

ABSTRACT

ZMUDY, M. H. The effects of participant belaying on self-efficacy of college students in indoor rock climbing. MS in Exercise and Sport Science-Physical Education Teaching, August 1999, 51 pp. (J. Steffen)

This study was designed to determine if participating in the technical skill of belaying during the activity of indoor rock climbing could improve self-efficacy. The sample included 41 male and female Ss. Subjects self-assigned themselves into 1 of 2, 8 week, indoor rock climbing courses offered at the University of Wisconsin-La Crosse. Ss were randomly selected as either a control (n = 20) or belaying (n = 21) group via random numbers table. Subjects completed a pre- and posttest measuring their general and rock climbing self-efficacy. Belaying subjects participated in 28 hours of rock climbing instruction during which time they were shown proper belay protocol and were assigned the responsibility for belaying climbers. Subjects in the control group received the same amount of climbing instruction but did not perform belaying. Results of a one-way ANCOVA indicated no significant ($p > .05$) difference between the two groups on the posttest scores. Also, the results indicated no difference between males and females in the belaying group on the posttest scores.

THE EFFECTS OF PARTICIPANT BELAYING ON SELF EFFICACY OF COLLEGE
STUDENTS IN INDOOR ROCK CLIMBING

A THESIS PRESENTED
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The candidate has successfully completed the thesis final oral defense.

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CHAPTER I

INTRODUCTION

In 1991 the National Association for Sport and Physical Education (NASPE, 1991) implemented outdoor adventure as an activity category to be utilized in public and private schools nationwide. Since that time, adventure activities have become a very popular aspect of many physical education curriculums. Some of the reasons adventure activities may have become so popular are that they offer a way for teachers to design lesson plans that focus on cooperation, full participation for all students regardless of ability level, and they incorporate all the domains (cognitive, psychomotor, and affective). One domain that outdoor adventure seems to emphasize is the affective domain. It is within this domain that instructors deliver experiences that point to the attitudes, values, and perceptions of self.

One adventure activity that is currently popular in physical education that can allow participants to learn skills such as climbing techniques and climber belaying is indoor rock climbing. In this sport, participants rise to the occasion of challenging themselves to climb to the highest point possible on an artificial rock surface that is constructed on an indoor wall face. The same equipment that is used for technical climbing in outdoor settings is also used for the indoor adventure. Equipment includes climbing shoes, a special dynamic rope that is designed for the purpose of rock climbing, harnesses to be worn by the climber and the person protecting the climber in the event of

a fall (the belayer), and many possible belay devices (pieces of hardware that are designed for a rope to go through to manufacture a friction dependent braking system that will stop a climber from falling more than a few inches). Also special clips called carabiners are used to clip a rope to a belayer or to a climber.

In many instructional situations it is typical for teachers to take the lead role when it comes to performing the technical skill of belaying. This is especially true in instances where the climbers are beginners. A positive point about teacher control over belaying is the likelihood that this extremely important skill will be performed properly. On the other hand, teacher control over belaying may detract from maximizing the extent to which students feel a sense of accomplishment in the adventure arena.

Priest (1995) conducted a study surrounding the issue of participant belaying utilizing corporate clients as subjects. The clients were all employees involved in assembly line functions of a four shift manufacturing process. Each corporate worker was paired with another employee as partners for the study.

The purpose of the study was to find out if the type of belayer in rock climbing had any influence over the development of trust between partners involved in the activity of rock climbing. Priest (1995) found that partners belayed only by clients of the manufacturing plant developed a higher level of trust between each other than any of the other possible belaying situations for the study (i.e., being belayed by program facilitators, climbing technicians, or not participating in climbing at all). According to Priest interactions were discovered for overall trustworthiness and four of the five subscales: "acceptance (of other people's ideas), (maintenance of) confidentiality, dependability (to get the job done), and encouragement (of risk takers)" (p. 108).

Means for the groups who were belayed by facilitators and technicians dropped 1 month after the rock climbing program and stayed lowered 3 months later. Means for the groups who were belayed by clients had risen 1 month after the rock climbing program and stayed raised 3 months later. "Obviously, the type of belayer had a profound effect on the development of trust and components of trust between partners in this instance" (Priest, 1995, p. 109).

Need for the Study

Currently in the field of outdoor/adventure education, there is much discussion and controversy about the safety and benefits of participant belaying in the sports of indoor and outdoor rock climbing. To date, few studies have been initiated involving college students and rock climbing (Barton, 1996; Frasier, 1998; McNamee, 1997). No studies were located that involve college students as subjects with regard to the benefits of participant belaying. Studies of this nature have generally focused on people working in corporate settings.

Purpose of the Study

The purpose of this study was to measure the effects of participant belaying on self-efficacy of college students enrolled in indoor rock climbing physical education classes.

Hypotheses

The following null hypotheses were tested in the study:

1. There will be no significant differences in self-efficacy between the control and belaying groups as a result of participating in the technical skill of belaying.

2. There will be no significant differences in self-efficacy between male and female belayers as a result of participating in the technical skill of belaying.

Assumptions

The following assumptions were made in this study:

1. Students were interested in performing the technical skill of belaying.
2. All subjects were honest and accurate in their responses to the questions in the pre- and posttests.
3. Any reports of increased self-efficacy from the treatment group were due to the actual experience of belaying and not merely due to being chosen as a belayer.

Delimitations

The delimitations for the study were:

1. Subjects were undergraduate students, both male and female, from the University of Wisconsin-LaCrosse (UW-L).
2. The format of instruction on how to perform the technical skill of belaying was the same for all subjects.
3. The same instructor taught both the treatment and control groups so that teaching style does not become a variable for the study.

Limitations

The limitations for the study were:

1. A nonrandom sample was used for the experiment due to the fact that subjects were volunteers from preestablished rock climbing courses at UW-L.
2. The researcher could not control motivation and mood levels of subjects.

Definition of Terms

Affective Domain- objectives in the affective domain point to student feelings, attitudes, values, and social behaviors (Rink, 1993).

