Melanie already understood that goals are much more achievable if the focus is not on the outcome, but instead on a natural increment of improvement.

Finally, Melanie addressed another key component of CHAMP—arousal control. Melanie noted she had already developed a good technique for calming herself before a competition. The use of deep breaths is a standard practice for arousal control. This previous awareness of how she had the ability to calm herself prior to a swimming competition proved to be a fruitful technique for Melanie when it was necessary to calm herself before mathematics exams.

**Toolkit**

As this study began, the researcher had developed a sequential approach for introducing and developing the techniques of CHAMP, which worked extremely well in the training process. It was being presented in the form of a kit—do this first, this second, this third. Each participant was asked to practice the various approaches as if they were tied neatly into one package. After the training portion of the study was completed, the researcher began to experience some discomfort with the “kit” approach to looking at the concepts.

As time passed, it became apparent that each participant began to focus more and more on those areas of CHAMP that each deemed to be most helpful to their own situation. Each reached a point where they no longer practiced the sequencing developed in the training component, but instead applied what they needed to their own situation.
By applying the techniques needed to their own situation, each naturally became more proficient with these techniques. This natural incorporation allowed each participant to internalize each of these chosen techniques.

Mark's focus, for example, became directed toward rehearsal, arousal control, and goal setting (focusing on the Here and Now). Amy continued her work with cue words but spent a great deal of time on positive affirmation and issues related to recall. Finally, Melanie continued her practice in the area of recall, but also began to focus her attention heavily in the areas of positive affirmation, rehearsal, and the use of cue words.

It was not until a conversation with Mark on July 28, 1998 that a proverbial light bulb came on with respect to how the participants were beginning to look at CHAMP. In essence, most of the credit should be attributed to Mark, for through his eloquent discussion, the "kit" (step-by-step) philosophy to CHAMP was shelved and replaced by the "toolkit" philosophy. It was through Mark's moment of reflection that the word "toolkit" was coined as the most appropriate way of describing CHAMP.

I have been making the attempt at thinking about [CHAMP] and thinking about the process. And that is having a positive effect on what I am doing because if you think about how you, if you start to ponder how you think about things and how you approach things and how you approach nervousness and confidence... And you start to pick it apart to find out what ticks.

Well, I've kind of been doing a lot of this all along, maybe not to the best degree, maybe not in the best way. For me the most beneficial aspect of this is not necessarily that I am learning a process for overcoming anxiety and developing confidence in math or stressful situations in general. I think it is rather, at least with me personally, it is rather that I am learning more about the ways that I am already doing this. I am learning...I am looking at this as more of a toolkit.
I am being handed a toolkit to work on the process. I am not necessarily being handed a process. And I think that is going to be a key factor in determining how this is put together to give it a general appeal to people. Because some people are not going to have the process. They are going to need the process and tools to work on it. Some people are already going to do this to an extent. So they are going to just need the tools.

I don’t know if it is important that you use all of these exact steps, but it is important that all of these exact steps are pointed out to you so that you can look at them, just like you look at a problem, when you look at all the steps you took to solve a problem.

I think it is important to me as a tool kit. That’s what it is. I mean it gives me a means to diagnose problems in my preparedness, to diagnose problems in my confidence. (Mark, July 28, 1998)

It was with that conversation that the perspective of the study changed somewhat. It is important to make this distinction clear. A kit is something that is packaged in such a way that in order to create the end result requires a set of step-by-step procedures and/or instructions. For example, if one were to purchase a model car kit and attempt to put the model car together, a clearly defined ordered set of procedures are needed in order to complete the car. On the other hand, a toolkit represents something that a person uses on an as-needed basis. If something is broken or not working correctly, a tool is needed to help fix it. In addition, when one has a sufficient toolkit, the best tool for the job is used. One normally would not use a pair of pliers to hammer a nail. So as the study continued, CHAMP no longer was looked upon as a kit that consisted of a step-by-step process, but it instead was look upon as a toolkit – something that was used as needed and focused on the right tool for the job.

After this conversation with Mark, each of the other participants were asked if they too felt this “toolkit” philosophy better described their view of CHAMP rather than the sequential “kit” thought process. Both Amy and Melanie agreed with this
philosophy. Each noted that for training purposes that the order of the training was useful and appropriate, but each felt somewhat pressured to continually practice certain techniques they felt were not directly tied to their immediate needs.

I don’t feel I need to use them in that order. And there are some things I know that we noticed that I did not use and stuff like that. My big thing is I don’t praise myself, so that was one area I really worked on. (Melanie, Focus Group, February 13, 1999)

I would agree with that one. A tool kit would be great ... because everyone is going to latch on to different pieces of it. If this was taught with math, do you know how much math grades would go up? No, I found myself not focusing on all of them or thinking about them in an order. If I would have continued to think C first, H second, A.... I would have been totally lost. But as a toolkit, I feel that I can use it even more. (Amy, Focus Group, February 13, 1999)

Through their actions, each of the participants had reached virtually the same conclusion regarding CHAMP. That is, each felt that the training process designed was appropriate and useful, but when the training process had ended, it was necessary for them to focus on the particular components of CHAMP each felt most beneficial to them. It was not until Mark verbalized his feelings that the “toolkit” philosophy became concrete. As a means to further demonstrate the internalization of CHAMP, it is important to demonstrate situations where each participant has demonstrated the effective use of the various components of CHAMP. In the following section, evidence of each student’s effective use of CHAMP will be supplied.

**Effective Use of CHAMP**

In this section, again through their own words, each participant will describe how they began to use various techniques of CHAMP. As mentioned previously, each participant did not necessarily use all the components of CHAMP, nor did each participant use the same component of CHAMP in necessarily the same fashion. In this
section, participants will discuss not only what components each chose to focus on, but also why and how they chose to focus on it.

**Amy.** In discussion with Amy, both individually and with other members of the group, she would always discuss the simplicity of CHAMP. At one stage she even pulled out papers and pamphlets she had acquired through University College as well as other resources relating to what it takes to be a successful student. These ranged in content from basic study skills, to researching skills, to being successful as a mathematics student. What was extremely helpful to Amy was the simplicity of the CHAMP concept.

This is remedial to me. If you take just five simple things. Five simple, unrestricted thoughts, and put them in your head and use them, it breeds success. (Focus Group, 2/13/99)

Within CHAMP specifically, Amy began to focus her attention on cue words, mental imagery, and positive self-talk. Contained on Table 4.8 are quotes from Amy regarding each of these topics.

For Amy, her continued focus on cue cards was evident. As mentioned previously, Amy was already somewhat in tune with the use of cue cards as note-taking devices.

When Amy was first introduced to the concept of cue words as they related to the solving of word problems, she initially struggled to try to break down the various steps needed into three to five key words. Her last quote with respect to cue words bears out how hard that was for Amy to do. But in the process of breaking all the steps associated with lengthy combination problems into a few cue words, Amy began to understand the analysis necessary to do so.
CHAMP Component

Cue Words
I never in the whole time I was in 050 I never figured this out. I never could figure out words that were the same and the problems to help me identify the same type of problem and I don't know why. (7/11/98)

Since I have so much trouble with signs, I built in a reminder for that. Just check signs. I do that all the time. Remember your signs. (7/11/98)

I feel the cue cards have been a great benefit. Definitely. I honestly thought I would be "crutching" on you. I did. And I always knew in the back of my mind I had you there. I would say, I am going to do this. You know, cause I am just applying my cards. I mean I am so thankful I did what I did when I did it. (8/14/98)

This is Math 050 (approximately 300 cue cards). Then my 075 is in here...it's not a very big stack, because I kept crunching on this. But when I got to 104, it was this (15 cards). And there is not much on any single card. And this is all I studied. But I just kind of like, "Oh I don't need this, I don't need this." So that was helping my confidence. And it go down to just being able to just jump quickly from a few equations which was three, and just remembering just a few crazy things of going right or left and processing or calculating. So the cue words became very important for me and I actually got it down to under 15 cards. (Focus Group, 2/13/99)

So I finally feel like with respect to word problems, how hard that was to get down to a few words. Those cards are everywhere. I do believe if I can figure out and come up with a chart, I will be able to study for any of my classes (8/26/98)

Look at how hard I worked to get those few words on those little cards. It was like outlining. That was really hard to do. (7/15/98)

Mental Imagery
I recalled more from my bad experience, the first one, than the second one. Because the second one was so much easier that it didn't leave as strong an impact on me because I didn't have the cueing like you were doing up here. You know, encouraging me to go on and finish it. I was trying out the key words to bring over in here for interpretation, and I have seemed to recall more about this than I did this. Which I thought was interesting. (7/15/98)

In his tests I always do what I know how to do first and then I go back. Whereas in 050, I just did one problem and kept right on going. The only thing I ever skipped over was word problems. Now I just look at and what ever looks the most comfortable to me, I do first. (8/14/98)

After I saw that film that I had done and that 2nd part of the video, I remembered laughing to get the second problem. And I started giggling in class on the test. And I remembered that picture of me standing there going, "What do you want me to do?" And I remembered that when you said you wanted me to talk and explain this one all the way through, I remembered that and said "Ok, let's go." I told myself the steps. I sat there and giggled my through those four problems. (8/14/99)

Recalled lecture experience as an aid to help practice recall in mathematics. (8/14/98)

Positive Self-Talk
If you take the negatives that his is creating and turn them into positives then you have this—you have the confidence building statements. (7/15/98)

Table 4.8: Evidence of effective use of CHAMP: Amy
In the process of understanding this analysis, Amy was able to apply this analysis to her cue cards. Instead of creating extensive note cards as she had done previously, Amy began to analyze her note cards and apply the cue word philosophy. What are the key components? What word can be used to describe that key component? The end result of Amy’s extensive analysis was twofold.

First of all, Amy was able to crunch what had at one time been 300 cards of material into just 15 cards. As discussed in the Changes section of this chapter, this also represented a change in how she prepared for tests. By doing this extensive analysis, she was able to better determine what she knew and what she did not, resulting in a more focused approach to her quiz and test preparations.

Beyond Amy’s ability to crunch the number of cards she also mentioned that if it had not been for this process, she would have felt the need to rely more heavily on the available tutoring being offered by the researcher as compensation for her participation in the study. Of the three participants, Amy took advantage of this opportunity on a very limited basis. She had developed her analysis to such an extent, she did not feel the need for a great deal of outside help. And when she did ask for additional assistance, it was when she had analyzed a problem to the extent that she only needed some minor clarification with respect to the problem. It became a case of “This is what I already understand about this problem. I think this is where I need to go with this problem. Is that an accurate analysis of the problem?”

Mental imagery, in particular mental recall, became another portion of CHAMP where Amy focused her attention. Through the training process, each student was videotaped performing two word problems. This was to serve as a training tool in the
area of mental recall. The replay of the video served the purpose of creating a mental
image of the experience for the students. In Amy’s case, the first problem she performed
did not go as smoothly as the second did. In the second problem, Amy worked through
the problem without delay. However, in the first problem, she continually stopped to ask
the researcher questions. When it came time to practice mental recall, the researcher
suggested that the second, almost flawless image should be used for this purpose. Amy
disagreed and chose the first one as her model for the mental recall exercise. Not only
was she able to recall more about the first one, but she also noted that the encouragement
and cues given by the researcher were more beneficial to the recall experience than her
ability to “crank through it,” as she did with the second one.

As evidenced by the quote regarding the second video experience, Amy was still
able to put this one to good use on a later test. She was able to recall her laughing her
way through the tape so much so that it prompted her to giggle about it during the actual
test.

Mark. As Mark progressed through the training related to CHAMP and beyond,
he was continually reflecting on CHAMP and the impact it was having on his learning.
Words such as “engrained” and phrases such as “I don’t need to think about it” became
commonplace in his discussions of CHAMP.

