The Impact of a Rock-Climbing Program:

A Mixed Methods Case Study of High School Students' Climbing Self-Efficacy

by

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B.Ed., McGill University, 2014

A Thesis Submitted in Partial Fulfillment of the

Requirements for the Degree of

MASTER OF ARTS

in the School of Exercise Science, Physical and Health Education

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Abstract

The popularity of rock-climbing is continuously increasing. However, little research is available on the pedagogy of rock-climbing. Student climbing self-efficacy and the learning activities and instructional strategies used were monitored throughout a five-month long high school rock-climbing program. The baseline rock-climbing experience of consenting participants (n = 26) ranged from novice to the junior competitive level. This case study of a single class of 30 students included both quantitative and qualitative data sources. Data collection methods included: (a) questionnaires, (b) observations of the learning environment, (c) individual reflection journals, (d) focus group interviews, and (e) a course outline. Quantitative analysis revealed no significant change in the self-efficacy scores of participants. Qualitative analysis provided insight into: (a) the type of learning environment conducive to improving climbing self-efficacy, (b) the influence of the sources of self-efficacy, and (c) the activities that were more efficient for developing student climbing self-efficacy. This study explored how sources of self-efficacy can be translated into learning activities and instructional strategies for rock-climbing programs. Learning activities and instructional strategies should be meaningful, diversified, individualized, progressively challenging, and take place in a safe and collaborative environment. A future study may investigate the effect of participation in climbing programs on motivations to pursue climbing independently.

Keywords: rock-climbing, self-efficacy, adventure physical activity, pedagogy, physical education

Table of Contents

List of tables

Acknowledgements

I would like to thank my mother, for sharing with me “les joies de l’aventure.” To my father, thanks for showing me a world that is “so bright I have to wear shades.”

An enormous thank you goes to the climbing program’s teacher and instructors for welcoming me into their climbing family. I am indebted to the entire class of enthusiastic students, who shared their thoughts with me over the course of an entire semester.

I would like to thank Dr. Sandra Gibbons, for providing me with “progressively challenging” activities throughout my degree, which allowed me to develop the self-efficacy to persist in academia. Your dedication to your students is truly inspiring. I would like to thank Dr. Viviene Temple, who provided much-appreciated insights on my work. I would like to thank Dr. Lara Lauzon, for allowing me to develop into a more well-rounded scholar. Thank you Stephanie Kendall for motivating me to “hang in there”. I am also thankful to Dr. P.J. Naylor and Jennifer McConnell for providing me access to the tools and resources to qualitatively analyze my data.

Chapter One

Introduction

Lifetime physical activities, such as rock-climbing, are less prominently featured in physical education curriculums than traditional team games (Fairclough, Stratton, & Baldwin, 2002). Nevertheless, they are more effective than traditional team games for promoting lifelong physical activity since they carry over more easily toward adult physical activity participation (The Outdoor Foundation, 2013) and they only require one or two people (Ross, Dotson, Gilbert, & Katz, 1985). The popularity of one of these lifelong physical activities, rock-climbing, is continuously increasing. In 2012, a growth of over 25% was observed in the number of new participants taking part in rock-climbing (The Outdoor Foundation, 2013). Currently, there are over five million rock-climbers in North America alone. One explanation for this growth in participation may be related to the increase of indoor rock-climbing facilities, which first opened in 1964 and allowed climbers to climb all year-round, despite bad weather (Hoibian, 2017). Indoor facilities have the added benefit of removing several risk factors (e.g., falling rocks) and were found to be the safest locations to practice rock-climbing (Woollings, McKay, & Emery, 2015). In addition, rock-climbing has been shown to be an effective way of promoting physical activity in youth (Siegel & Fryer, 2015). For example, rock-climbing has been shown to improve muscular strength, endurance, cardiorespiratory fitness, and mental health (Gallotta et al., 2015; Luttenberger et al., 2015; Siegel & Fryer, 2015).

According to the Climbing Business Journal (2017), at least 13 climbing gyms were opened within Canada in 2016, which resulted in an increase of 15% more climbing gyms. As rock-climbing facilities continue to increase in availability, it is becoming

easier to add rock-climbing as a physical activity option within school curricula. Rock-climbing activities have been used in school curricula for a variety of physical, cognitive, and affective outcomes. For example, climbing was shown to increase muscular strength in elementary students (Lirgg, Di Brezzo, & Gray, 2006). Rock-climbing may contribute to cognitive benefits such as more efficient observational skills and problem solving skills (Boschker, Bakker, & Michaels, 2002; Mittelstaedt, 1997). Rock-climbing programs have also been used to support moral development. For example, Hansen and Parker (2009) had students progress through five levels of accountability (i.e., from respecting others to teaching rock-climbing skills to others).