Air Traffic Controller- a modification of the original Sticht plate invented in Germany; a belay device that is designed in such a way that if needed, the rope can be passed through it twice (Watts, 1996).

Belaying- a technique of protecting the climber in the event of a fall. A rope from the climber's harness is anchored and controlled by a belay device (either the human body or a mechanical system). The rate at which the rope passes through that system, or around the body, is controlled by a belayer (someone who can hold the rope and can stop the fall of the climber with the friction created by the belay device) (Priest, 1995).

Figure 8 Follow Through- a knot that is commonly used to tie a climber into a belay system having the appearance of a number eight. It is known as the figure 8 follow through due to the retracing of the knot that is done with the free end of the rope (Luebben, 1993).

Outdoor/Adventure Education- a situation in which the student is placed in a novel setting and experiences a state of disequilibrium while being faced with unique problem solving situations (Project Adventure, 1989).

Self-Efficacy- the belief of a person that a certain behavior can be accomplished in order to achieve a desired outcome (Bandura, 1977).

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

This chapter examines physical education, outdoor/adventure education, self-efficacy, indoor rock climbing, and the ways in which these areas of study interrelate. A review of related literature on these topics is presented and conclusions are drawn about their relationships as a basis for discussion.

Physical Education

American physical education seems to be one of the only professions intentionally educating the nation about proper skills execution combined with knowledge and benefits of physical activity. The distinguishing factor is the specialization activity areas, proper movement, and skills execution combined. The distinction of specialization of activity categories (individual, team, dual, aquatics, dance, and outdoor) (NASPE, 1991) as well as proper skills is noted because there are in fact many entities that support the notion that physical activity is beneficial for people.

In July 1994, the office of the Surgeon General of the United States authorized the Center for Disease Control to serve as lead agency for preparing the first Surgeon General's Report on Physical Activity and Health (U.S. Department of Health and Human Services, 1996). The purpose of the report was to summarize literature on the role of physical activity preventing disease. Also to be examined were national efforts

The President's Council on Physical Fitness and Sports joined the Center for Disease Control in this effort as a collaborative partner representing the Surgeon General. Also involved were the following: the Office of Public Health and Safety (Office of the Secretary); the Office of Disease Prevention; the National Heart, Lung and Blood Institute; the National Institute of Child Health and Human Development; the National Institute of Diabetes and Digestive and Kidney Diseases; and the National Institute of Arthritis and Musculoskeletal and Skin Diseases. Other nonfederal agencies participated in the effort including the American Alliance for Health, Physical Education, Recreation and Dance, the American College of Sports Medicine, and the American Heart Association (U.S. Department of Health and Human Services, 1996).

According to the Surgeon General's report, regular activity improves health, and greater health benefits can be achieved by increasing the amount (duration, frequency, and intensity) of physical activity. Among the benefits achieved through physical activity were reduction of the following: premature death; heart disease; developing diabetes; developing high blood pressure; developing colon cancer; feelings of depression and anxiety; and being overweight. Other benefits reported were maintenance of healthy bones, muscles, and joints; older adults being stronger and less likely to experience injurious falls, and the promotion of psychological well being (U.S. Department of Health and Human Services, 1996).

The term physical education has been misinterpreted in several ways. "To some it is associated only with play -- a concept denoting little or no purpose and the lack of need for physical education specialists. To others physical education is synonymous with the highly competitive endeavor we attribute to interscholastic and intercollegiate athletics.

Still others compare physical education to the "regimented" form of activity associated with the military. These interpretations are not accurate" (Seaton, Schmottlach, Clayton, Leibee, & Messersmith, 1993, p. 1).

The term physical education means training the physical; and equally important, educating people about their bodies and their bodies' needs (Bucher & Thaxton, 1981). According to Bucher and Thaxton, in order to meet the challenge of providing adequate health services for the nation, physical education must concern itself not only with physical activities, but additionally with informing the public of the biological impact that physical activity has on the body.

Furthermore, Strand and Johnson (1998) stated that incorporated in physical education is the term "fitness." A statement made by the American Medical Association and the Association for Health, Physical Education, and Recreation (1964) said: "fitness for effective living implies freedom from disease, enough strength, agility, endurance and skill to meet the demands of daily living; sufficient reserves to withstand ordinary stresses without causing harmful strains; and mental and emotional adjustment appropriate to the age and maturity of the individual" (p.123). Learning about fitness can promote good health and well being throughout life.

According to Rink (1993), instruction in physical education is seen as a goal oriented activity. This means the process is meaningless unless it is designed with a clear goal regarding what the student will learn. Instructional processes are specific to intent. This means that the teacher selects an instructional process to best accomplish a specific purpose. For instance, a teacher may lead students through a problem-solving experience in balance to help them understand principles related to base of support. The teacher

selects problem solving rather than telling because the teacher's objective is not just that students know the information but that they are able to use the information in their balance activities.

Different teachers have different beliefs about teaching that affect the way they teach. Beliefs in teaching commonly have their roots in theories of learning in psychology and philosophy and are concerned with issues related to what is most important for schools to teach and how people best learn (Rink, 1993).

Physical education has historically been a field in which the goal was to educate the whole person. There were objectives pertaining to an individual's mental, emotional, and social well being. At times, this holistic goal seems to have been lost to an emphasis on physical fitness and skill development alone (Bunting, 1989). This is apparent especially in programs where "traditional" team sports are the only emphasis. Fortunately, the trend of a holistic approach was carried into the 1990's by the implementation of the outdoor adventure area as a category of teaching physical education (NASPE, 1991).

Sport is an excellent vehicle for reaching physical education objectives (Siedentop, 1994). However, there are many additional ways to accomplish lesson planning that will still incorporate all three domains of physical education

If a school desires a holistic physical education program, then having an outdoor/adventure education component can greatly assist in accomplishing that objective. Outdoor education emphasizes learning in all domains through physical activity as well as for physical well being and fitness (Bunting, 1989).

When one observes the three domains of physical education (cognitive, psychomotor, and affective) and how fitness and skill development have been emphasized, it may be apparent that the affective domain has at times been left behind.