As I said, it’s all pretty much engrained. I don’t have to specifically think about it.
In fact, I don’t have to specifically think about exactly what it is by definition that
I’m doing. (Focus Group, 2/13/99)

Another commonplace word that Mark began to incorporate into his discussions
regarding CHAMP was the word “disassemble.” This word came from Mark’s ability to
break down and analyze various components of CHAMP. He often would use an
analogy with respect to a mechanic and how a mechanic must first take apart an engine before he/she can diagnose a problem with the engine. In other words, the mechanic must disassemble the engine. This is how Mark first came to the concept of the toolkit—disassemble the situation and decide what portion of the toolkit was going to fix the problem. For Mark, he was able to take this “disassemble” philosophy and tie it to how he approached mathematics testing specifically and mathematics in general.

But I was able to glean a lot of things from it and I think it helped me also kind of...I don’t know what the word would be...that the side benefit of it was that I started looking at mathematical gained knowledge and skills as sort of a tool kit also. I started looking at tests as sort of a disassembly kind of thing. I never looked at that before. I started to look at them in sort of reverse direction—no that it was something that I had to conquer and climb over but rather something I could take apart and disassemble and throw the bits back at ‘em. (Focus Group, 2/13/99)

In comparing Mark to the other participants, it can be said that Mark was the only participant who at some level demonstrated that he had found ways to effectively use each of the components of CHAMP. Table 4.9 offers evidence of this.

A continuing theme for Mark was the situation where it was sometimes hard for him to verbalize the use of varying components of CHAMP simply because each had shifted somewhat into his subconscious. As mentioned in the Awareness section, Mark found himself constantly saying, “Hey, I’ve been doing that all along.” It was difficult for him to sometimes distinguish between the awareness of something he had been doing all along and the conscious use of a component of CHAMP.
<table>
<thead>
<tr>
<th>CHAMP Component</th>
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<tbody>
<tr>
<td><strong>Cue Words</strong></td>
<td>I know I am using the key words. I don’t know if I am consciously thinking about the actual words, but know I am still doing it in the same order and fashion. (7/16/98)</td>
</tr>
<tr>
<td><strong>Here and Now</strong></td>
<td>I know the Here and Now is something we discussed, but maybe not as heavily as the other stuff. We talked about focus, but not necessarily in the here and now in the deepest sense or staying in the present. But that’s true. I mean that’s what I was...I mean review the controllables, establish achievable goals. I mean that works perfectly. (Focus Group, 2/13/99)</td>
</tr>
<tr>
<td><strong>Arousal Control</strong></td>
<td>I mean, it started out with tests. I started thinking about an association with tests and preparation for the test. But by doing that, that is when the whole recognition thing came in and I started realizing I was doing it at other times too. I mean class, quizzes, homework—all the time. So, I think it was just...I was actually using all of it all the time, but since it was focused more on testing and that’s really where the arousal control issue was. I mean that was the only one I had a lot of problem with was keeping my cool before a test. So that is why it focused itself more there. (Focus Group, 2/13/98)</td>
</tr>
<tr>
<td><strong>Mental Imagery</strong></td>
<td>I mean, in the practical sense, a lot of these things worked. Using positive and mental images, picturing success...that works very well when you are studying and when you are doing your homework problems. I mean, when I first sit down I might say, “I don’t get this.” But I can see myself getting it by the end of the night. (Focus Group, 2/13/99)</td>
</tr>
<tr>
<td><strong>Positive Affirmation</strong></td>
<td>First time Mark did band imagery, it was more of a description than a visualization</td>
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<tr>
<td></td>
<td>I would probably tend to do bits and pieces of this stuff as a blurb all at once. That might be hard for me to record if I do. I tend to think about these ideas on the way home from here. (7/16/98)</td>
</tr>
<tr>
<td></td>
<td>Once you get to the point that you are in the game zone, you can’t absorb all of this, that’s all around. All you can see is this. You can’t watch all of this. (7/14/98)</td>
</tr>
<tr>
<td></td>
<td>I mean that’s good for me, being able to visualize. I mean some of the previous problems in 050, I couldn’t even get the concept. (7/16/98)</td>
</tr>
<tr>
<td></td>
<td><strong>Table 4.9: Evidence of the effective use of CHAMP: Mark</strong></td>
</tr>
</tbody>
</table>

Table 4.9: Evidence of the effective use of CHAMP: Mark
The use of cue words is a perfect example of this situation. In his comment related to cue words, Mark is questioning whether or not he can or is capable of consciously thinking about their use.

With respect to the Here and Now, Mark had not really thought about concepts related to goal setting. It was discussed, but in his case did not become a focal point. It was during the focus group interview that Mark came to the realization that the concepts related to goal setting truly did make sense to him—review the controllables, establish achievable goals.

Arousal control was the one area Mark felt he needed to address more heavily throughout the study. He spent a great deal of time working on arousal control with respect to his preparation for tests. The continued focus on his test preparation eventually allowed him to realize he was not just focusing on arousal control to help prepare for tests, but he also came to the realization he was using it for quizzes and when doing homework as well.

As mentioned in the Awareness section, Mark was surprised to realize that what his tennis instructor had him doing years earlier was something that could be applied to mathematics. He had already established a good pattern of mental rehearsal from tennis and from his work in his band. On numerous occasions he was able to mentally rehearse for future band dates. Mark had come to understand the “picturing forward” part of mental imagery very well. What Mark struggled with was the mental recall philosophy. He made numerous attempts to try to “picture backward” previous events as a way to increase his confidence regarding upcoming events. He had difficulty creating a detailed picture of recall. As Mark mentioned, it became a sequence of “blurbs” or quick
“flashbacks.” Therefore for Mark, although he noted on numerous occasions his ability to see the benefits associated with mental recall, for him it was not something he was ever completely able to grasp. Mental rehearsal served a greater purpose for him.

Positive affirmation and positive self-talk was again something Mark was comfortable with prior to the study. For him these ideas became a natural extension to what he had already been doing. The Little Engine That Could discussion was Mark looking deeply into the concepts related to positive affirmation. Mark was constantly looking to different levels of application for the techniques in CHAMP. In this instant, he was verbalizing that in the case of positive affirmation statements, this concept is and should be introduced at a very young age.

**Melanie.** As was the case with Mark, Melanie came to this study with a fundamental awareness regarding many of the components of CHAMP. This would seem to make sense considering that components of CHAMP were drawn from sports psychology and considering Melanie’s extensive athletic and coaching background. For Melanie, the components of CHAMP that she was able to most effectively begin to use in mathematical settings were cue words, arousal control, mental imagery, and most importantly in her case, positive self-talk.

With respect to cue words, Melanie did find that she was able to effectively use them for word problems. She had always struggled with multiple-step word problem settings. Beyond the use of cue words with respect to word problems, she noted she was able to use cue words in other settings. Often times, however, these were used as mnemonics as an aid to memorization.
### CHAMP Component

#### Cue Words
When I am reading my story problems, I use my cue words-I mean the words we went over ...(8/11/98)

I do use cue words. Like more how you say through memorization. I put a word with another word to remember what the definition is or something in that respect. (Focus Group, 2/13/99)

#### Arousal Control
I think that I've learned to focus more on myself and control some of the things that I don’t and pep myself up for a test and in class and in part of my life. (Focus Group, 2/13/99)

I do take a lot of deep breaths ... I think that is the biggest thing that calms myself down, is just my deep breaths and telling myself you will get through this and everything will be ok. (8/24/98)

I put my name on every single paper. That is definitely the first thing I do, on every page ... that is the first thing I do before I even look at the problems. It relaxes me before I start to read the first problem. (8/24/98)

#### Mental Imagery
Used mental recall experience from Math 050 as an aid to mentally preparing for upcoming test (8/11).

If somebody is sitting in my seat, it really throws me off. That was a big thing I tried to prepare myself for. What else am I going to focus on in the room? So on the second test there was a girl sitting in my seat, but I just sat at the same table, but I sat a seat over. That was ok, because I had talked to myself enough, you know what happens if someone is sitting in my seat; where else should I sit. (8/24/98)

When I walk home, I still do the problems in my head. It was just like that one night I called you when I couldn’t get that airplane problem. I had to have it figured out before I could go to sleep. (8/24/98)

Developed extensive mental rehearsal for her third test in Math 104. As a portion of this rehearsal, described in detail the solving of a work problem. Did the same thing using a mixture problem. (8/24)

In math, I can literally sit in class and can picture where a topic is on a particular page of the textbook. I can bring it back in my head and I can tell you exactly where it was on a paper. I can tell you exactly where it is on my notes. I can tell you everything else around it too... I can recall and I can see the steps to where I’ve messed up on a homework assignment or a quiz or something that I messed up at a certain point...to where I put it in my head so I won’t mess up at that point again. (Focus Group, 2/13/99)

#### Positive Self-Talk
I remind myself to do positive thinking. I try to take all of my "can'ts" out and replace them with cans. I mean I will walk home after a test and I am like, “My God, I am so proud of myself.” I try to tell myself that I am proud of what I do. (8/24/98)

A lot of times right before my test I just know, I say to myself I can do this. (Focus Group, 2/13/99)

I mean I have put it on paper. I didn’t used to think about other positive things that have happened to me, but now I do, especially before math tests. (Focus Group, 2/13/99)

I know during one session we had I must have said sorry at least 25 times in 5 minutes. And he was like, if you say I’m sorry ....it didn’t matter what I did. And I admit that it really bought it to my attention in how much I do say I’m sorry and stuff. So I do try to use this. I do, I talk to myself walking to class. I give myself positive peptalks walking to class. Driving in my car, I talk to myself. (2/13/99)

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**Table 4.10: Evidence of the effective use of CHAMP: Melanie**

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With respect to testing in general, but specifically in the case of taking mathematics tests, Melanie would often struggle with her inability to control her emotions. By experiencing CHAMP, Melanie found ways to help control this arousal somewhat. For example, she used a technique she often employed when preparing for a swim meet—taking deep breaths. She found that this too worked in testing situations. She also developed some of her own techniques to help her calm down. For example, she would go through and put her name on every sheet of the test prior to actually looking at it. She also learned to incorporate positive self-talk specifically in these situations.

That positive thinking has carried over to other mathematical settings as well as non-mathematical settings. The “can’ts” she used to associate with tests have been replaced with “cans.” Melanie has learned to focus on her efforts prior to a test and praise herself regarding that preparation. She has learned to look at other positive things that have happened to her as a means to help prepare for mathematics tests. As she notes, during one of the introductory sessions, Melanie had said “sorry” so many times that it prompted the researcher to keep track. By an unofficial count, she had said the word “sorry” at least twenty-five times in the span of a few short minutes. At that point it had become a reflex of sorts. When questioned on why she says sorry so often, she had not realized she had even done this. As the study progressed, this represented one of the biggest differences in how she looked at herself. By the end of the study, there was little or no evidence of this continued use of the word “sorry.”

Mental imagery, especially in the area of mental rehearsal also became a component of CHAMP that Melanie became effective in using. Of the three participants, Melanie could be considered the most effective in this area. One of Melanie’s biggest
fears when taking mathematics tests was that someone would be sitting in her normal seat. She felt that she would lose her focus if she were not able to sit in the same seat. So working carefully with Melanie, the researcher devised a mental rehearsal text that Melanie could use prior to the next test. The text began with her walking to the test, working through the review that happened prior to each test, and concluded with her putting her name on each sheet and beginning the test. Included in the rehearsal text was the scenario of someone sitting in her seat. After being introduced to the text, Melanie mentally envisioned working through the text. This proved to be very effective for Melanie, especially since someone was sitting in her seat for the test she had rehearsed for. The first quote in the mental imagery component represents her comments regarding that test and her ability to sit somewhere else without affecting her performance.