Motivations to participate in rock-climbing are quite diverse (Ewert, Gilbertson, Luo, & Voight, 2013). Perceived control over risk is often central to the motivation people have for participating in adventure physical activities (Ewert et al., 2013). Personality traits, such as high levels of sensation seeking have also been correlated with a motivation to take part in rock-climbing (Boudreau & Rhodes, 2017; Rhodes & Boudreau, 2017). Self-efficacy has been discussed as a key motivational factor for participation in adventure physical activities (Llewellyn, Sanchez, Asghar, & Jones, 2008; Slanger & Rudestam, 1997). Considering the limited scope of research on climbing pedagogy, Sandlin (2013) suggested that research in rock-climbing should focus on "understanding how indoor climbing program attributes affect the climbing self-efficacy of indoor rock climbers and how program attributes can be optimized to facilitate increases in climbing self-efficacy" (p. 51).

Self-efficacy is a core feature of Bandura's social cognitive theory. The social cognitive theory explains human behaviour through a triadic reciprocal and causal

relationship. Specifically, personal, behavioural, and environmental factors each affect one another (Bandura, 1988). Depending on the given situation, certain factors will play a larger role in determining a given behaviour. Self-efficacy is an integral component of the personal factor and is defined as the confidence an individual has in his or her ability to perform a specific behaviour (Bandura, 1977). People with higher self-efficacy are more likely to challenge themselves, expend additional effort, and persist following setbacks (Bandura, 1997).

Bandura proposed four main sources of influence that may enhance or decrease an individual's self-efficacy: mastery experiences, vicarious learning, verbal persuasion, and physiological and affective states (Bandura, 1997). The most effective method of developing self-efficacy is through mastery experiences. In other words, when an individual accomplishes a goal successfully, that person will enhance their self-efficacy for that specific goal. Mastery experiences will be most influential for determining the self-efficacy of individuals who are learning new behaviours (Bandura, 1994). Vicarious learning experiences are the second most efficient source of information for enhancing self-efficacy. These experiences consist in observing a social model performing a behaviour and establishing a belief about one's ability to perform the same or a similar behaviour. Bandura (1994) suggested that the third source of self-efficacy, verbal persuasion, is more effective at undermining than enhancing self-efficacy. For example, if a student is provided overenthusiastic verbal persuasion that they can accomplish a certain behaviour and is afterwards confronted by failure, their self-efficacy may plummet. In addition, the self-efficacy of a student can be lowered if they are verbally persuaded that they lack the capability to climb a certain route. Finally, the interpretation

of physiological and affective states may impact one's self-efficacy. For example, if a student feels stressed before a competition, a negative appraisal of that stress will result in a diminished self-efficacy. This study was informed by Bandura's theory of self-efficacy and the four main sources of self-efficacy.

Physical Education teachers use a range of learning activities to help students achieve diverse outcomes. A pedagogy of rock-climbing may utilize both teacher-centered and student-centered learning activities. A teacher-centered learning activity may, for example, have a student observe a demonstration of a particular climbing stability skill and then practice that rock-climbing skill to reach a higher level of proficiency. In a student-centered learning activity, students may instead be given the task of discovering on their own the most stable position between two holds. The research reported in this thesis examines the learning activities that focus on enhancing climbing self-efficacy. In addition, this research focuses on various instructional strategies used in the indoor rock-climbing environment to accomplish various learning outcomes. For example, teachers may provide cues as verbal support, and provide performance feedback to enhance climbing self-efficacy.

Purpose Statement

The purpose of this study was to explore the effectiveness of learning activities and instructional strategies utilized by teachers in a school-based rock-climbing program on students' climbing self-efficacy.

Research Questions

The focus of this research was to investigate the characteristics of a rock-climbing program and determine which learning activities and/or instructional strategies may be

most beneficial for improving the climbing self-efficacy of high school students. Three main research questions were addressed in this study:

1. What are the activities that take place?
2. What are the sources of self-efficacy embedded in the learning activities and/or instructional strategies of the rock-climbing program?
3. How did the learning activities and/or instructional strategies impact the self-efficacy of high school students?