Outdoor Adventure Education

Outdoor education with its many facets continues with the goal of educating the whole person (Bunting, 1989). With holistic learning being at the heart of outdoor education, all three domains (and especially the affective domain) are intentionally emphasized and planned for.

Outdoor adventure education involves the purposeful planning and implementation of educational processes that involve risk in some way. The risk may be physical, as in a trip in a mountain wilderness where people may be caught in storms, may become lost, or may become injured by falling rocks. It may be social, as in asking someone to expose their fear of speaking before groups or otherwise risk social judgement. The risk may be spiritual, as in placing the learner in a situation where he or she must confront the self and perhaps the meaning of life and death (Miles & Priest, 1990).

The defining characteristic of adventure education is that a conscious and overt goal of the adventure is to expand the self, to learn and grow and progress toward the realization of human potential (Miles & Priest, 1990). In our world, the horizon extends beyond the classroom. It soars across town, into the country, and away into unknown places. "As we feel the urge to grow and explore, it is not enough for children to remain in classrooms and look out" (Swan, 1987 p. 2). They must directly experience the excitement for themselves.

During the time period from the late 1800's to the 1980's, people all around the world gradually took an interest in the outdoors for leisure-time experiences. Since World War II, the amount of available outdoor activities has increased astonishingly. Literally millions of people are backpacking, cross-country skiing, rafting, canoeing, bicycling, and hiking, climbing or caving. These participants are "moving across land and water in search of enjoyment in natural and primitive settings" (Ford & Blanchard, 1993, p. 1).

In recent years, there has been a very large increase in professional interest in the subject of high adventure programs. This interest has of course paralleled the aforementioned popularity of high adventure pursuits (Meier, Morash, & Welton, 1987).

Unfortunately, the "purposes as well as the benefits of outdoor adventure activities seem to be, at times, generally misunderstood" (Darst & Armstrong, 1980, p. xi). Darst and Armstrong stated that much of what has been written about adventure programs suggests a negative reaction, due to a reluctance to assume legal responsibility for those involved. However, the number of participants continues to rapidly increase emphasizing the need for high-quality education programs to develop competent leaders who can deliver appropriate instruction in the area of outdoor adventure.

A positive response to this need appeared in 1991 when the National Association for Sport and Physical Education (NASPE) introduced its new benchmarks for the standards of physical education curriculums nationally (NASPE, 1991). At the eighth grade level, this document specifically stated students shall "explore introductory outdoor pursuit skills (e.g., backpacking, rock climbing, hiking, canoeing, cycling, and ropes courses" (NASPE, 1991, p. 7). Additionally, it is stated as an objective that "students

will be able to demonstrate basic competence in physical activities from each of the following categories: aquatics; self-defense; dance; individual, dual, and team activities and sports; and outdoor pursuits" (NASPE, 1991, p. 8).

The implications of adding outdoor pursuits as a category for physical education teaching seem important in terms of recognition for the field of outdoor/adventure education. The Surgeon General, as well as many other organizations, supports physical activity as being beneficial to health. The American Alliance for Health, Physical Education, Recreation, and Dance (AAHPERD), which is the governing body in which NASPE is an association, was one of the entities to add support to the report of the Surgeon General. AAHPERD is also the leading Alliance for providing direction for physical education teaching curriculum in the U.S. It would seem then that if the Surgeon General along with many other organizations are in favor of AAHPERD and NASPE, and NASPE supports outdoor adventure as a category for teaching, then the nation has moved toward accepting outdoor adventure as a reasonable curricular offering.

It has been suggested that (in addition to outside organizations) teachers in schools should recognize the inherent qualities of adventure education, which incorporates adventure and the experiential learning process (Westheimer, Kahne, & Gerstein, 1992). Westheimer, Kahne, and Gerstein stated that experiential education philosophically and educationally provides a perspective that is in line with many educational reform initiatives. They noted that adventure education emphasizes activity, cooperation, challenge, risk and problem solving. Additionally, many traditional approaches rely on abstract principles and result in student passivity.

Students enroll in physical education classes to meet varying needs and expectations. "Movement opportunities, fun, the learning of new skills, self-expression, feeling competent and successful, and being members of a group are a few examples of why students may become involved in physical education" (Grineski, 1989, p. 21).

Project Adventure (1989), a leading organization for the development of adventure activities and ropes course programs, stated that "the aim of many activities is to allow the students to view themselves as increasingly capable and competent. By attempting a graduated series of activities, which involve physical or emotional risk, and succeeding (or sometimes failing) in a supportive group atmosphere, a student may begin to develop true self-esteem" (p. 3).

While adventure education programs may teach such skills as navigation, canoeing, and rock climbing, the teaching of such skills is not the primary goal of the enterprise. The learnings about the self and the world that come from engagement in such activities are the primary goals (Miles & Priest, 1990). Perhaps a benefit of learning about the self through adventure experiences is that they will reach individuals in such a way as to enhance self-efficacy.

Self-Efficacy

According to Bandura (1977) self-efficacy beliefs have four principle sources. The sources are: 1) enactive mastery experiences; 2) vicarious experiences (comparisons); 3) verbal persuasions and allied types of social influences; and 4) physiological and affective states.

Enactive mastery experiences are authentic experiences during which a person must produce the behavior needed to succeed in a given situation. Due to the aspect of

authenticity, these experiences are seen as the most influential of the efficacy information sources. Successes help build a strong sense of efficacy, whereas failures undermine it. This is especially true if a failure occurs before a firm sense of efficacy is established.

“Vicarious experiences impact self-efficacy through modeling” (Bandura, 1997, p. 86). Modeling can be an effective way to raise efficacy because people often measure their own capabilities in relation to the capabilities of others. For example, if my best friend is a great batter in baseball and I believe I am very much like my friend, I may attain a stronger sense of my own batting capabilities by watching and evaluating him/her.

Classic to physical education teaching, “verbal persuasion can have an effect on self-efficacy through the use of various kinds of feedback” (Bandura, 1997, p. 101). Evaluative feedback describing a person’s capabilities may influence efficacy beliefs. Ability feedback (specific in nature) at early stages of the learning process may impact self-efficacy. And feedback suggesting that effort will impact success can impact one’s perceived self-efficacy.