**Teaching Others CHAMP**

As with mathematics, one of the greatest reinforcements of your own understanding of a particular topic is having the ability to teach someone else about that subject or topic. Each participant demonstrated at various times their ability to teach others regarding CHAMP. In this final installment regarding internalization, evidence of each participant’s ability to teach others the components of CHAMP will be outlined.

**Amy.** Of the three participants, Amy seemed to make it an ongoing endeavor to inform others regarding CHAMP. Since Amy was the only teacher in the group of participants, her willingness to teach CHAMP to others could be deemed a natural occurrence. Amy was not only able to teach different components of CHAMP to her varying classmates, but also to one of her professors and to her boyfriend.
Amy had to deal with some medical issues throughout the study. On a few occasions, this medical condition forced Amy to miss class time. In addition, various hospital stays were required. One such occurrence took place while Amy was taking Math 104.

Within this class, she and two other students had started a study group. The study group would meet consistently. When Amy was admitted to the hospital for a series of ongoing testing, the other members of the group took it upon themselves to meet with Amy in the hospital to help her catch up.

One of the girls was only 20 and she says, “Gosh it is so exciting to see you do so well because you are so old.” And she goes how did you even think to take math classes. And I told her I am at the point in my college career if I don’t take math courses, I don’t graduate.

And so we got into that little story, then I told her what I had done in summer and how I had got the department to listen to this man’s teaching technique as a bad one and how I got into this little program working with you. And they thought it was the coolest thing. They said so what are you learning and so I told them of the things and showed them my stuff and they just started laughing and they said this is pretty cool. I can do this. And so because I had used, actually the P, the positive self-talk, and said now if I can learn it, you can learn it. And it wasn’t in a demeaning way, it was just letting them know that if I could do it, then you guys could do it, trust me. It was enough that they felt confident too. (Amy, Focus Group, 2/13/99)

As mentioned previously, Amy focused a great deal of her attention on the portion of CHAMP related to cue words. On two occasions specifically, Amy was able to teach others regarding this process. In the first occurrence, she herself was learning how to use the cue words when solving word problems. As she was trying to understand the concepts related to the use of cue words, she decided to reinforce the concepts in her own mind by teaching them to her boyfriend.
The second occurrence took place in her Geography class and involved her instructor.

In Geography this summer, I actually got the worst grade I’ve ever gotten in college. And I thought oh no, I am going to flunk this class and it is not even math. So I came out of that class and I went up to my teacher and said I have a problem with all of this. Not the grade, but there is so much to memorize. I cannot memorize all of this. So we sat there and talked and started to work things out. And it dawned on me, because we had started working in these words, I said Mat [instructor], what about cue words? And he said, I don’t know what you mean. Tell me where you are coming from in terms of cue words and Geography. And I said I have an idea, I’ll be back. And I went back and I took this 11 by 14 sheet of paper and I put...because we had to learn about regions. So I put all the countries in the region on the left. I took his entire outline, A to J, you know, across the top...just cue words across the top. And then as he was lecturing, I would fill it in. So here is this 11 by 14 sheet of paper that’s like all this massive information that I had to learn.

Well, anyway, when I showed this to my instructor, he couldn’t believe it. He thought this was great. He kind of giggled when he saw it. Then he asked me to show him exactly what I had done. (Amy, Focus Group, February 13, 1999)

In this second case, she was able to take the concepts related to cue words and apply them to her Geography class as a means to help her better organize the massive amounts of notes given within the class. In the process of creating her outline cue word based grid, she was able to teach her instructor about what she was doing.

In Amy’s case, she found “teaching moments” where she felt she could enlighten others with respect to various components of CHAMP. She consciously looked for these opportunities and acted on them when these opportunities arose. For Mark and for Melanie their demonstrations of portions of CHAMP to others took place somewhat more subconsciously.

Mark. In Mark’s case, the component of CHAMP that he was able to pass on to others was positive affirmation statements. This however did not occur within a
classroom setting nor was it tied to an academic setting. In Mark’s case, his subconsciously passing on occurred with his band.

Sort of a side note and also I’ve noted recently that I’ve been using affirmations concerning the band in conversation with the band mates and with people in general which I found interesting. Because after I started thinking about positive affirmation and I realize that a lot of times when I’m telling the band that I think this was destined to happen, you know I think there was some sort of predestiny here that we’re supposed to do this and that everything is happening the way it should...and things are falling into place and how confident I feel about it. In a way it is not necessarily belief as much as it is that I’m affirming ... I’m making positive affirmations to myself to make myself believe it. At least part of me subconsciously must have known that because I’ve been making these affirmations, these statements to band mates in the attempt to get them to believe it. If they agree then I’m more apt to believe it myself. And vice versa. So it’s kind of we are throwing affirmations at each other in order to get feedback.

If I can infect other people with this positive affirmation, how that will affect the ultimate goals of the band and whether or not we reach them or not. (Mark, August 25, 1998)

In Mark’s case, he was not consciously promoting positive affirmations. He was trying to determine in his own mind why he was discussing them with his band mates. Mark notes that “The simple fact of the matter is we tend to let our nerves affect us too much.” In making these positive affirmations statements to the band, he was in some ways trying to alleviate some of the nervousness that band members feel prior to a performance. Part of his goal for making statements to the band was to reinforce in his own mind how he felt and further reinforce his beliefs about the band. Even though he did not formally train or teach his band mates regarding positive affirmations, he did lead by example. In any case, the feedback he was seeking out did occur and the feedback not only directly came back to him as a means of reinforcement, but he was also further able to reinforce his band mates’ statements.
Melanie’s influence on others was also at a secondary level. As in Mark’s case, Melanie did not specifically train or teach others directly about components of CHAMP. She did however discuss in an ongoing basis the various components of CHAMP with a variety of people, including her roommates and her family. As in Mark’s case, these conversations often centered around positive affirmations as well and served as a continued reinforcement for Melanie.

Don’t worry, you have my roommates and my family, and they all know I do this. So of course they will not let me say one negative thing around them. All my friends at home I talk to, my ex-boyfriend that I talk to on the telephone, everybody. Are you thinking positive thoughts? What are you doing? No negative thoughts here. You must have called them or something. (Melanie, August 24, 1998)

As can be seen by these statements, Melanie’s friends and family have come to understand the concepts related to positive affirmation and are looking for Melanie’s continued use. Although Melanie did not consciously train others in the use of this technique, her ongoing conversations with them transferred the knowledge associated with positive affirmations and she in turn received feedback regarding that knowledge.

**Summary**

Amy, Mark, and Melanie were able to demonstrate the internalization of CHAMP in a variety of ways. Each reflected on CHAMP itself and became aware of how they were using certain techniques prior to the study. Through this reflection, each independently discovered that looking at CHAMP in a sequential matter, although highly beneficial for training purposes, was not necessarily the best approach for its ongoing use. Instead of looking at CHAMP as a step-by-step process (kit), it was determined that a more appropriate view of CHAMP was viewing it as a toolkit—components that were of most benefit to each individual in a particular situation.
The toolkit philosophy further allowed each participant to focus on the components of CHAMP each was able to use most effectively. Evidence of this effective use of various components of CHAMP further demonstrated a level of internalization with respect to the individual techniques.

In addition to creating an awareness of what components each entered the study with and their ongoing effective use of various components, each student also addressed situations where he/she was able to either consciously or subconsciously train others on some of the techniques associated with CHAMP.

Beyond the specifically mentioned evidence of internalization mention in the previous pages, there also existed subtle indications that each student had internalized various ideas related to CHAMP. Recall that CHAMP had its beginnings in the area of sports psychology. Although not a focus of this study, it is interesting to note the ongoing phrases associated with sports that started to flow from the mouths of the participants as each continued their work. A sampling of some of these words and phrases are listed below.

- game plan
- It was a game. (in reference to deciphering which word problem(s) would appear on a test.
- beat it
- beat this course
- He is not going to win.
- I defeated this course.
- Psyching yourself up
- That's like the win—you want to be able to tackle these things.
- I am competing with my own brain.
- I nailed that. I clobbered that. (in reference to a test)
These statements and/or phrases did not appear at the beginning of the study, but began to appear at a greater frequency throughout the study. Most of these statements appeared during the last two interview sessions and during the final group interview. These phrases did not come from one individual, but rather from each of the participants. Not only had the participants in this study internalized various techniques, but they had also begun to pick up the "lingo" as if confident players in an upcoming sporting event.

Scanning the complete cycle of internalization from awareness to the toolkit philosophy to the use of individualized techniques, there also existed a cycle of going from the subconscious to the conscious and back to the subconscious again. In other words, each of these participants became aware of something that was already in their subconscious; aware of techniques they had been using for quite some time. To create that awareness, each participant had to take these subconscious ideas and allow them to become conscious. Each had to focus on the technique in order to realize it was already being used. Once they focused on these items and added new techniques to them through training, the techniques slowly slipped back into the subconscious. They had to become natural occurrences.
Using CHAMP on Their Own

In the first section of this chapter, each of the participants was introduced by discussing his/her background and entry-level mathematical self-efficacy. In the second section of Chapter 4, documented changes in each participant’s mathematical self-efficacy were presented. The section preceding this one discussed how each participant came to internalize the techniques of CHAMP. The final installment to Chapter 4 centers on each participant’s ability to begin to use CHAMP on their own.

In the internalization section, the participants discussed how they came to understand CHAMP and addressed which of the components of CHAMP became most useful to them. Most, but not all, of this took place in observations and discussions over the specific time in which the researcher was directly involved with the participants, that is, during the Summer Quarter 1998. During this time, Amy was enrolled in Math 075, and Melanie and Mark were each enrolled in Math 104. The majority of the following discussion is centered on the time frame that the researcher was no longer directly involved with the students, in particular, the time frame from the end of the Summer, 1998 quarter to the date of the focus group interview, February 13, 1999.

In this section, accounts of how each participant used CHAMP in subsequent mathematics courses will be discussed. For Amy, this discussion centers on Math 104. Mark had successfully completed Math 148 during the Fall 1998 quarter. Melanie did not take a mathematics course in the fall of 1998, but was enrolled in Math 130 at the time of the focus group interview.
Moreover, each participant used components of CHAMP in other academic courses and disciplines. Although the training took place in a mathematics setting, each student was able to extend the concepts of CHAMP to other courses as well.

Beyond the academic settings, each participant also demonstrated his/her ability to apply CHAMP to everyday life situations. For example participants were able to apply the concepts of CHAMP to such settings as teaching, personal life experiences, and the remodeling of a house.

**Other Mathematics Classes**

As a means to demonstrate an extended level of internalization exists for each student with respect to CHAMP, it is important that each be able to take CHAMP and apply it to mathematical settings where the researcher was not directly involved.

I think the only reason I did so well in 104 is because I had this. Because we were the first quarter of a new book in 104. We had no practice tests anywhere that had been created. They created words, and this was the key, and I brought them with me. They created word explanations of what we were to cover. And I didn’t freak out. My review questions were facts. They didn’t give us sample tests, they just wrote them in a row, 1 through 9, 1 through 10, 1 through 15. It was hysterical. And I was not psyched out and I was not petrified, horrified. So if I hadn’t had [CHAMP], knowing that this was a completely new program, and that didn’t even psyche me out. I was like, oh well, it’ll be fine because look what I went through this summer. (Amy, Focus Group, February 13, 1999)

When Amy entered 104, it was during a quarter that Ohio State was switching to a new textbook. In previous course, Amy had always relied on review sheets and in some cases old exams as a means to prepare for her tests. With the new text, there had not yet been the opportunity to create practice tests and reviews directly associated with the text. Since her previous mental preparation included these tools, this created a situation where it was necessary to have confidence in her own abilities to work through this course. She
maintained her confidence throughout the course and did not allow herself to be psyched out due to this difference in preparation.

In Mark’s case, his confidence in his ability to do well in Math 148 was demonstrated by his self-reliance.