Assumptions

It is assumed that students provided truthful answers to the questionnaires, journals, and focus group interview questions. It is also assumed that the teacher and instructors of the program did not modify his or her teaching practice during the program of this research.

Delimitations

This scope of this study was limited to one high school rock-climbing program.

Limitations

A secondary observer did not confirm the accuracy of the observations.

Operational Definitions

Case study. Case study is described as a research approach to answer "how" and "why" questions within a bounded system. The focus of this approach is to study a contemporary phenomenon and its context. The case study approach can make use of several qualitative and quantitative data collection methods depending on the requirements of the research questions involved (Yin, 2014).

Rock-Climbing Program. The rock-climbing program was an elective school-based program designed to allow students to develop the competencies to pursue climbing as a lifelong professional or recreational activity.

Learning activities. Learning activities refer to the lesson activities that are conducted for educational purposes. For example, interval training on a bouldering problem is a type of learning activity that can be used in a rock-climbing program.

Instructional strategies. Instructional strategies refer to how an instructor teaches the learning activities. For example, an instructor may use instructional strategies such as feedback, cues, and demonstrations.

Self-efficacy. Self-efficacy is defined as the confidence an individual has in his or her ability to perform a specific behaviour (Bandura, 1977).

Rock-climbing self-efficacy. Rock-climbing self-efficacy, which is also referred to as climbing self-efficacy (Llewellyn & Sanchez, 2008), is an individual's confidence to climb a vertical wall successfully with efficient techniques.

This thesis has been organized in six chapters. The following chapter provides an overview of the literature on rock-climbing and self-efficacy. The third chapter addresses the methodology of the study. The fourth chapter illustrates the results. The fifth chapter discusses the meaningfulness of the results. Finally, the sixth chapter provides a summary of the study in addition to future research considerations.

Chapter Two

Review of the Literature

This literature review has been divided into four main sections. Section one examines research on various learning activities and instructional strategies that focus on improving rock-climbing performance in general. The second section reviews, briefly, the learning activities and instructional strategies discussed in rock-climbing manuals for physical education teachers. A review of teaching manuals was conducted to establish a record of the activities and strategies that may be currently used in climbing programs. The third section of this review examines research on learning activities and instructional strategies that research demonstrates as being effective for improving self-efficacy in physical activities that are comparable to rock-climbing. The final section of this review examines research on learning activities and instructional strategies that are effective for improving climbing self-efficacy.

Learning Activities and Instructional Strategies for Improving Rock Climbing Performance

The majority of research on rock-climbing learning activities has focused on improving the performance of rock-climbers through physical training (e.g., de Geus, O'Driscoll, & Meeusen, 2006; Magiera & Roczniok, 2013). Research on instructional strategies for improving rock-climbing performance is limited. Most recently, researchers have investigated the effects of psychological learning activities on rock-climbing performance.

Strength and conditioning training. The average competitive rock-climber spends approximately 7-13 hours per week training for resistance, endurance, and

coordination (de Geus, O'Driscoll, & Meeusen, 2006; Magiera & Roczniok, 2013; Mermier, Janot, Parker, & Swan, 2000). According to Macias, Brown, Coburn, and Chen (2015), when grip strength, pinch strength, and number of pull-ups to exhaustion were measured, men who participated in rock-climbing but not in resistance training had significantly higher relative strength than men who participated only in resistance training. Deyhle et al. (2015) nevertheless suggested that training is crucial for improving rock-climbing performance. According to Deyhle et al. (2015), strength training that focused on improving the muscular endurance of the digit flexors and the elbow flexors muscle groups specifically may be the most effective for improving rock-climbing performance. According to Mermier et al. (2000), the training component of rock-climbers investigated (i.e., muscular strength, endurance, and power) accounted for 58.9% of the variance in performance. On the other hand, anthropometric (e.g., the height of the climber) only accounted for 0.3% of the variance in performance. It is therefore a misconception to think that taller climbers have an unfair advantage. Although counterintuitive, higher flexibility does not seem to significantly predict improved performance (Mermier et al., 2000). Overall, research demonstrates the effectiveness of combining rock-climbing-specific strength training with regular rock-climbing exercises such as completing standard rock-climbing routes. Interval training, which consists of taking breaks between submaximal attempts at boulder problems[1] has been shown to be more effective at improving hanging and climbing endurance than conventional bouldering[2] (Medernach, Kleinoder, & Lotzerich, 2015). Furthermore, neglecting

[1] A boulder problem is a short climbing route or sequence of moves on a bouldering wall.
[2] Bouldering is a form of rock-climbing that is usually done on shorter walls, without ropes, and above protective mats.

strength training may "potentially lead to muscular imbalances, overuse injuries, and deny the climber the opportunity to overcome physical limitations, which may lead to suboptimal performance" (Phillips, Sassaman, & Smoliga, 2012, p. 12).