Physiological and affective states (Bandura, 1997) such as tension, fatigue, or mood can have an effect of self-efficacy. Bandura stated that “affective states can have generalized effects on personal efficacy in diverse spheres of functioning. Therefore, the fourth major way of altering efficacy beliefs is to enhance physical status, reduce stress levels and negative emotional proclivities, and correct misinterpretations of bodily states” (p. 106).

Pajares (1996) stated “self-efficacy is defined in terms of individuals’ perceived capabilities to attain designated types of performances and achieve specific results”

(p. 546). The aspect of achieving specific results through ones own capabilities is what differentiates self-efficacy from other theories regarding perception of self.

Generally, assessments of self-efficacy are done by researchers by asking people to tell the strength, generality, or level of their confidence to accomplish a task or succeed in a certain situation (Bandura, 1977). According to Anderson (1994), "strength describes how confident the person is that the estimate is correct. Level describes the performance level or task difficulty one feels capable of mastering. Generality refers to the range of behaviors or contexts to which efficacy applies. For example: 'I am absolutely certain (strength) that I can teach college level calculus (level) to any interested student in this school (generality).' This indicates a higher efficacy than 'I am fairly sure that I can teach basic algebra to the top 25% of my students'" (p. 15)

In terms of self-efficacy, Albert Bandura (1977) is noted as the leader of all theorists when it comes to proper understanding.

Bandura stated: "an outcome expectancy is defined as a person's estimate that a given behavior will lead to certain desired outcomes. An efficacy expectation is the conviction that one can successfully execute the behavior required to produce the outcomes. Outcome and efficacy expectations are differentiated, because individuals can believe that a particular course of action will produce certain outcomes, but if they entertain serious doubts about whether they can perform the necessary activities, such information does not influence their behavior" (p. 193).

Ozer and Bandura (1990) used the term control in explaining that perceived self-efficacy is concerned with "peoples belief in their capabilities to mobilize the motivation, cognitive resources, and courses of action needed to exercise control over given event" (p. 472).

Self-efficacy as a behavior predictor is believed to depend on two assumptions. The two assumption are: a) ample motivation to perform the behavior, and b) possession of the skills needed to perform it (Anderson, 1994).

Albert Bandura (1986) stated that each individual possesses a self-system enabling them to exercise a measure of control over his/her thoughts, feelings and actions. Bandura as quoted in Pajares (1996) painted a picture of human behavior and motivation "in which the beliefs about themselves are key elements in the exercise of control and personal agency" (Pajares, 1996, p. 549). Bandura (1986) considered self-reflection to be the most unique of human capabilities. He stated that "through this form of self referent thought, people evaluate and alter their own thinking and behavior" (Pajares, 1996, p. 562). These self-evaluations include perceptions of self-efficacy, or "beliefs in one's capabilities to organize and execute the courses of action required to manage prospective situation" (Bandura, 1986, p. 2).

Low self-efficacy may lead to a person believing that things are tougher than they really are. This is a belief that could foster stress, depression, and a "narrow vision of how best to solve a problem" (Pajares, 1996, p. 545). High self-efficacy, on the other hand, can help a person feel calm and relaxed when approaching difficult tasks and activities.

Crucial to understanding the true meaning of self-efficacy is the grasping of the idea that the definition of self-efficacy does not stop with the notion that one believes he/she is capable of accomplishing a desired behavior. "Bandura suggested that a person's perception of self-efficacy will determine whether that person engages in a certain behavior" (Anderson, 1994, p. 15).

As reflected in this review, when a discussion of self-efficacy is at hand it will be virtually impossible to neglect the expertise of Albert Bandura. For many years, the works Bandura have been recognized as the most influential. That is not to say though, that many others have not made substantial contributions. Because of the extent to which Bandura has influenced research regarding self-efficacy, the following quotes from Bandura have been included to help the reader further understand the definition and different facets of self-efficacy.

Bandura (1999) quotable quotes:

- "What people think, believe, and feel affects how they behave. The natural and extrinsic effects of their own actions in turn, partly determine their thought patterns and affective reactions."

- "Success and failure are largely self-defined in terms of personal standards. The higher the self-standards, the more likely will given attainments be viewed as failures, regardless of what others might think."

- "Ironically, it is the talented who have high aspirations, which are possible but exceedingly difficult to realize, who are especially vulnerable to self-dissatisfaction despite notable achievements."

- "By sticking it out through the tough times, people emerge from adversity with a stronger sense of efficacy."

- "People who hold a low view of themselves will credit their achievements to external factors rather than to their own capabilities."

"If self-efficacy is lacking, people tend to behave ineffectually, even though they know what to do."

- "Persons who have a strong sense of efficacy deploy their attention and effort to the demands of the situation and are spurred by obstacles to greater effort."
- "Perceived self-efficacy also shapes causal thinking. In seeking solutions to difficult problems, those who perceive themselves as highly efficacious are inclined to attribute their failures to insufficient effort, whereas those of comparable skills but lower perceived self-efficacy ascribe their failures to deficient ability (p. 3)."

Indoor Rock Climbing

Many studies have been conducted regarding adventure education and activities and their different effects on the growth and development of people as individuals as well as in groups (Bunting, 1989; Dyson, 1996; Flor, 1991; Hunt 1991; Luckner, 1994; Priest, 1995; Priest & Gass, 1997; Wright, 1983). However, only a few have focused on isolated rock climbing skills. Fewer yet, if any at all, have focused on specific climbing skills and their effects on self-efficacy.

A currently popular sport that is in the adventure category, which equally emphasizes all three domains of physical education, and may provide experiences that allow participants to develop self-efficacy, is indoor rock climbing. Rock climbing has become quite popular and has grown as an adventure activity. Understanding the definition of rock climbing in modern times can be both easy and difficult due to the distinctions between bolt protected and free climbing. If those interested in climbing are looked upon as a group then "modern" rock climbing would be described as bolt-protected face climbing (Skinner & McMullen, 1993). This means certain equipment

must be utilized to aid a climber in ascending the face of a rock. When climbers are looked upon as individuals, the climbing of a rock is noted as free climbing.