Now I did have you to help me in 104, but from a tutoring perspective, you mainly helped me review for the tests. And that was all. And you helped me with a couple of sections of material because my own teacher wasn’t explaining. But I didn’t have any tutors for 148, not you, not anybody. I never went to the math room or anything. I didn’t need to. For 148, I didn’t use anybody but myself. I did it all myself. And I used CHAMP in 148. I mean I used this stuff in 148. And it worked, it really did. And I got a great grade in that class, and I passed every midterm with flying colors with no problems whatsoever. And I understood every word. (Mark, Focus Group, February 13, 1999)

As mentioned previously, free tutoring was offered as compensation for becoming a participant in the study. In his statement above, Mark makes it very clear that his efforts in Math 148 offer evidence in the usefulness of CHAMP. He notes that he received virtually no outside assistance in Math 148, yet at the same time regularly used the components of CHAMP throughout his 148 experience. So at least in Mark’s mind, it was clear that his success in Math 148 had a great deal to do with his continued use of CHAMP.

It should be noted that it was difficult to find extensive evidence in this area for Melanie. Since Melanie was not enrolled in a mathematics course in the fall of 1998 and she was just beginning her Math 130 experience in the winter of 1998, it was difficult to establish evidence of CHAMP’s continued use in her subsequent mathematics course.

Just as the participants were in general able to continue their use of CHAMP in subsequent mathematics courses, each began to experience situations where CHAMP could be applied in other courses. Even though the training took place through the use of
mathematics, having the ability to introduce the concepts of CHAMP to other disciplines adds even further credence to each participant’s ability to internalize CHAMP.

**Other Classes**

In the quotes that follow, Mark applies CHAMP to economics and Asian Philosophy.

I mean for instance, I had an economics class midterm just recently. And I took it apart. I mean that’s exactly what I did to it. That’s the way I went about it. And that’s the way I looked at it. I disassembled it. And that works really well. And as long as I focus on doing that, all the outside stuff is not a problem. (Mark, Focus Group, February 13, 1999)

I mean I did it during math, sometimes I’ll tie a definition to ...Like the SOHCAHTOA thing. I could have invented SOHCAHTOA. Seriously, I mean that would have been something I would have come up with. I would have envisioned the SOHCAHTOA Indians. And that to me is what cue words mean. But if you’re never introduced to the tool, you never get to think about the use. And once you have that, then you can start to see when they are valuable. I mean I never realized how valuable that could be. Knowing, wow, this actually works for me and it has worked for me all along. I never realized. And I’ve been doing that in my current Asian Philosophy course because there are all these Chinese and Japanese and Indian words you have to remember and if you can associate them with something else ... (Mark, Focus Group, February 13, 1999)

In the first quote Mark again references his “disassemble” philosophy. Just as he disassembled CHAMP into its toolkit representation and had taken apart mathematics tests, he too had discovered he could apply this thinking to economics and in particular, an economics exam. In his second quote, Mark is commenting on a specific component of CHAMP, namely cue words. In this statement, Mark has come to the realization that the concept of cue words can be applied to numerous situations. In this case, he has found that he was able to apply the use of cue words as an aid to recalling a variety of words within his Asian Philosophy class. To make the image clearer in his own mind,
Mark tied this use of cue words to a common mathematical use of cue words—

SOHCAHTOA from trigonometry.

From the Internalization section of this chapter, it could be seen that Melanie worked quite extensively on the use of mental rehearsal. In the mathematical sense, she was using it as an aid to her preparation for testing. In the following quote one sees another non-mathematical situation where Melanie was able to apply mental rehearsal.

I did an English presentation. I could see myself doing it beforehand. I mean, I was standing in front of the class and talking about what I was going to teach them. Yeah, I could see myself. (Melanie, August 5, 1998)

Melanie has discovered that this visualization techniques has advantages not only in the preparation for mathematics testing, but also in the area of giving presentations.

As for Amy, her work in geography (see Internalization section of this chapter) not only offered evidence of her ability to teach others concepts related to CHAMP, but in so doing, she has discovered she could extend the use of cue words to her study of geography.

Beyond the academically-based extended use of CHAMP, each of the participants was able to determine situations in their everyday lives where CHAMP could be of benefit. In the next section, evidence of this extension will be found.

**Real-life Uses of CHAMP**

In the following descriptions a variety of real-life applications of CHAMP will be demonstrated ranging from general comments regarding how each participant’s life has been affected by CHAMP, but in some cases how CHAMP could be used as a benefit to others.
The first quote comes from Melanie. Melanie has not only seen the benefits of CHAMP in academic settings such as testing but in other areas of her life as well. Recall that Melanie has had difficulty maintaining a positive outlook in the past. From her comments below, it can be determined that CHAMP has given her a means to control some of those negative feelings about her life in general.

I feel that I have learned and I’ve become a better person from CHAMP, not only in mathematics, but also in my life. I feel more confident in myself and I have large control of some of the frustrations that I had walking away from tests and looking at the future things and stuff like that. So I don’t feel the tutoring you did with me was the reason why I feel better about mathematics; it was CHAMP that was the bigger part of that. Because I think I have learned to focus more on myself and control some of the things that I don’t that I didn’t, and pep myself up for a test and in class and in part of my life. (Melanie, Focus Group, February 13, 1999)

Amy is in agreement with CHAMP’s ability to help create a positive outlook in a variety of settings, including a trip to the dentist.

I agree with [Melanie] 100%. Because I’m taking classes now I would have never taken. And I’m taking harder classes now and in subjects that I was just totally petrified of and now I’m not worried about anything. In fact, if you recall the card we did for 050, I said the only worse thing than going to a math class was going to the dentist. Well, you know what. I have had all my major dental work done that I have put off for 11 years. That’s how petrified I was. That, and so you can imagine if I was that petrified to put off dental work, how much more I hated math. So to me, it’s like I go in there now, and I just find a ceiling tile and I just like count all the little puncture holes in it and I get through that dental visit just as easily as I do all my subjects. Because it’s like I’ve used this and I continue to use this. I will continue to use this in any teaching class I go into. And knowing that I want to go into pre-school to four is like ... It’s seeing those words today with tool kit. That’s it. (Amy, Focus Group, February, 13, 1999)

Early on, when Amy first became a student in the researcher’s mathematics course, she maintained the same level of hate for mathematics as she did for the dentist’s chair. The reference to the card she mentions is a continuation of a sentence each student was asked to complete on the back of an information card the first day of class:
"When I see or hear the word mathematics, the first thing that comes to mind is..." In Amy's case, she correlated the pain of a mathematics class to that which one would experience in a dentist's office. What is extremely interesting to note is that once she used the CHAMP techniques to conquer her fear of mathematics, she was also able to apply these techniques to another fear of her's — a trip to the dentist's office. The focus technique she references (counting the number of holes in ceiling tiles) is much like the focusing techniques athletes use when preparing for competition. For example, weightlifters will often focus on an object as a way of concentrating prior to making the lift. On a personal note, it is the same technique I used to employ when required to do extended minutes of leg lifts in wrestling practice. If you focus hard enough you can virtually remove yourself from the situation and in turn remove the pain associated with the activity. A similar thought process is employed in Lamaze natural birth training.

Amy is the teacher of the group. In the last comment in the previous quote, it can be seen that she is making a pact with herself to continue to use these techniques within her own teaching. The quotes that follow are evidence that she plans to maintain this self-employed pact.

I'm working with this little boy from Somalia now that nobody wants to teach because ... and they told him in the classroom, until you start talking English, don't come back in our group. For God's sake, he is in kindergarten and only been in this country for three weeks. I've already gotten the word "hug" out of him and "golla" is how you say it in Somali. I'm already putting cue words up around the classroom, coloring and putting them in Somali and in English. I'm doing cultural experiences with the students.

To me if I can see the relevance of him being in that classroom, and I'm not even a certified teacher yet, it's totally because I feel confident in my skills to be able to go out and do that. Whereas before, I guarantee you, it just wouldn't have happened. I was a mouse in class, just getting through it one quarter, one class at a time. And I have been so enriched in my classes that I feel like these past three
quarters I’ve gotten so much more out of my classes, just on participation alone. (Amy, Focus Group, February 13, 1999)

Not only did Amy find a way to use CHAMP to help this little boy, she continued to think extensively about the impact CHAMP can have on education. The following quotes offer evidence of how she has further incorporated CHAMP, but also offers a glimpse as to how she plans to even further incorporate it down the road.

Since I am a visual person, it was easy for me to see CHAMP as a tool kit. C could be a clamp and H could be a hammer and the A as the...I could put a tool that I would be associated with each of these things and this help my recall. Because I actually created the tool chest. When I was teaching vowel sounds, each piece of the tool was A, E, I, O, and you know like all the different sounds. And so I actually did that because I thought that would help them if they would look at a tool and just think of the sound, they would be able to do better than if they just sat there and say the vowel sounds. I created a paper tool box and everything so I had that in front of me. (Amy, Focus Group, February 13, 1999)

Having my experience of being fat, dumb, and ugly, you couldn’t have been any more channel-blocked in a teacher’s mind. By putting things into a visual setting, like this toolbox idea, I will be able to create an anti-biased curriculum. That is my goal. Cause I can teach...If you take that and just take the words that are underlined here, I can teach that in kindergarten. That’s kindergarten mentality. And if you take that and teach them that in kindergarten, then they’ll be able to have a successful 11 more years of their life. I really believe that. (Amy, Focus Group, February 13, 1999)

If you can get them through high school and they are using this they’re going to use it in the work place. Instead of developing just language things through LA and all these phonetically charged instructions they spend 20,000 dollars per teacher to train, if they would just take a few moments and try to teach this...for less than 20,000 per teacher they could do much more with that and they would have much more consistency in a classroom, they would be able to focus the same CHAMP strategies in every single class. Which I have incorporated into my other classes and even in my education classes, like my literature. I’ve been able to outline my stories that I have read, you know, so much quicker. And I can just look for key things that are so much more important. And my reports are so much better. And they have gone from being 10 and 15 pages to one and a half and two. My teachers are like, wow, you really condensed this. So I feel like it has really helped me in ways that I never would have thought possible. (Amy, Focus Group, February 13, 1999)
Amy also used CHAMP to keep a positive outlook during a particularly difficult time that began during the summer of 1998 and continued into the fall of 1998. During that time it was determined that she might have cancer and required numerous rounds of testing and hospital stays. Amy felt she was able to get through this troubling time in part due to CHAMP.

In the Fall [1998], I actually had to go in and have surgery and have a mass removed. Normally, if they would have told me that in the spring quarter [1998], I would have either had to drop out of school or postpone surgery until I could think about it or something. I don't know how I would have dealt with it spring quarter.

Finally, Mark offers his usual unique perspective on a variety of ways that he uses CHAMP in his everyday life.

I've got a million things that this stuff relates to. I've got that typical lying down reflecting on the day kind of thing, or reflecting on the coming day. I mean that is the only time you are really to yourself anymore. The only time you ever have is before you fall asleep. You know, riding my bike. Making good miles. Making longer trips requires psyching yourself up. The band getting on stage requires psyching yourself up. If you go up there thinking you are going to [stink], you are going to [stink]. I'm working on a house doing stuff I've never done before, which is especially good for this, because I've never moved a vent before. I found out today along with the vent in the same hall, I've got to move two electrical lines. I've never done that before. I can do it though. But you've got to psyche yourself up for it. If you go in there thinking I'm never going to get this, you are going to break it. Because my life in general, to be honest with you right now is probably good for this stuff. Because I've got just a ridiculously hectic schedule, and unless you keep some measure of positivity you are never going to be able to keep it together. (Mark, August 26, 1998)

The majority of Mark's discussion is centered on his ability to psyche himself up to perform certain tasks or events—riding bike, getting on stage with his band, and doing remodeling work on his house. He also sees the importance of maintaining a positive attitude when it comes to surviving the hectic lives everyone encounters these days.
Summary

In this section it was important to demonstrate that upon internalizing CHAMP, that each participant was able to make it his/her own. That is, the goal was to demonstrate ways that each student was able to use the techniques of CHAMP beyond the scope of the study. From this discussion we see that the students were able to apply CHAMP to a variety of other classes, both mathematics classes and non-mathematics classes. Each was able to find real-life uses of CHAMP which ranged from teaching, to remodeling a house, to even surviving dental work.