Research on effective instructional strategies. Gains in performance are faster when students receive cues that help them to focus on one specific part of a task (Fronske & Blakemore, 1997). Cues are defined as concise verbal or visual phrases. McNamee and Steffen (2007) provided cues for rock-climbing tasks to twenty randomly assigned college students. The instructional content provided by the instructors to the control group was exactly the same, however students in the experimental group received performance cues (e.g., "feet first") before and after each climb. Although both groups performed better on their posttest following seven rock-climbing instruction sessions, the group who received performance cues did significantly better. Specifically, the experimental group improved by an effect size of $d = 0.22$ compared to the control group. Limitations of the study included the short duration of the program. Although the different instructors for the control and experimental group used the same detailed lesson plan, it is possible that these findings resulted in part from differences in instructional strategies.

A unique characteristic of rock-climbing is that it can allow participants of varying ages and abilities to participate together. In this regard, an intervention based on stimulus control designed for students with autism was shown to be successful for teaching the participants to follow a designated rock-climbing route (Kaplan-Reimer, Sidener, Reeve, & Sidener, 2011).

Psychological training. Research in rock-climbing has suggested that psychological factors may account for up to approximately 30% of the variation in rock-climbing performance (Mermier et al., 2000; Phillips, Sassaman, & Smoliga, 2012). Rock-climbing provides unique physical but also psychological challenges, which can impact the affective state of participants and consequently their performance (Giles et al., 2014). For example, doing an on-sight lead climb, which requires a climber to attempt a route for the first time without beta[3], elicits the greatest amount of somatic and cognitive anxiety (Baláš et al., 2017; Giles et al., 2014). Cognitive anxiety refers to concerns about failure or negative pre-occupations (Hardy & Hutchinson, 2007). For example, a climber may be cognitively anxious that they will fall at the same place as their previous attempt. Somatic anxiety refers to the thoughts one has concerning physiological responses (Hardy & Hutchinson, 2007). For example, a climber can interpret sweaty hands as a sign that they are scared as opposed to excited.

Cognitive relaxation methods that could be used include mental rehearsal, mental imagery, and visualization (Stanković, Raković, Joksimović, Petković, & Joksimović, 2011). Whereas, somatic methods could include biofeedback, progressive muscle relaxation and meditation (Stanković et al., 2011). Although relaxation techniques have been effective at improving the affective outcome (i.e., reducing anxiety), research on the effectiveness of relaxation for optimizing rock-climbing performance is inconclusive. For example, Fraser, Steffen, Elfessi, and Jack (2001) found no significant difference in performance between a control group, who took part in 15 rock-climbing classes, and an

[3] Beta is information about a route or problem, such as a description of the holds to use and the most efficient sequence to grab these holds (Phillips, Sassaman, & Smoliga, 2012).

experimental group, who in addition to the rock-climbing practices were provided with 120 minutes of relaxation and stress management training. Future research would be useful to investigate if a more prolonged relaxation intervention could lead to more significant improvements in performance.

Psychophysiological research on climbing showed that expert climbers are better able to cope with anxiety and consequently better able to reduce the negative impact various climbing stimuli can have on their performance (Giles et al., 2014). The superior coping abilities of experienced climbers is likely due to their knowledge of the risks of rock-climbing, their habituation to anxiety, and their ability to cope with higher levels of anxiety when climbing (Giles et al., 2014).

When deciding which strategies to use in order to reduce the anxiety of climbers, it is important to first establish the type of anxiety that is most dominant. Maynard, MacDonald, and Warwick-Evans (1997) found that the treatment that matched the dominant type of anxiety was most effective at reducing anxiety. The study administered somatic relaxation techniques to a group who experienced higher levels of somatic anxiety, a group who experienced higher levels of cognitive anxiety, and a control group who experienced both types of anxiety equally. Findings indicated that the group experiencing more somatic anxiety on their pre-test experienced the greatest reduction in overall anxiety. In other words, it was more effective to receive treatment focused on the dominant type of anxiety experienced by the climber.