Skinner and McMullen (1993) indicated that the activity of free climbing is entirely dependent on footwork, ability, skill, and physical strength in order to make the ascent up the rock face. The equipment that is used during the free climb (harness, rope, carabiner, and helmet) is present only for safety in the event of a fall.

Generally, indoor climbing facilities nationwide incorporate the style of free climbing as the only means allowed. Rarely, if ever, will one observe the practice of aid climbing maneuvers at an indoor facility (Frasier, 1998).

Indoor climbing walls have become increasingly popular all over the U.S. and have emerged in such places as university field houses, recreation centers, schools, and camps. In 1992, Fesko estimated that there were between 1,000 and 1,500 indoor climbing facilities in the nation open for public use (Fesko, 1992). This does not consider the ones that were in operation for educational uses only. Since that time, "the climbing gym industry has expanded into a worldwide phenomenon" (Martin, 1997, p. 1).

Climbing walls are advantageous because they allow the beginner to experience success during a safe and enjoyable introduction to climbing. Advanced climbers are able to practice and perfect technique without distractions of weather, loose holds, and route finding (Long, 1994).

One particular aspect of indoor rock climbing that may have self-efficacy enhancing potential is the skill of belaying. According to Priest (1995), belaying is a "technique of protecting a climber in the event of a fall. A rope from the climber's

harness is anchored and controlled by a belay device (either the human body or a mechanical system). The rate at which the rope passes through that system, or around the body, is controlled by a belayer: someone who can hold the rope and can stop the fall of a climber with the friction created by the belay device” (p. 107).

CHAPTER III

METHODS AND PROCEDURES

Introduction

The primary purpose of this study was to measure the effects of participant belaying on self-efficacy of college students enrolled in indoor rock climbing physical education classes. Half of the subjects in the study were climbers as well as belayers (belaying group), while the other half were climbers only (control group). The following hypotheses were tested:

1. There will be no significant differences in self-efficacy between the control and belaying groups as a result of participating in the technical skill of belaying.
2. There will be no significant differences between male and female belayers as a result of participating in the technical skill of belaying.

This chapter presents information concerning a) subjects, b) instruction for the study, c) the activity environment, d) testing and instrumentation procedures, and e) statistical treatment of data.

Subjects

Male and female college students were eligible to participate in the study on a volunteer basis after enrolling in one of two sections of indoor rock climbing (ESS100) at the University of Wisconsin-La Crosse. Each class was divided in half by use of a random numbers table.

Half of each class was placed in the belaying group, and the other half was placed in the control group. Therefore, each of the two class sections was comprised of 50% belayers and 50% nonbelayers. This method of dividing groups was used so that each class would be self-sufficient. If one whole class would have been assigned to be the control group (nonbelayers), that class would have had to rely on much outside help for belaying assistance.

After enrolling in the class on their own, students were randomly assigned to either the belaying or control group via the use of a random numbers table (Thomas & Nelson, 1996). A number was randomly selected (the number 7 on the table), and the seventh person on the list became the first person to be assigned to the belaying group. From here, every other person was assigned to either the control or belaying groups until all were placed in one of the two groups. The two halves from each class that were in the treatment groups comprised the whole belaying group for the study, while the two halves from each class in the control groups comprised the whole control group for the study.

One class section began meeting in January 1999 and finished half way through the spring semester (Section I). The other class began in March 1999 and finished in May (Section II).

Class Section I

There were 21 subjects in the first class section. After random assignment, the belaying group consisted of 11 and the control group consisted of 10.

Class Section II

There were 20 subjects in the second class section. After random assignment, both the belaying and control groups each consisted of 10.

Instruction

The first class section began January 25, 1999 and ended March 2, 1999. The class met 14 times for approximately 28 hours of instruction. The second class section began March 22, 1999 and ended May 5, 1999. This class also met 14 times for approximately 28 hours of instruction. The same instructor taught both class sections, and the same lesson plan format was utilized for each class (see Appendix A). Therefore, teaching style was removed as a factor that could have an effect on the results of the study.

On the first day of each class the researcher met the students and explained the study. At this time, the informed consent (see Appendix B) and pretest (see Appendix C) were administered to those who chose to participate in the study. All present were given the opportunity to have questions answered.

During the second class session, the subjects in the belaying group were shown proper belaying protocol (see Appendix D) for the climbing class while the control group was sent to another room to view a rock climbing video. From this point on, the people in the belaying group were to be the only ones allowed to perform belaying (in addition to the instructor) during the time of the study.

On the third to last class period during each class section the posttest was administered. Remaining time was spent explaining the belaying protocol for the class to

the control group. During the last two class periods, all involved in any aspect of the study were allowed to perform both climbing and belaying.

The Activity Environment

All climbing and belaying activity during the time of the study was conducted at the Mitchell Hall indoor climbing wall on the campus of the University of Wisconsin-La Crosse.

Testing and Instrumentation

A pre- and posttest design was used to determine self-efficacy of participants. All subjects were tested under identical conditions with exactly the same instrument for both the pre- and posttests (see Appendix C).

The instrument used in all pre- and posttests was a self-efficacy inventory with 18 questions. The first 10 questions were about general self-efficacy and were designed by Schwarzer (1992). The next eight questions were about self-efficacy in rock climbing and, with written permission from Schwarzer, the researcher designed these questions by modeling them after the first 10 questions (the general scale). All questions in the instrument are answered on a Likert type scale with four possible responses to each question. The possible responses were: 1) not true at all; 2) hardly true; 3) moderately true; and 4) exactly true. The person taking the assessment read each statement and circled the numbered response which best described him/herself.

The general scale was first written in the German language and was developed by Jerusalem and Schwarzer in 1981 in a 20-question format. Later, the scale was converted

into a 10-question version in many languages, including English (Jerusalem & Schwarzer, 1992).