This allowed the research to come full circle. In this study real-life occurrences were used as an aid to develop CHAMP, in particular with respect to the mental imagery component. By taking CHAMP and making it their own, each participant was then able to re-apply CHAMP to real-life occurrences and situations in order to complete the cycle.
CHAPTER 5

CONCLUSION

The purpose of this study was to train three non-traditional college mathematics students in the use of the researcher-developed, sports-based intervention techniques known as CHAMP and assess the extent to which these intervention techniques enhanced mathematical self-efficacy, as well as the extent to which these students were able to both internalize these techniques and begin to use the techniques on their own. Specifically, this study was designed to answer the following three questions:

1. What changes in mathematical self-efficacy occurred during the application of the CHAMP toolkit?
2. To what extent did the students seem to internalize the techniques of CHAMP?
3. To what extent did the participants begin to use these techniques themselves?

This case study profile investigation was conducted from June 1998 to February 1999. Three students—Amy, Mark, and Melanie—from the researcher’s previous developmental mathematics class, now enrolled in introductory college algebra courses at a large Midwestern university, were the participants in this study. Qualitative data were collected through individual interviews, direct observations, a focus group interview, researcher and participant journals.
Training sessions took place from June 1998 to August 1998. During the initial session, data were collected using a background questionnaire; the Mathematical Self-Efficacy Scale (MSES), a 20-question ranked scale that determined each student’s mathematical self-efficacy with respect to standard problems found in introductory college algebra classes; and an initial interview. This data served to create an initial profile of each participant’s “mathematical upbringing” and entry-level self-efficacy.

Beginning with the first session, and throughout subsequent sessions, each participant was trained in the use of the various components of CHAMP:

C: cue words

H: here and now (defining and achieving controllable goals)

A: arousal control

M: modeling and mental imagery

P: praise, verbal persuasion, and positive self-talk

Combination word problems (e.g., mixture, investment, coin, ticket) served as the primary tool utilized in this training, especially in discussions related to cue words, arousal control, modeling and mental imagery, and positive self-talk. A detailed description of these training sessions, in the form of a table, can be found on pages 120-127. Since each student worked through these sessions at a slightly varied pace, the table should be read as a reasonable representation of the actual training order and content. Practice sessions were also utilized between the training sessions, but are not included in the detailed description.

Numerous phone conversations took place between the researcher and the participants during Autumn 1998 as a means to follow up on their ability to utilize
CHAMP on their own. A final focus group interview was conducted in February 1999 to elicit overall merits of techniques employed and to offer suggestions for the improvement of these techniques.

The rest of this chapter is organized into the following sections:

1) Summary of findings
2) Implications of current research
3) Directions for further research
4) Concluding Remarks

Summary of Findings

This section will summarize each of the research questions posed by the researcher. Noted changes in each participant’s mathematical self-efficacy will be discussed first. Next, evidence as to how each participant internalized CHAMP will be summarized. Finally, general conclusions relating to how each participant began to use CHAMP on his/her own will be discussed.

Changes in Mathematical Self-Efficacy

Three distinct changes in mathematical self-efficacy were noted throughout the study. These changes were: 1) changes in participation; 2) changes in preparation; and 3) changes in how each participant viewed word problems.

Changes in participation. Prior to beginning this study, the students admitted that they did not freely participate in class because of a lack of confidence in their mathematical abilities. Any questions that an individual might have had during class were saved for one-on-one discussions with the instructor outside of the classroom. It was also noted that each rarely helped other students in class, nor prior to the study did
other students seek out their assistance. In addition, they noted that they had rarely corrected an instructor in class and/or debated any issue of classroom policy.

*If the individual had a question during class, he/she now had the confidence to ask the question in class rather than waiting until later.* Each had discovered that it was his/her right to ask a question in class and that the best time to ask the question was now, and not later.

*As the students progressed through the study, they showed a greater willingness to interact with other students.* The participants found themselves more willing to help other students in the class. The students had confidence in their own mathematical abilities to explain concepts and/or procedures to other members of the class. In addition, and quite to their surprise, the participants found that other students began to seek them out for extra help. Due to their increased participation within class, other students began to view these students as models of capable and confident mathematics students and looked to these students for assistance.

Prior to the study, the participants noted that whenever there was an issue of instructors performing incorrect work on the chalkboard, incorrect grading, or inconsistent classroom policies, they would remain silent and allow other members of class to bring up such issues with their instructors. On occasion, the participants noted they would privately mention these things, but would have never considered bringing them to the attention of the instructor during class. *Through their participation in the study, each not only became more focused in looking for these teacher inconsistencies, but each was more willing to speak out regarding these inconsistencies during class.*
In addition to each participant’s willingness to initiate contact with other students and with the instructor, each began to use the other people in class as a vicarious source for their own mathematical self-efficacy. Each began to compare themselves to others as to how they felt they were doing with respect to the rest of the class. The literature discusses this vicarious source from two perspectives. Observing others of equal competence succeed persuades the observer that he/she can also be successful. However, observing someone of similar competence fail lowers the observer’s self-efficacy (Bandura, Adams, Hardy, & Howells; 1980). A slight twist to this theory, however, occurred in this study. Here, the participants discovered that noting cases when others were frustrated, but they were not, resulted in increased confidence in their own ability.

**Changes in preparation.** The participants also changed in the way each prepared for their current mathematics course. Two specific changes were noted in the area. *First of all, each of the participants became more focused with respect to their preparation.* Prior to the study, each of the participants studied everything over and over again, in some cases to the point of confusion. Throughout the course of the study, the participants became more efficient in their preparation. Each began to analyze their own tendencies with respect to preparation and learned to focus on “what they knew and what they did not know.” In addition to analyzing their own tendencies, the participants began to analyze the tendencies of the instructor and prepare for those tendencies.

*The individuals in this study also began to focus on his/her ability to handle mathematical situations emotionally.* Anxiety with respect to mathematics, and in particular with respect to mathematics tests, was prevalent in all three participants at the beginning of the study. Upon completion of the study, each student had learned various
techniques for controlling this anxiety. None of the students completely eliminated the anxiety each had with respect to mathematical situations, tests in particular, but each found ways to ease the anxiety. As each discovered, some anxiety (arousal) is important especially within testing situations. The key is not to eliminate the anxiety completely; the key is to find the optimal amount of anxiety to perform efficiently.

Although this study involved three different course instructors, they were remarkably consistent with respect to how they handled test/quiz days. Rather than give the test/quiz at the beginning of the class the instructors would begin the day of a test or quiz by covering new material, then review for the test/quiz, and finally give the test/quiz at the end of class. Initially this pattern was extremely disturbing to the participants. Each was prepared to take the quiz and/or test upon entering the classroom. The use of visualization techniques, specifically mental rehearsal, combined with cue words and positive self-talk allowed each of the three participants to prepare for the delayed test in advance.

**Ability of students to solve word problems.** The participants in this study each initially rated their ability to solve word problems low on the Mathematical Self-Efficacy Scale. As the training began, each continued to demonstrate a lack of confidence in his/her ability to solve word problems. *By the completion of the study, each participant noted a much greater confidence in the ability to solve word problems.* Not only did each demonstrate greater confidence in his/her ability to perform word problems, each sincerely enjoyed solving them.
Internalization

In this study, Amy, Mark, and Melanie each brought a unique perspective to his/her own understanding and subsequent use of CHAMP. Three specific areas of demonstrated internalization were found and discussed.

1) Awareness of CHAMP techniques already being used
2) Effective use of CHAMP
3) Teaching others CHAMP

The participants became aware of different components of CHAMP that each was already using. As the participants became more aware of components each was using, they began to analyze the various components of CHAMP. In this analysis, each came to the independent conclusion that rather than treating CHAMP as a step-by-step kit, it was best to look at CHAMP as a toolkit. By thinking of CHAMP as a toolkit, the participants were free to use whatever tool of CHAMP they needed given the situation. In this way, the participants took what had originally been devised as a general program and turned it into an individualized one.

The toolkit philosophy further allowed the participants to focus on the components of CHAMP each was able to use most effectively. Although each of the participants did utilize each component of CHAMP, he/she did not use all the components of CHAMP at the same level, nor did each participant use the same component of CHAMP in necessarily the same fashion.
One of the greatest reinforcements with respect to understanding a particular topic is having the ability to teach someone else about that topic. Ultimately, the participants found opportunities to teach CHAMP to others, including classmates, roommates, and even other instructors.

**Using CHAMP on Own**

Upon internalizing CHAMP, the participants were able to make it his/her own by applying CHAMP to a variety of other classes, both mathematics classes and non-mathematics classes. Each was also able to find real-life uses of CHAMP, which ranged from teaching, to remodeling a house, to surviving dental work.

**Implications of Current Research**

This section will discuss the implications of the current research from two perspectives. First, the current research will be compared to previous research, and in so doing, address how this research supports or counters previous findings. Since it is believed that this research will have its greatest impact in education, the second part of this section will address specifically the implications of this research with respect to teaching and learning.

**Comparison to Previous Research**

When studying self-efficacy, Schunk (1995) notes the need for alternative forms of data collection such as case studies and oral histories. Although this would involve the use of fewer subjects, these approaches would yield rich data. The current research supports this claim. By creating a study that focused on fewer subjects and using qualitative means of data collection, the research produced rich data that could not have otherwise been uncovered using purely quantitative means.
The work in this study is consistent with efforts used by sports psychologists as they work with athletes. Bull (1991) addresses the role of the sports psychologist by describing a framework for the implementation of a consulting service aimed at enhancing the performance of an individual athlete. In it, Bull describes the importance of creating an individualized mental training program. The design of such a program would determine the individual needs of the athlete and create intervention techniques appropriate for the individual athlete. This study supports this claim. The training of each participant in the use of CHAMP was accomplished individually. Each participant had different needs, and therefore each student focused on the components of CHAMP that would be most beneficial to these individual needs.

In athletic circles, Schunk (1995) calls for trainers to include periods of self-directed mastery or independent practice where learners practice skills on their own. Bull (1991) notes the importance of withdrawal of the sports psychologist when the athlete becomes more experienced at employing the techniques successfully. This study took these two notions and extended them into an academic setting. Each of the participants was given the opportunity to work independently throughout the study and the researcher withdrew direct contact when the participants became more experienced in the use of CHAMP.

The training performed in this study points to the notion that self-efficacy is domain specific and that the training should be tied directly to a given context. In the initial phases of this study, additional participants were included. Each of these additional participants was not currently taking a mathematics class. These students were seemingly having less success with CHAMP because it was not being directed at a
particular course. They did not have the opportunity for direct application of the
components of CHAMP. Therefore, feedback started to become minimal. The three
students discussed in the study were more successful with CHAMP because it had a
direct application for them.

In the following excerpts, Mark and the other participants were in agreement with
the need to tie the use of CHAMP to a specific domain for training purposes. (Focus
Group, February 13, 1999)

Mark: By nature, it has to have something to relate it to. That’s the way the
whole thing was designed. It is designed to work with something. I mean that’s
the way this system works—recognizing how you’re learning. You can’t
recognize how you are learning unless you are learning something. You are a
math teacher. That’s what you know, that’s what you teach best, that’s what you
do.

Amy: So you teach us with math.

Melanie: Absolutely.