Hardy and Hutchinson (2007) found that situationally-induced anxiety, such as lead climbing[4] as opposed to top roping[5], was associated with increased effort in rock-climbers. Adding support to the processing efficiency theory, Hardy and Hutchinson (2007) found that a moderate increase in anxiety can actually be associated with maintained or improved performance. However, the authors stressed that high anxiety may impair performance.

Route previewing. It is common to see rock-climbers standing at the bottom of a route, staring up, and sometimes moving their hands in anticipation; this is called 'route finding'. According to Jones and Sanchez (2017), the "ability to visually inspect the route and correctly interpret the movement sequence required is critical to climbing performance" (p. 254). To determine if it was possible to remember the path of a rock-climbing route, Boschker, Bakker, and Michaels (2002) asked novice and expert rock-climbers to observe, memorize, and reconstruct a route on a scale model. Expert rock-climbers were found to focus on the function of a route as opposed to the structure of holds. Furthermore, experts were more likely to remember clusters of information as opposed to individual holds (Boschker, Bakker, & Michaels, 2002). Using eye-tracking technology, Grushko and Leonov (2014) confirmed this finding by analyzing where and how expert rock-climbers inspected routes. Grushko and Leonov (2014) termed the strategy "sequence of blocks" (p. 142) to describe how climbers observed the most difficult routes from bottom to top by focusing on 2-4 handholds or footholds at a time.

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[4] Lead climbing is a form of climbing that requires the climber to clip the rope into metal clips, called quickdraws, throughout their ascent. Falls taken while lead climbing will typically be much larger than while top-rope climbing.

[5] Top-rope climbing is done with a rope that has already been fixed at the top of a climbing wall by a lead climber.

Interestingly, Sanchez, Lambert, Jones, and Llewellyn (2012) found that rock-climbers did not increase their performance after being given 3 minutes to inspect routes. However, experts stopped less often and executed their movements with better form when they were allowed to inspect the route beforehand.

Grushko and Leonov (2014) suggested that practicing route visualization by inspecting a route, memorizing it, and then drawing it out could be an educational process useful for optimizing performance. Considering that the most efficient strategy is the "sequence of blocks," students should concentrate on clusters of holds and picture how their body will move on these clusters. Students should then be prompted to practice route visualization prior to every climb.

Review of Rock-Climbing Manuals for Physical Education Teachers

Instructional strategies. Stiehl and Ramsey (2005) stressed the importance of using three strategies in rock-climbing activities to cater to the needs, abilities, and interests of students. First, activities should be changed often to allow for students to remain interested in climbing (e.g., by changing partners or types of holds used). Second, the difficulty of climbing activities should be deliberately made challenging to avoid boredom, yet easy enough to avoid discouraging students. Finally, climbers should be provided with choice. For example, an experienced climber could be given the choice between completing a harder but shorter bouldering problem or a longer but easier climbing route. Zakrajsek, Carnes, and Pettigrew (2003) emphasized the importance of safety and cooperation within their climbing wall activities. For a summary of the rock-climbing teaching manuals, please see Table 1.

Table 1

Summary of Rock-Climbing Teaching Manuals

Authors	Resources provided
Stiehl and Chase (2008)	This manual provides various activities, which can be done on small traverse rock-climbing walls. The activities are focused on developing fundamental movement skills and strategies for a younger audience.
Stiehl and Ramsey (2005)	This manual provides comprehensive information on developing a climbing wall and climbing program. The climbing activities described focus on developing fundamental climbing techniques and strategies.
Zakrajsek, Carnes, and Pettigrew (2003)	A section of this textbook provides lesson plans to introduce rock-climbing over the course of 1-2 days of instruction.