According to Schwarzer (1992), the scale has "been used in numerous research projects, where it typically yielded internal consistencies between $\alpha = .75$ and $.91$. The scale is not only parsimonious and reliable, it has also proven valid in terms of convergent and discriminant validity. For example, it correlates positively with self-esteem and optimism, and negatively with anxiety, depression and physical symptoms." (p. 2-3).

After the scale was developed in full by the researcher with 18 questions, it was piloted among a small group of experts in the areas of self-efficacy and rock climbing. After the piloting process, appropriate revisions were made to the scale and it was administered at the meetings with the class sections.

To monitor subjects in the study, yet still maintain confidentiality, the researcher asked each of the participants to come up with a four-digit code name that only each person respectively and the researcher would know. To be "in line" with current trends in research protocol, the researcher insisted that code names not be related in any way to social security numbers.

Statistical Treatment of Data

Descriptive techniques were computed for control and belaying group characteristics and for mean scores and standard deviation on the efficacy assessment. Independent samples t-tests were computed to look for initial differences between control and belaying groups, and gender groups. Analysis of covariance was used to measure

self-efficacy scores as a result of performing the technical skill of belaying during indoor rock climbing.

CHAPTER IV
RESULTS AND DISCUSSION

Introduction

This chapter presents the results and discussion for the following data: a) demographic information of subjects, b) independent samples t-tests for initial differences among belaying and control groups, and c) analysis of covariance for posttest scores. The .05 level of significance was used for all statistical calculations.

Demographics

The demographics for the subjects (N = 41) in the study are presented in Table 1 by control group (n = 20), belaying group (n = 21), males (n = 26) and females (n = 15).

Table 1. Subjects Demographic Information

	Control	Belayers	Total
Male	n = 13	n = 13	n = 26
Female	n = 7	n = 8	n = 15
Total	n = 20	n = 21	N = 41

Pretest Analysis

Independent samples t-test for initial differences were calculated among genders in both general and rock climbing efficacy. This information is presented in Table 2. The information obtained from the test indicated a significant initial difference ($p < .05$) for

gender and general efficacy at a level of .028 with males reporting a higher level of efficacy than females. This information does not specify treatment groups (or levels of self-efficacy for those groups) that the males or females were placed in for the study.

Table 2. General and Rock Climbing Efficacy by Gender (pretest)

Gender	N	Mean	Standard Deviation	Significance (2-tailed)
General Pre-Males	26	3.5808	.3150	.028
General Pre-Females	15			
Rock Pre-Males	26	3.8077	.3067	.928
Rock Pre-Females	15			

Table 3 shows the results of the independent samples t-test for initial differences among the control and belaying groups. No significant difference ($p > .05$) between groups was reported indicating that the control and belaying groups were similar in both general and rock climbing efficacy at the beginning of the study.

Table 3. General and Rock Climbing Efficacy by Treatment Group (pretest)

Group	N	Mean	Standard Deviation	Significance (2-tailed)
General Pre-Control	20	3.5600	.2563	.198
General Pre-Belay	21			
Rock Pre Control	20	3.8250	.2344	.630
Rock Pre-Belay	21			

Posttest Analysis

An analysis of covariance was conducted to determine differences in general self-efficacy among the control and belaying groups on the posttest scores. No significant differences appeared indicating that performance of the technical skill of belaying had no effect with regard to general self-efficacy on the belaying group. These results are presented in Table 4.

Table 4. ANCOVA for General Efficacy by Treatment Group (posttest)

F	df	Significance
.007	1,18	.936

An analysis of covariance was conducted to determine differences in rock climbing efficacy among the control and belaying groups on the posttest scores. No significant differences were calculated indicating that the groups were similar at the end of the study, and performance of the technical skill of belaying had no significant effect on rock climbing efficacy. These results are presented in Table 5.

Table 5. ANCOVA for Rock Climbing Efficacy by Treatment Group (posttest)

F	df	Significance
.651	1,18	.425

An analysis of covariance was conducted to determine differences among genders in general self-efficacy in the belaying group at the end of the study. No significant differences were found indicating that males and females in the belaying group were similar at the end of the study, and performance of the technical skill of belaying had no effect on general self-efficacy of either gender. These results are presented in Table 6.

Table 6. ANCOVA for General Efficacy by Gender and Belaying Group (posttest)

df	F	Significance
1,18	1.213	.285

An analysis of covariance was conducted to determine differences among genders in rock climbing efficacy in the belaying group on the posttest scores. No significant

differences were found indicating that males and females in the belaying group were similar at the end of the study, and the performance of the technical skill of belaying had no effect on rock climbing efficacy of either gender. These results are presented in Table 7.

Table 7. ANCOVA for Rock Climbing Efficacy by Gender and Belaying Group (posttest)

F	df	Significance
.785	1,18	.387

Discussion

In the pretest analysis, an independent samples t-test indicated significant initial differences in general efficacy between genders at .028 ($p < .05$) with females having lower efficacy than males. The difference indicated was for all females combined whom participated in the study without distinction of whether they were in the control or belaying group. No other initial differences were noted for gender or treatment groups.

Analysis of covariance indicated no significant difference between treatment groups. These results demonstrate that participation in performance of the technical skill of belaying had no effect on either general or rock climbing efficacy of subjects in the belaying group. An analysis of covariance (ANCOVA) was also conducted to determine differences among males and females in the belaying group. The analysis of gender reported no significant difference between males and females in the belaying group as a result of participating in the technical skill of belaying. The initial difference in general self-efficacy between all males

and females combined (without specification of group) disappeared at the conclusion of the study.

Based on the results obtained from the analysis of covariance, the first hypothesis that there would be no significant differences in self-efficacy between the control and belaying groups as a result of participating in the technical skill of belaying failed to be rejected. Additionally, the second hypothesis that there would be no significant difference in self-efficacy between male and female belayers as a result of participation in the technical skill of belaying also failed to be rejected.

According to the statistical analysis, these results were indicated due to the apparent similarity of groups (control and belaying) both before and after the study. The researcher noted the results of the current study did not concur with a similar study conducted by Priest (1995). In the Priest study, which examined the effects of belayer type on development of trust between subjects, the results indicated a significant gain in trust among subjects due to participant belaying.