Each of the participants further agreed that although CHAMP needs to be taught
through one specific domain, that some of their other instructors could have also taught
CHAMP through their own courses.

The encapsulation model proposed by Rybash, Hoyer, and Roodin (1986)
suggests that basic mental capacity and fluid mental abilities become increasingly
dedicated to and encapsulated within specific domains of knowledge during the course of
adult development. As general processes and abilities become encapsulated within
domains, adults’ knowledge becomes more expert in nature. The encapsulation model
also suggests that the acquisition of new knowledge becomes increasingly less efficient
with advances in age. The ability of these adults to extend their knowledge of CHAMP
and self-efficacy beliefs in general across a variety of domains would seem to counter the arguments made within the encapsulation theory.

Although the training needed to take place in one particular domain, this study further demonstrated the ability of CHAMP techniques and self-confidence to generalize to other domains. There has been an ongoing question about the generality of self-efficacy. Self-efficacy is usually conceptualized as being domain specific, especially for the purpose of predicting behavior (Bandura, 1986; Schunk, 1989). Most studies have not investigated whether self-efficacy generalizes beyond specific domains, but there is evidence for a generalized sense of self-efficacy. This study supports the possibility of this generalized self-efficacy. The participants were able to generalize an efficacious event from their past and transfer it to a mathematical situation. In addition, the participants were able to apply the various components of CHAMP to other domains, and in so doing, increase self-efficacy in those domains.

As mentioned previously in chapter 4, one of the nicest surprises to come from this study was the fact that each of the participants had previously used some of the components of CHAMP to some level prior to entering the study. In Melanie’s case, this past experience came by way of her athletic experience. The other two had limited or no athletic experience whatsoever, and yet had been exposed to various components of CHAMP previously. The ability of this research to tap the subconscious resources that each participant maintained and bring those into the conscious mind, might prove to be its greatest benefit.
Implications for Teaching and Learning

The research supports the assumption that aptitudes, prior experiences, and social supports, affect students' initial self-efficacy for learning or performing (Schunk, 1995). Each of the participants entered the study with various past experiences that impacted their initial levels of self-efficacy. Experiences as early as middle and junior high were still affecting each of the participants in this study, especially in the case of Amy. Before beginning any form of intervention such as CHAMP, it would seem important to first know the backgrounds of the students. Since a longitudinal study was not possible with these particular students, mathematical autobiographies proved fruitful in obtaining this data.

Each of the students entered the study with a past history that included an ineffective and/or unsympathetic teacher. In the case of Mark and Amy in particular, their current teachers added to their initial angst. All three participants used a significant amount of time and energy finding ways to overcome the structural make-up of courses, especially with respect to the timing of tests/quizzes. Feedback offered by the instructors was often presented in a curt and ambiguous manner. Educators must consider how feedback is likely to be interpreted by students prior to delivering it. This study points to the need to train teachers as to the importance of self-efficacy, which in turn would create an awareness of how fragile self-efficacy can be.

Training courses and/or seminars could be implemented discussing the use of CHAMP and other possible intervention techniques. In addition, these seminars could assess each teacher’s own teaching style and evaluate their current skills and their impact on self-efficacy beliefs. Such techniques could also be incorporated into teacher training.
programs at colleges and universities in order to demonstrate the importance of self-efficacy. In addition, tutors in learning centers, mathematics learning centers in particular, could be trained in the use of these techniques and incorporate the use of these techniques in tutoring sessions.

During the crucial formative period of a child’s life, the school functions as the primary setting for the cultivation of self-efficacy. Teachers who are well versed in their subject matter and have a high sense of efficacy about their teaching capabilities can motivate low achievers and enhance their development (Aston, 1985). The researcher currently teaches mathematics courses designed to prepare elementary and middle school teachers to teach mathematics at these levels. Many students come into these courses with low mathematical self-efficacy. There exists evidence that teachers with low self-efficacy may avoid planning activities they believe exceed their capabilities, may not persist with students having difficulties, may expend little effort to find materials, and may not re-teach in ways students might understand better. (Ashton & Webb, 1986). The researcher is particularly interested in incorporating the CHAMP intervention techniques within mathematics courses for teachers and reporting changes in mathematical self-efficacy that results. By following these same teachers into the classroom and observing the extent to which these teachers are able to transfer this knowledge to their students would also be of interest to the researcher.

**Directions for Further Research**

The focus of the current study centered on non-traditional students. Non-traditional students seem more prone for success due to their reflective abilities and the fact they are more likely to attach success to more stable factors such as effort. Further
investigation is needed to determine whether CHAMP works as effectively with traditional students. This type of research could also pinpoint possible adjustments that might be needed with respect to CHAMP and/or training procedures associated with CHAMP. In addition, future research should extend to include other ethnic categories.

As mentioned previously, CHAMP needs to be revisited with respect to other students at the college level, in particular, education majors and traditional students. Beyond the college level, proficiency testing seemingly represents an avenue for further investigation with respect to the use of CHAMP or other intervention techniques. These techniques should prove especially beneficial in cases where students have made numerous attempts to pass a proficiency test and yet have continued to fail. It would seem that a portion of their inability to pass would be tied to the beliefs they have with respect to their own abilities. Research is therefore needed to determine the impact CHAMP or similar intervention techniques would have on these students’ ability to pass proficiency exams.

The current study was designed using an individualized approach to train the subjects in the use of CHAMP. Many intervention programs within the world of sports are also based on a one-on-one application of the intervention techniques. To have a more widespread impact, it is important to revisit CHAMP in group settings. Research needs to determine the feasibility of training whole classes in the use of CHAMP and its components and, in particular, determining what changes in structure would need to take place for such training to occur.

Graham and Harris (1989a, 1989b) and Schunk and Swartz (1993a, 1993b) found that changes in self-efficacy, strategy use, and achievement, brought about by educational
interventions maintained themselves for up to 12 weeks. The current study supported these findings and extended this 12-week timeframe. Through the students’ own admonitions, it could be assumed that their ability to maintain these changes would extend beyond the study, but due to the limited timeframe of the study, no definitive evidence was available to support these claims. As continues to be stressed throughout the literature associated with self-efficacy, there is a need for longitudinal studies, especially in academic settings, which would allow for the ability to not only judge the development of self-efficacy beliefs, but also to better determine the impact of intervention techniques. Therefore, longitudinal studies need to be created that address each of these issues.

The development of self-efficacy beliefs in itself represents an important area for future research. As mentioned previously, aptitudes, prior experiences, and social supports affect students’ initial self-efficacy for learning or performing. For many students, experiences as early as middle or even elementary school have impacted how they view their mathematical abilities by the time they reach college. Although a longitudinal study might represent the best approach for determining these developmental issues, an analysis of mathematical autobiographies using Bandura’s sources of self-efficacy could go a long way in determining these developmental issues and point to earlier intervention with respect to self-efficacy. The researcher has access to numerous such autobiographies, collected from varying levels of mathematics students ranging from developmental students to elementary education majors to calculus students. Due to the fact that this data already exists, a study of this type represents the next logical direction for research.
Sports psychologists use a variety of methods for obtaining information relating to a sport-related psychological profile. In this arena there exist standard questionnaires that are used as an aid in developing these profiles (e.g., SCAT, SCAI-2, SPSQ, and TSCI). Many of these tools could be adapted to an academic setting. Research into the use of such adapted questionnaires could go a long way in better determining the types of intervention techniques needed for each individual student.

**Concluding Remarks**

This dissertation has been a story – a story of three non-traditional college mathematics students. It has been a story of these three individuals, mathematical self-efficacy, and something called CHAMP.

Ultimately, the participants in this study became co-researchers, for their contributions to this study were much more than subjects from which to obtain data. Their influence shaped this study. As each has done so eloquently throughout the study, it only seems fitting that each be given one final opportunity to summarize in his/her own words what CHAMP has come to mean to each of them.

For Mark the most important thing about CHAMP was that in his opinion, it taught him to analyze not only what he was learning, but more importantly how and why he was learning it.

This is why CHAMP is so important. No one ever teaches you to learn how to learn anything. They never cover this is school. They never talk about it. And that in and of itself, is the main reason why...regardless of your personal opinions on it; regardless of whether or not we’re trying to defend something that we feel is valuable. And defend it against anybody who wants to come up with a skeptical opinion or a reason why it doesn’t work. That doesn’t matter. Because it’s a process of learning how to learn. And learning how, how you are viewing things and what’s going on in your head---the psychological process of what is going on in your head when you are subjected to learning new things. And it had more to do with that than math. And I’ve taken English 110. I’ve taken Art History 211.
I've taken economics [and] Asian Philosophy. It has worked across the board because it has taught me how to analyze how I learn. (Focus Group, February 13, 1999)

For Amy, CHAMP has allowed her to become more independent, to sort of break out of her shell. It allowed her to see that the same person that could stand in front of over 800 people and give a lecture, can also do mathematics, and in her case to know that she can teach mathematics. For Amy, it was a simple matter of tapping into the self-confidence she had in other abilities and redirecting that into other areas.

If I didn’t have CHAMP, I probably would have just continued to flounder. I never would have had the strength to say ok, I can do this. I can rise above this. And I can come out and be a certified teacher. I never would have done that. I would have just dropped out, sulked, gone in my corner, and withered again. Now, I feel like I’m still like this flower, I’m just in hibernation ready to finish coming out. (Amy, Focus Group, February 13, 1999)

Mark extended the importance of this from an educational perspective.

To me there are people who think about living their life and there are other people that sort of live it. They sort of see their life as a linear, day-to-day sense. It is one day after the other and these are the things I have to do in my life. They don’t view their life as a package thing. They are just sort of droning right through it. They don’t think of it in a big picture sense. If you could teach them to do this with things they are trying accomplish, particularly when you are tying it to education, I believe you can take somebody like that who is sort of droning through life and open their mind up a little bit. (Mark, July 16, 1998)

As for Melanie, CHAMP has had the greatest impact in her everyday life.

Melanie entered this study with the assumption that whenever anything good happened to her it would be followed closely by something bad happening to her. In some cases, it had become a self-fulfilling prophecy for her. In a quote that was used previously, but bears repeating, one can see the importance CHAMP in Melanie’s mind.
I feel I have learned and I've become a better person from CHAMP, not only in mathematics, but also in life. I feel more confident in myself and I have large control of some of the frustrations. Because I think that I've learned to focus more on myself and control some of the things that I didn't ... and pep myself up for a test and in class and in part of my life. (Melanie, Focus Group, February 13, 1999)

As has been the case throughout the study, Mark is magically able to put into words what others, including the researcher is feeling or thinking. Below, Mark further summarizes what CHAMP has meant to him and to his fellow co-researchers. These quotes demonstrate that CHAMP will continue to be used for quite some time.

CHAMP has become like a chapter in a book—a chapter of acquired knowledge. I now have a tool for solving math problems. The further I go, I will always be associating it with math. Originally I saw its usefulness in many aspects of life, but now I associate it more with math because of how we used it.

How can I not use it? It now represents a sort of mental seeding. Something that is always there. It is so much a part of me now, I can't really not use it. In math it has changed my thinking about how I look at tests. I realize now why I do what I do. I can't help but not think of it. It is the first thing I think of when approaching tests.

I won't forget 2 plus 2 equals 4 and I won't forget how to use this information.

I have experienced a 10-week course on math confidence. How to practice; things that affect preparedness; thinking about, being aware of how I go about doing things. (Mark, Focus Group, February 13, 1999)

Each of the participants in this study has truly developed a winning mindset. Each entered this study as an underdog and emerged as a CHAMP.