Learning Activities. The majority of activities presented in teaching materials on rock-climbing cater to students being introduced to climbing. These activities target the development of fundamental rock-climbing skills and strategies. For example, Stiehl and Chase (2008) described the importance of basic climbing strategies, such as maintaining three points of contact on the wall, keeping a climber's weight on his or her feet, and resting effectively on the wall. Some activities described in rock-climbing manuals for physical education teachers encourage the combination of health and climbing topics. For example, the 'my pyramid' game has students retrieve from the climbing wall cards labeled with food items which need to be placed in an appropriate location on the food pyramid (Stiehl & Chase, 2008). Another common theme among activities discussed in teaching manuals focused on cooperation. For example, the game 'cooperative climbs' has students traverse on a wall attached to one another with a length of yarn (Stiehl & Ramsey, 2005; Stiehl & Chase, 2008). Certain activities described in teaching manuals mimic professional variants of the sport of rock-climbing. For example, Zakrajsek,

Carnes, and Pettigrew (2003) discussed the activity of 'speed climbing' as a way for students to challenge themselves by comparing their personal time on two trials of any climbing route.

Self-Efficacy in Comparable Physical Activities

Rock-climbing is a complex physical activity that poses unique physical and mental challenges (Hardy & Hutchinson, 2007). For example, a rock-climber has to determine a sequence of climbing holds to use while maintaining dynamic and static balance positions. A rock-climber must therefore be confident that he or she can meet these challenges. According to Bandura (1997), self-efficacy will influence the probability that an individual attempts a task. If individuals gain self-efficacy for climbing tasks, they will be more likely to engage in rock-climbing and in the process benefit from the increase in physical activity levels. Although self-efficacy has been shown to be often confounded in research with one's "can do" motivation to engage in a physical activity (Williams & Rhodes, 2014), the complexity of rock-climbing makes self-efficacy a pertinent construct to assess. Therefore a review of the literature of physical activities with comparable characteristics is warranted.

Being an individual-oriented activity that is a closed skill, which incorporates strength, grace, and flexibility, gymnastics shares common characteristics of rock-climbing. Reppa and Theodorakou (2015) compared the effectiveness of a creative gymnastics program to a program of free movement activities on self-efficacy. Characteristics of the creative program included allowing for mistakes and focusing on new kinetic solutions and freedom of expression. The authors suggested that the significant improvement in self-efficacy for the group taught with the creative gymnastics

program was due primarily to the numerous opportunities for successful past experiences (i.e., mastery experiences). It is important to consider however that the outcome measurement of this study was overall physical activity self-efficacy. Bandura (1997) suggested that self-efficacy measurements are better at predicting future behaviours if the self-efficacy measures are operationalized based on a specific activity (e.g., a measurement of gymnastics self-efficacy).

Similar to rock-climbing, ropes courses provide psychological challenges such as fear of heights and physical challenges such as pulling one's body weight up. In a mixed-methods study examining the effect of a high ropes course, Cordle, Puymbroeck, Hawkins, and Baldwin (2016) found that generalized self-efficacy and self-efficacy specific to ropes course improved significantly following university students' experience on a high ropes course. The qualitative portion of study provided information on the sources of the gains in self-efficacy. Overall, mastery experiences were suggested to be the most pertinent source of their self-efficacy.

Investigating the effectiveness of a four-day long adventure and health program that included cooperative games, wall climbing, and a "mini Olympics" for childhood cancer survivors, Li, Chung, Ho, Chiu, and Lopez (2013) found a significant increase in physical activity self-efficacy, physical activity levels, and quality of life.

Following a two-week long adventure recreation program with a larger sample size (n = 262), Widmer, Duerden, and Taniguchi (2014) found an increase in the outdoor and academic self-efficacy of adolescents. This program included backpacking, whitewater rafting, mountain biking, and rock-climbing activities.

This review of research on self-efficacy and physical activities comparable to rock-

climbing compliments the sparse research relating specifically to climbing self-efficacy. Mastery experiences were described to be the most influential source of self-efficacy within a gymnastics program (Reppa & Theodoraku, 2015) and a ropes course (Cordle et al., 2016).

Sources of Climbing Self-Efficacy

Climbing self-efficacy is a useful construct for determining the likelihood that participants will attempt rock-climbing and persist despite failures. Climbing self-efficacy, which measures an individual's confidence to climb a vertical wall successfully with efficient techniques, has been shown to increase the frequency of attempts made by climbers (Gómez, Hall, Hill, & Ackerman, 2007).

Bandura posited that there are four main sources of self-efficacy. Mastery experiences or successful previous attempts are considered to be the most important source of self-efficacy (Bandura, 1997). Vicarious experiences or observational learning are considered an important source of self-efficacy. Verbal persuasion, or the information that is provided to an individual may affect his or her self-efficacy. Finally, affective states, or how an individual feels about the task they are about to undertake will also affect her or his self-efficacy. This portion of the literature review will examine the effectiveness of various techniques, based on the four main sources of self-efficacy that teachers and programmers can use to improve the climbing self-efficacy of participants.