Additionally, Bandura's (1997) research on self-efficacy has as a crucial component the aspect of enactive mastery experiences (experiences during which a person must produce the behavior needed to succeed in a given situation). Successes help build a strong sense of efficacy whereas failures undermine it. Pajares (1996) stated that "self-efficacy is defined in terms of individuals' perceived capabilities to attain designated types of performances to achieve specific results." (p. 546). When one observes the technical skill of belaying as a set of behaviors that can be mastered by the individual that must also be successfully and appropriately delivered, the conclusion can be drawn that the outcome of the current study does not concur with research conducted by either Bandura or Pajares.

With indoor rock climbing being an activity that seems to be of high level adventure, the researcher believes that the self-selected group utilized as subjects for the study likely had a generally high level of efficacy to begin with because the mean for initial general and rock climbing efficacy for both the control and belaying groups was reported to be 3.5 on a 4.0 scale. For this reason, it would seem unlikely that significant changes in self-efficacy as a result of participating in the technical skill of belaying would occur.

In spite of the results of the study, the researcher noted the opinion that participant belaying is important because of the way in which it lends itself to enhancing experiences in the affective domain (Rink, 1993). In Priest's (1995) study, trust was developed and enhanced between partners due to participant belaying. Belaying is a task requiring a high level of responsibility. Developing sound relationships with others that incorporate trust, good feelings, and positive attitudes are an integral part of the interaction between a climber and a belayer. In the current study, the researcher looked upon self-efficacy as a relationship enhancing component that could be developed between a participant and him/herself.

In the field of outdoor adventure, the personal experiences of the researcher have been that of being encouraged to participate in the performance of technical skills to the maximum extent possible based on good judgement and sound leadership from instructors. *These experiences have had a major impact on feelings of competence and self-trust.*

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to determine the effects that performing the technical skill of belaying has on self-efficacy of college students in indoor rock climbing. Forty one subjects from the University of Wisconsin-La Crosse completed the study.

The subjects were derived from two class sections of the ESS 100 level indoor rock climbing physical education class. Half of each class was placed in a control group, only to perform climbing and not belaying during the time of the study. The other half of each class was placed in a belaying group with the assignment of performing both climbing and belaying during the time of the study. Each class section met 14 times for approximately 28 hours of activity time.

All subjects participated in pre- and posttesting during which they completed an 18-question self-efficacy scale (including general efficacy and rock climbing efficacy) with a four point Likert type scale. Efficacy scores were calculated for each individual, each gender, the control group as a whole, and the belaying group as a whole. Pre- and posttest data were collected from all groups and statistically analyzed to determine if increases in self-efficacy (both general and rock climbing) occurred as a result of participation in the technical skill of belaying.

The t-tests for initial differences indicated that the control and belaying groups were

similar. Incidentally, an initial significant difference among genders without specificity to control or belaying groups appeared at the level of .028 ($p < .05$) with females having lower general efficacy than males. However, due to lack of group specificity this information was beyond the scope of this study and therefore was considered by the researcher to have no impact on the overall outcome.

An analysis of covariance revealed no significant differences among control or belaying groups indicating that participation in the technical skill of belaying had no significant effect on either general or rock climbing efficacy. Analyses of covariance also indicated no significant difference in general or rock climbing efficacy between males and females in the belaying group.

The researcher believes that any significant change in self-efficacy among subjects would have been unlikely due to the fact that this self-selected group reported an initial general and rock climbing efficacy mean of 3.5 on a 4.0 scale.

Conclusions

Based on the results of this study, the following null hypotheses failed to be rejected:

1. There will be no significant difference in self-efficacy between the control and belaying groups as a result of participating in the technical skill of belaying.
2. There will be no differences in self-efficacy between male and female belayers.

Recommendations

Based on the conclusions of this study, the following recommendations for future studies were presented:

1. Conduct a study with a group who did not self-select into the activity of indoor rock climbing.
2. Conduct a similar study with a group in which all the members have been identified as having low self-efficacy initially.
3. Because significant initial differences in self-efficacy among genders was identified in general, focus further studies on this area and analyze gender as a factor.
4. Repeat the study with a larger sample size.
5. Repeat the study using only females as subjects.
6. Repeat the study using only males as subjects and compare it to the "female only" study.

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APPENDIX A
LESSON PLAN FORMAT

LESSON PLAN FORMAT

Topics for instruction during each section of the indoor climbing classes included:

- A. Acquaintance games
 - Name games, icebreakers, team building.
- B. Rope care
 - Mountain climbers coil; butterfly coil; proper storage.
- C. Rope set-up
 - Stacking a rope for safety; proper tie in to the anchor system on the climbing wall using a girth hitch with the parachute chord; figure 8 placement with respect to the intended route of the climber to avoid a pendulum swing in the event of a fall.
- D. Proper use equipment including belay devices and harnesses
 - Demonstration and instruction on how to properly place a harness on the body; instruction and explanation about the Air Traffic Controller and Sticht plate (Watts, 1996), and their proper set up and uses.
- E. Knot tying skills
 - figure 8 (Luebben, 1993)
 - figure 8 follow through (Luebben, 1993)
 - double fisherman's safety (Project Adventure, 1989)
 - bowline on a bight (Project Adventure, 1989)

F. Hand and arm movements for belaying (Priest, 1995).

- Focus on the slip, slap, slide method and modified methods thereof (i.e. palm face down on brake hand).

G. Back-up belaying techniques

- Explanation of increased engaged time for participants; demonstration and instruction on purpose and proper method of the back up belaying.

H. Class safety

- Use commands: On belay, belay on, climbing, climb away; no stepping on ropes; belayers to keep their eyes on climbers at all times; no pushing, shoving or running in climbing area; triple check on all harnesses and knots before climbing.

I. Climbing movements and special techniques

- Basic instruction in smearing, flagging, nose over toes, emphasis on legs, not arms.