*Whatever the MIND of man can CONCEIVE and BELIEVE it can ACHIEVE.*

Napoleon Hill

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APPENDIX A

Formal Reflective Documents
Performance Review List

Description:

The performance review list is a simple, yet effective way of developing a positive attitude towards preparation and performance. This list allows you to reflect on the performance which has just occurred. The technique works best when used within 24 hours following the activity. You should first compile a “good points” list. This list will vary in length and content but should include all aspects of the test which you felt went well. Then, the same process occurs for the negative elements of the test — a “bad points” list is compiled. When both lists are completed, the following steps should be performed.

1. Read the “bad points” list carefully and consider how the elements on it can be improved in the future. Make some notes to assist discussion with the instructor or identify how practice or preparation may be modified to strengthen any weaknesses. In other words, get something positive from this list.

2. **Throw the “bad points” list away and forget it.** Some positives have emerged from it but otherwise it’s history. Continually reflecting on them and brooding for days will decrease the chances of entering the next phase of preparation and subsequent test in a totally positive frame of mind. Otherwise, you risk the same negative aspects of performance occurring again --- simply because they’ve been thought about so much!

3. Read the “good points” list carefully and recall the positive feelings associated with these successful elements of the activity. Keep this list.

4. Re-read the list again several days later or whenever you feel in need of a confidence boost. Work hard to focus on the positives and recall the feelings associated with executing these positive aspects of performance. Even if it’s only one thing. Remember it and use it to your advantage.

5. In the future, focus on repeating the positives. Realize that not everything will go your way, but try to rely on your strengths.
PERFORMANCE REVIEW LIST

Name: ____________________________

Course: _______________________

Test Number: ______

Date/Time: ______________________

GOOD POINTS LIST:

•
•
•
•
•
•
•

[Note: Cut off bad points list and throw away after use]

BAD POINTS LIST

•
•
•
A Positive Frame of Mind

This exercise is designed to enhance your confidence in your ability to do mathematical word problems by focusing on your performance accomplishments. The exercise invites you to describe three aspects of yourself under the headings:

Strengths
Improvements
Achievements
Preparation
Edge
Previous Performance

All descriptions should be written using the following guidelines:

- Be phrased positively.
- Be in your own words.
- Refer to behaviors you can control.
- Refer to specific events or behaviors rather than global terms.
- Be written on the chart.

A brief description of each is given below:

Strengths: Three statements describing what you consider to be your strengths, attributes or qualities when solving word problems. Remember, an estimation of your own ability is far more important than that of others.

Improvements: Three statements describing what you consider improvements in your ability to solve word problems.

Achievements: Three statements outlining accomplishments, successes and realizations which you are particularly satisfied.

Preparation: Three statements relating to aspects of preparation which have gone well.

Edge: Three statements, if possible, of those advantages that give you an edge when solving word problems.

Previous Performance: Descriptions of three positive aspects of a previous performance in solving word problems.

My Goal(s):
This assists you in focusing on what you intend to accomplish with respect to word problems. Include daily, short-term, and long-term (if applicable) goals. Effective goals should be controllable, realistic, process (rather than outcome oriented), and positively phrased. A goal can be established by completing the sentence: What I aim to do is ....
# A Positive Frame of Mind

**Pseudoname:** ____________________

<table>
<thead>
<tr>
<th>Strengths:</th>
<th>Improvements:</th>
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<table>
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<tr>
<th>Achievements:</th>
<th>Preparation:</th>
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<th>Edge:</th>
<th>Previous Performance:</th>
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**MY GOAL(S):**
APPENDIX B

Questionnaires
Background Questionnaire

1. Student Identification Number (SSN): ______________________

2. Please pick a pseudoname (First and Last): ______________________

3. Gender (M/F): ______

4. Age: ______

5. Major: _______________ Minor (if applicable): _______________

6. Current Standing: (Circle appropriate letter)
   A. Freshman  B. Sophomore  C. Junior  D. Senior  E. Continuing Education

7. Program entry into college: (Circle appropriate letter):
   A. Continuing Education
   B. First-time Freshman
   C. Transfer
   D. Other (Please list): _______________

8. The following is a list of possible mathematics courses offered in high school. Place a check mark next to each that you took in high school. If a course you have taken in high school does not fit any of the categories listed, please list course(s) under “Other”.

   _____ Business/General Mathematics
   _____ Algebra I
   _____ Algebra II
   _____ Geometry
   _____ Trigonometry
   _____ Advanced Mathematics (i.e. Calculus)
   _____ Other (Please list) _______________ _______________

9. Number of years since completion of high school. _______
10. Circle the letter which best describes the type of high school that you attended.

A. Rural
B. Exempted Village
C. Suburban
D. Urban/Inner City
E. Private/Christian
F. Other (Please list)___________

11. College mathematics courses taken to date: (excluding present quarter). If course was taken at Ohio State, list the course number and/or title. If taken elsewhere, classify the type of course: Pre-Algebra, College Algebra, Precalculus, Mathematics for Elementary Teachers, Probability/Statistics, Calculus, etc. (include levels) and the number of quarter or semester hours taken:

_________ _________ _________ _________ _________

12. In general, what grade have you received in mathematics? On the continuum for each category, place an “X” where your average grade in mathematics would appear.

High School

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<td>D</td>
<td>E(F)</td>
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College (If applicable)

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<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E(F)</td>
</tr>
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</table>
Post Focus Group Writing Request

Modification of Mathematical Self-Efficacy Beliefs Using CHAMP

Name/Pseudoname: ____________________________

Please respond to the following questions. Feel free to use the back of the paper or additional paper if you would like more space for your response.

1. Is there anything you would like to have added to the discussion, but did not have the opportunity to add?

2. Is there anything you would like to have added to the discussion that you would rather not share with the others?

3. Are there any questions you would have liked me to ask, but I did not?

4. By participating in this discussion group, what additional information did you learn about yourself and the confidence you have in your own mathematical abilities?
APPENDIX C

Interview Protocols
Initial Interview Protocol

Main Question:
Would you please tell me about your previous experiences with respect to mathematics? What is your mathematical history? What is your mathematical autobiography?

Follow up:
- Beliefs about ability to perform mathematics; understand mathematics
- Specific instances, ages, situations
- Issues which specifically had an impact on perception of student’s ability to do mathematics
- Issues which specifically impact effort and/or persistence when performing mathematics
- Specific questions related to mathematical self-efficacy scale; comparison of high vs. low efficacy evaluations
- Feelings and emotions when asked to specifically perform a high efficacy problem; a low efficacy problem
- Distinction between knowing how to do a problem (process) versus obtaining correct answer (accuracy – outcome)

Focusing topics:
- When you see or hear the phrase “mathematics,” what is the first thing that comes to mind? Please explain.
- What is your first memory of mathematics?
- What do you think it means to successfully perform mathematics?
  - Is this process oriented (knowing how) or accuracy oriented (correct answer)
- How important is it for you to become confident in your ability to successfully perform mathematics?
- What affects your level of confidence in your ability to successfully perform mathematics?
  - What kinds of instances, experiences, or situations have bolstered your confidence in your ability to do mathematics?
  - What kinds of instances, experiences, or situations have weakened your confidence in your ability to do mathematics?
  - In what ways is your confidence or lack of confidence dependent on the type of subject matter: arithmetic, algebra, geometry?
  - What kinds of experiences outside the classroom have influenced your confidence: family, peers, media, society, etc.?
- Do you feel that all students can successfully perform mathematics?
- What do you do, in general, if you get stuck while doing a problem?
- Try to picture a time when you were able to successfully perform mathematics. What was going on then? What were you doing or saying to yourself? What were you focused on?
- What about a time when you haven’t been successful in performing mathematics? What was going on then? What were you doing or saying to yourself? What were you focused on?
Focus Group Interview Protocol

1. Could each of you please discuss the confidence you had in your ability to do mathematics prior to beginning this study.

Follow-up:
- Being successful in mathematics
- Importance of grades

2. Now, think about where you are now (end of summer). What changes have you experienced?

- Specific instances/experiences which demonstrate a change/improvement
- Classroom experiences: answering questions, questioning teacher, helping other students.
- Changes in level and strength

3. How much of this change do you attribute to CHAMP?

Follow-up:
- Overall impressions of CHAMP
- Specific instances/experiences regarding its use.
- Components of CHAMP that were most useful to you.
- Instances in which particular portions were most useful.
- General use vs. test preparation
- Word problems vs. non-word problems
- Confidence you felt going into Fall Quarter compared to how began Summer Quarter.

4. Of those techniques you did not use consistently, why do you think that was the case? Of those, which do you feel could still be useful and why?

Follow up:
- Issues of practice

5. Mat at one time in our conversations made the analogy that CHAMP represented more of a tool kit as opposed to a kit to aid in the improvement of self-confidence. (kit = step-by-step process; tool kit = use component that seems more useful at the given time, diagnostic tool kit). Do you agree with that analogy? In your mind, is that how it should be presented and used?
6. In many of our conversations, I got the feeling that some of these techniques were 
not necessarily new to you—created a higher level of awareness to something 
you had been doing already. Could you comment on this.

7. A concern of my committee will be the fact that I was directly involved in this 
process. Recall that some days we focused directly on CHAMP and on other days 
tutoring took place. Could you please comment on this influence with respect to 
any changes in your confidence to do mathematics? Did it have an impact?

8. Hypothetically speaking, if you had never had the opportunity to work with the 
components of CHAMP, do you feel your level of confidence in your ability to do 
mathematics would be the same as it is today? What other influences on your 
confidence occurred during this time? How much of this confidence do you 
contribute to these other influences and how much do you attribute to CHAMP?

9. In Summer 1998, most of you had issues with the instructor teaching the course in 
which you were enrolled—teacher obstacles. Could you relay some of these 
stories, especially instances that had an affect your confidence in your ability to 
do mathematics. Did CHAMP help you overcome these assaults on your 
confidence? Discuss.

10. Discuss to what extent you have been able to internalize CHAMP, your ability to 
use CHAMP individually, and your plans for continued use.
   ♦ Instances where felt became “natural”---used automatically.
   ♦ Instances of continued use of CHAMP
   ♦ Non-mathematical uses

11. Discuss a little bit your follow-up quarter and the level in which you continued to 
use CHAMP or any of its components.
   ♦ Entry into follow-up quarter
   ♦ Specific instances/experiences
   ♦ Follow-up teaching experiences (better for all—influence on confidence)

12. Where do you see the benefit of CHAMP for others? What settings? What types 
of students?
   ♦ Grade-oriented students (Note: Study group, in general, not overly focused 
on grades)
   ♦ Incorporate as part of the curriculum
   ♦ College/High School/Elementary settings

13. What improvements/changes would you make in CHAMP?

14. Anything you would like to add?
APPENDIX D

Consent Forms
PRELIMINARY CONSENT FOR PARTICIPATION IN THE MODIFICATION OF
MATHEMATICAL SELF-EFFICACY OF INTRODUCTORY COLLEGE MATHEMATICS
STUDENTS

I. Below you will find the tentative duration of the study and the means in which data
will be collected.

A. Duration of Study
The study is designed to take place during the first six weeks of Summer Quarter
1998. Participants' time involvement will be approximately three hours per
week (two 1-hour sessions with researcher per week; additional hour per
week for practice, journal writing, etc.). Therefore, each participant's
overall time commitment will be approximately 18 hours over the six-
week period. All sessions will be arranged at the convenience of the student.

B. Means of Data Collection
1. Initial survey
2. Individual interviews (2)
3. Copies of worked problems
4. Audio- and videotapes of sessions
5. Reflective materials and/or journal
6. Group interview (optional)

II. Researcher's commitment:
The researcher agrees to tutor each participant free of charge in course taken during
Summer 1998 and/or Autumn 1998.

III. General Information
It will be important that I contact you in the next two weeks in order to establish the first meeting
date, time, and location. A more detailed description of the study will be made available at that
time. Please fill out this information completely.