APPENDIX B
INFORMED CONSENT FORM

INFORMED CONSENT FOR THE EFFECTS OF PARTICIPANT BELAYING ON SELF EFFICACY OF COLLEGE STUDENTS IN INDOOR ROCK CLIMBING

I give my informed consent to participate in this study of self-efficacy and participant belaying for college students in indoor rock climbing. I consent to presentation and publication or other dissemination of study results so long as the information is confidential and disguised so that no identification can be made. I further understand that although a record will be kept of my having participated in the experiment, all experimental data collected from my participation will be identified by number only.

- (1) I have been informed that as a participant in this study, if I am randomly selected to be in the treatment group I will be given instruction on how to belay and I will be a belayer for climbers in the activity of indoor rock climbing. Further, I understand that belaying is using a rope and a friction-creating device to protect a climber in the event of a fall. If I am randomly selected to be in the control group I will be a climber only and I will not be given instruction on how to belay (during the time frame of the study) and I will not belay. **If placed in the control group, I will be able to receive proper training in belaying at the conclusion of the study.**
- (2) I have been informed that the general purpose of this study is to study self-efficacy in college students who perform the skill of belaying in the activity of indoor rock climbing. Further, I have been informed that I will be asked to fill out a written survey as a requirement of being a subject.
- (3) I have been informed that discomforts such as fatigue, sore muscles and calluses forming on hands from holding a rope may result from performing the skill of belaying.
- (4) I have been informed that there are no disguised procedures in this experiment. All procedures can be taken at face value.
- (5) I have been informed that the investigator will answer questions regarding the procedures of this study when the experimental session is completed.
- (6) I have been informed that I am free to withdraw from the experiment at any time without penalty.

- (7) I have been informed that a decision not to participate in this study, or withdrawing from participation, will not affect my class grade for ESS 100 indoor rock climbing in any way.
- (8) I have been informed that as a participant in this study I will be required to sign the agreement, release, and acknowledgment of risk form given as a standard procedure of the UW-L Adventure Program to all indoor rock climbers prior to activity.

Concerns about any aspects of this study may be referred to the principal researcher, Mark Zmudy 608-784-5129, or Jeff Steffen 608-785-6535. Questions regarding the protection of human subjects may be addressed to Dr. Garth Tymeson, Chair, UW-La Crosse Institution Review Board (608) 785-8155.

Researcher _____

Participant _____

(Date)

(Date)

APPENDIX C
PRE- AND POSTTEST

Class section # _____

ID # _____

QUESTIONNAIRE ON SELF

Please respond to the following statements by circling the number which best describes you. Please answer honestly. Your first response to a question is usually the best.

1=Not True At All
2= Hardly True
3= Moderately True
4= Exactly True

General

1. I can manage to solve difficult problems if I try hard enough. 1 2 3 4
2. If I am opposed, I can find the means and ways to get what
want. 1 2 3 4
3. It is easy for me to stick to, stay focused and accomplish my
goals. 1 2 3 4
4. I am confident that I could deal efficiently with unexpected
events. 1 2 3 4
5. Thanks to my resourcefulness, I know how to handle unforeseen
situations. 1 2 3 4
6. I can solve most problems if I invest the necessary effort. 1 2 3 4
7. I can remain calm when facing difficulties because I can rely on
my coping abilities. 1 2 3 4
8. When I am confronted with a problem, I can usually find several
solutions. 1 2 3 4

9. If I am in trouble, I can usually think of a solution. 1 2 3 4
10. I can usually handle whatever comes my way. 1 2 3 4

Please respond to the following statements by circling the number which best describes you. Please answer honestly. Your first response to a question is usually the best.

1= Not True At All
 2= Hardly True
 3= Moderately True
 4= Exactly True

Rock Climbing

11. I am certain I could continue to concentrate on protecting a climber with a rope even if I became fatigued. 1 2 3 4
12. I believe I could offer helpful verbal support to a climber experiencing difficulty climbing a route. 1 2 3 4
13. I believe I could ask a question about equipment in front of a group of my peers if I don't understand the proper use of the equipment. 1 2 3 4
14. I could remain calm when a climber I am protecting with a rope unexpectedly falls off the route being climbed. 1 2 3 4
15. I believe I have the potential to understand how to properly set up a system with a rope to protect a climber. 1 2 3 4
16. I believe I am trustworthy enough to assume responsibility for another person's physical safety. 1 2 3 4
17. I could manage to earn and keep the trust of others if I try hard enough. 1 2 3 4
18. I believe I could encourage others to do their best while climbing a route. 1 2 3 4

APPENDIX D
BELAYING PROTOCOL

BELAY PROTOCOL

Objective: Students should be able to identify and properly perform at least three methods of belaying during a climbing experience on the indoor climbing wall.

Extension: Belaying

Refinement:

A. Slip-Slap-Slide method. After putting on a harness and securing the belay device and rope into place, tie in the climber using a follow through figure 8 knot and go through the verbal contract "on belay; belay is on; climbing; climb away."

Next, take the left side of the rope and put it in the left hand with palm facing up. Do the same with the right side of the rope in the right hand. The braking hand is the hand that is holding the working end of the rope. From this point on, **never take your braking hand off the rope.**

For right hand braking, feed the rope through the belay device by pulling the rope with the right hand up toward the sky while guiding the left side of the rope by pulling down toward the ground (**slip**). Next, slide the left hand up past the right hand, clasp both the left and right sides of the rope with the left hand (**slap**), and slide the right hand back down so it is positioned once again near the belay device (**slide**). Continue this process as the climber ascends up the wall. When the climber has reached the top of the climb, gradually allow the rope to slide back through the belay device by adjusting the rope tension with the braking hand. When the climber has reached the ground listen for the climber to say "off belay." Then announce that the "belay is off."

- B. Over-hand slide. Basically the same as the slip-slap-slide, except that the braking hand palm is down allowing for a different feel in the action of braking.
- C. Over-hand reach. Basically the same as the over-hand slide, except that the nonbraking hand comes off the rope completely in order to assist the braking hand during the "slide" aspect of the motion.

Adapted from: Project Adventure (1989).