Name: ______________________________________
Address: ______________________________________
Phone Number(s): Home: __________ Office: __________
E-mail: ______________ Fax: ______________
Best way to reach you? ______________________
Best time to reach you? ______________________

IV. Preliminary Consent. I consent to participate in this research. I acknowledge that I
have the opportunity to obtain additional information regarding the study at any time. I
further understand that I am free to withdraw consent at any time and to discontinue
participation in the study without prejudice to me.

Signed: ___________________________ Date: __________
CONSENT FOR PARTICIPATION IN RESEARCH ON THE MODIFICATION OF MATHEMATICAL SELF-EFFICACY OF INTRODUCTORY COLLEGE MATHEMATICS STUDENTS

I consent to participate in the research entitled The Making of a CHAMP: The Modification of Mathematical Self-Efficacy Beliefs of Introductory College Mathematics Students Using the Integration of Bandura's Self-Efficacy Theory and Techniques Adapted from Sports and Sports Psychology.

Dr. Sigrid Wagner or Ronald Zielke has explained the purpose of the study, the procedures to be followed, and the expected duration of my participation. I understand that data will be collected in the form of:

- Initial survey;
- Interview transcripts;
- Copies of worked word problems;
- Reflective journal

These data will be used for research purposes only, in particular, professional writing and conferences.

I acknowledge that I have had the opportunity to obtain additional information regarding the study and that any questions I have raised have been answered to my fullest satisfaction. Further, I understand that I am free to withdraw consent at any time and to discontinue participation in the study without prejudice to me.

Finally, I acknowledge that I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Date______________________ Signed _________________________________________
(participant)

Signed

(Dr. Sigrid Wagner or Ronald Zielke)

Witness

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APPENDIX E

Mathematics Self-Efficacy Scale
Please read all instructions and respond carefully and completely.

Please provide the following information.

Pseudonym or SSN: _________________________________________

Date ________________ Age____________________ Gender (Please Circle): F  M

Mathematics Self-Efficacy Scale

Directions:

This is a math test in which NO PROBLEMS ARE SOLVED. Indicate how confident you are in your ability to solve the problem by circling the letter according to the following 5-point confidence scale.

Confidence Scale:

No Confidence at all Very little Confidence Some Confidence Much Confidence Complete Confidence

A        B        C        D        E

It is important that you not spend much time thinking about the problem —limit yourself to a maximum of about 20 seconds per problem. DO NOT SOLVE THE PROBLEMS.

(Please Go To The Next Page)
Indicate how confident you are in your ability to solve each problem. **DO NOT SOLVE.**

<table>
<thead>
<tr>
<th>No Confidence at all</th>
<th>Very little Confidence</th>
<th>Some Confidence</th>
<th>Much Confidence</th>
<th>Complete Confidence</th>
</tr>
</thead>
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<td>A</td>
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</table>

1. Solve: \( \frac{1}{6}x + \frac{1}{2}x = \frac{1}{3}x - 4 \)

2. A rectangular computer screen measures 8 inches by 11 inches. Find the length of a diagonal on the screen.

3. Solve: \( \frac{1}{x} - \frac{1}{5} = \frac{1}{2} \)

4. The price of a magazine subscription rose 5% this year. If the subscription now costs $21, how much did the subscription cost last year?

5. Solve the inequality \( 2(x - 2) - 3 < 3(1 - 2x) \)

6. Solve \( A = P + PRT \) for \( P \)

7. One-fifth of a number plus one-fourth of the number is five less than one-half the number. What is the number?

8. Write the equation of line in slope intercept form that passes through the points (2, 5) and (0, 9).

9. Solve:
   \[
   \begin{align*}
   3x + y &= -2 \\
   3x - y &= -10
   \end{align*}
   \]
Indicate how confident you are in your ability to solve each problem. **DO NOT SOLVE.**

<table>
<thead>
<tr>
<th>No Confidence at all</th>
<th>Very little Confidence</th>
<th>Some Confidence</th>
<th>Much Confidence</th>
<th>Complete Confidence</th>
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</table>

10. A runner runs a course at a constant speed of 6 mph. One hour after the runner begins, the cyclist starts on the same course at a constant speed of 15 mph. How long after the runner starts does the cyclist overtake the runner?

11. Simplify and write without negative exponents.

\[
\left( \frac{x^3 y^{-4}}{3x^5 y^{-7}} \right)^{-2}
\]

12. An accountant invests part of a $6000 bonus in a 5 percent simple interest account and the remainder of the money at 8.5 percent simple interest. Together the investments earn $370 per year. Find the amount invested at each rate.

13. Factor completely \(5x^3 - 9x^2 - 2x\)

14. Solve \(x(2x - 8) = -6\)

15. A chemist mixes an 11% hydrochloric acid solution with a 6% hydrochloric acid solution. How many milliliters (ml) of each solution should the chemist use to make a 600-milliliter solution that is 8% hydrochloric acid?

16. Simplify \(\frac{x + 1}{x^2 - x} - \frac{x}{x - 1}\)

275
Indicate how confident you are in your ability to solve each problem. **DO NOT SOLVE.**

<table>
<thead>
<tr>
<th>No Confidence at all</th>
<th>Very little Confidence</th>
<th>Some Confidence</th>
<th>Much Confidence</th>
<th>Complete Confidence</th>
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17. Krista must have at least 90% of the points in her math class to get an A. The grade is determined by three 100-point tests and a 150-point final exam. If she has 85, 92, and 96 on her tests, what range of scores on the final will give her an A?

18. If Mary can mow a yard in 6 hours and Katie can mow the same yard in 3 hours, how long will it take to mow the yard if both work together?

19. Simplify $\sqrt[3]{27x^3y^2}$

20. The length of a rectangle is 8 cm. more than the width. Find the dimensions if the area is 240 cm$^2$.

**Thank you!!**
APPENDIX F

Technique Guidelines
Positive Affirmation Statements

What are positive affirmation statements?

Positive affirmation statements are short sentences and/or statements that implant in your subconscious mind ideas which are designed to enhance self-image, achieve a positive mental attitude, or help lead you toward a specific goal. They are statements that affirm a belief you want to feed to your subconscious mind. They can be used to counterbalance and overcome the negative thoughts that we so often focus on with our self-talk.

Developing positive affirmation statements

The use of affirmation statements requires that the first affirmations be general in nature. Statements such as "I can do it," or "I believe I can," or, simply "I believe" would be appropriate. These statements are so general that they are not suggesting in any way what you can do; they are just opening the mind for acceptance as well as for more specific statements in the relaxed state.

Guidelines for developing affirmation statements

1. Word the positive affirmation statements so that they are positive in nature. Focus the statement on what you will be doing — no on what you will not be doing. For example, state "I am relaxed" rather than "I am not tense." Remember, the mind focuses subconsciously on the behavior you are suggesting. Instead, the statement should be reconstructed to reinforce the positive behavior you want carried out. For example: "Be careful with the milk" compared to "Don't spill the milk on the rug."

2. Make the positive affirmation statements as brief as possible. Focus the statements on precisely what you would like to achieve, the exact goal. There is no sense in creating a fog caused around the goal, disguising it with unnecessary words.

3. Select vivid words for your positive affirmation statements. The way you state or verbalize something can influence your mood and feelings, so be precise as well as vivid in selecting the statement. Each time you repeat the affirmation, you want to reinforce the emotional feeling that accompanies the action it describes.

4. Use the present tense whenever possible in your positive affirmation statements. This makes the visualization as well as the emotions evoked more vivid and more believable.
Guidelines for Mental Recall

1. Select a recall experience or experiences in which you performed perfectly or near perfectly.
   - Does not have to be an event that was entirely successful, but one in which a portion of the experience was highly successful.

2. Recall the experience in as much detail as possible.
   - After identifying a recall event, and before you begin practicing, make a written list of as much detail as you can recall consciously: your feelings before the event; your confidence; the actual event as seen from your eyes.
   - The key to developing detail is to use as many senses as possible.

3. Relive the experience from inside the body -- just as it actually happened.

4. Carry each recall experience through to completion.

5. REHEARSE DAILY
   - The key here is the same as it is for physical conditioning and skill acquisition --
     Regular Practice.
   - Daily or near-daily basis.

   - If you have difficulty staying alert, shorten practice sessions or break up practice sessions. Don't get too relaxed.
MENTAL REHEARSAL

Positive affirmation statements affirm a belief you want to feed to your subconscious mind. Mental recall provides the strength for the upcoming program by recalling, step by step, feelings of success by implanting in your subconscious images and feelings of success you’ve already experienced. Now, through mental rehearsal, you will use powers of your mind to improve future performances.

What is mental rehearsal?

Mental rehearsal is a skill, a process during which you use your mind to visualize desired results of a future event. The key is to remember that during mental rehearsal you will guide the mind—be in control of it—to accomplish desired results.

You’ve used visualization before. We all have. But all too often visualization is used in a negative, destructive manner. People use the detrimental side of visualization by viewing undesired results as well as by worrying, thus imprinting in the subconscious mind negative thoughts, feelings and behaviors that erode self-concept and reinforce negative behaviors.

Using the above definition of mental rehearsal, we will be focusing on the positive—selected goals and behaviors that you would like to achieve rather than the negative thoughts and worries that so often fill one’s mind. In this way we will be etching a blueprint of these desired results into our subconscious.

Why use mental rehearsal?

1. To enhance self-image. You always perform consistently with your self-image. If you are not performing up to the level of your abilities, it is quite probable that your self-image is not at the level it should be. By repeatedly visualizing positive upcoming events, you can strengthen the self-image base which was laid by mental recall.
2. To practice future events. Mental rehearsal can be used to practice future events which are likely to happen. You can not only visualize in your mind what you want to happen, but you can also visualize every conceivable situation that could happen. This would be done to help you prepare for and respond to each of these possible situations.

Goals and mental rehearsal

To be successful with visualization you must have clear and concise pictures of the desired behavior. The success mechanism in our body is activated by goals. Research indicates that successful people (1) all have Goals— they know exactly what they want, and (2) resolve to pay the price necessary to accomplish these goals. Obviously, one cannot resolve to pay the price, in fact, one cannot know what the price is, unless one has identified the goals in the first place.

To be successful, one must not only define goals but also have a general understanding of goals and of how to use them properly.
Goals provide direction

There is an old saying in education that states “If you don’t know where you are going, you are liable to end up somewhere else.” This is true in all aspects of our life. You don’t receive a college diploma because you happen to be walking by an auditorium on commencement day. To accomplish that degree, you have a goal. You know what you want, know what you have to pay to accomplish the goal, and are willing to put years of effort into taking classes, studying, and working in a specific direction — to get the degree.

The goal provided direction. When you know what your goal is, you know when you get off track and can take corrective action to get going in the right direction again. Without goals, you can’t assess whether you are on track and moving in the right direction or not.

Goals should be specific

To be most successful using visualization, you should develop specific goals.

Goals should be high but achievable

You should select goals within your reach yet high enough to allow you to move to the next plateau of achievement.

Goals should be written

If goals are to be specific and provide direction, they must be written down. Many people argue that they have thought about their goals and know what they are and, therefore, don’t need to write them down. However, unwritten goals often remain vague. Committing goals to paper helps you make them more specific. You gain a new perspective when they are in this more concrete form. Once goals are in written form you can add sub-goals as well as analyze, change and update the goals on a regular basis.

The key to success is to identify the most important goals and then regularly visualize the achievement of these goals. Establish a major goal and related sub-goals; then use mental conditioning to accomplish these goals.

Guidelines for practicing mental rehearsal

Once you have selected a specific goal, it is time to add mental rehearsal to mental conditioning. The guidelines for mental rehearsal are similar to those for mental recall.

1. Visualize a performance that is near perfect, positive, and during which you accomplish your goal.
2. Visualize the experience in detail, using as many senses as possible.
3. Visualize the performance from inside the body as if you are actually performing.
4. Carry the visualization through to completion.
5. Rehearse regularly.