Mastery Experiences. Mastery experiences refer to having had previous success at a task. For example, a rock-climber may develop self-efficacy for performing a specific climbing technique (e.g., mantling up) after having successfully completed a route using this technique. Several authors have suggested mastery experiences may be

particularly influential within high risk sports (Brody, Hatfield, & Spalding, 1988; Jones, Milligan, Llewellyn, Gledhill, & Johnson, 2017). Gómez et al. (2007) have suggested, "rock-climbing by nature is a recreational activity that may be highly influenced by mastery of attempts" (p. 307). In other words, if climbers successfully complete rock-climbing routes, they are more likely to improve their self-efficacy for completing similar routes.

Mazzoni, Purves, Southward, Rhodes, and Temple (2009) examined the effect of an existing rehabilitation therapy climbing program on the self-efficacy and self-perceptions of students with special needs. It was hypothesized that successful attempts at climbing would result in increased levels of self-efficacy and consequently increased levels of overall self-esteem. The self-efficacy questionnaire designed for this study included the basic climbing tasks associated with youth engaged in climbing for the first time and was appropriately framed for the clientele. The scale was originally tested in a pilot test and demonstrated a high internal consistency ($\alpha = .91$). A 4-point scale was used, which did not correspond to Bandura's (1997) suggestion for scaling self-efficacy questionnaires, however, it was appropriate for the sample of students with special needs investigated. After six one-hour long sessions, a significant increase in self-efficacy ($d = 0.84$) was observed in the experimental group.

Vicarious Experiences. Vicarious experiences allow an individual to observe someone else performing an activity and have been shown to be an effective source of self-efficacy (Bandura, 1997). Vicarious experiences are thought to be most effective when the model is similar in characteristics and ability levels to the individual making the observation (Bandura, 1997).

Two studies examined the effect of observing rock-climbing models on climbing self-efficacy. Based on self-modeling techniques used in other sports, de Ghetaldi (1998) provided an intervention group (n = 20) with observation sessions of their previous performances. The video recordings of the intervention group were edited to remove instances of mistakes. Prior to each climbing session, participants viewed the video of their successful climbing attempts over the course of four climbing sessions. A control group (n = 20) participated in the same climbing sessions but did not undergo a self-modeling intervention. Following the intervention, no significant differences in self-efficacy scores were found between participants in the intervention and control groups. Although the self-efficacy scores of the participants increased nearly twofold, the self-efficacy scores increased similarly for the control group. The results of this study support the greater effectiveness of mastery experiences as opposed to vicarious experiences.

Harrison and McGuire (2006) examined the effect of observing different models on the climbing self-efficacy of participants (n = 38). Prior to the climbing portion of a rock-climbing course, two intervention groups observed a youth or an adult model a rock-climbing task and a control group did not observe anyone perform the climbing task. A significant difference in climbing self-efficacy from pretest to posttest between the control and intervention groups was found. However, there was no significant difference between the group who observed a youth and the group who observed an adult. In addition, the researchers found no significant difference in self-efficacy when controlling for the participants' perceived similarity to the model or the rock-climbing experience of the participants. Harrison and McGuire (2006) do not provide examples of the types of statements included in their climbing self-efficacy questionnaire. Therefore, it is difficult

to compare the validity of the findings with similar research on rock-climbing self-efficacy. In addition, no mention of the effect size is provided. Nevertheless, this research provides evidence for the effectiveness of using vicarious experiences within rock-climbing programs in order to improve the climbing self-efficacy of students.

Verbal Persuasion. Verbal persuasion is the information provided to an individual that allows him or her to believe that they can accomplish a task. Receiving positive verbal persuasion may therefore increase a participant's self-efficacy. For example, the self-efficacy of a student may increase when, before starting a difficult climb, a classmate shouts, "You can do it!"

Goal setting. Verbal persuasion can be used in the form of goal setting. Goal setting is defined as the objective of an action limited by time (Baghurst, Tapps, & Kensinger, 2015). For example, if an instructor provides a goal for a participant, the instructor is telling the participant that he or she can accomplish this goal in a specified amount of time. Goal setting has been successfully used in the physical education context to affect behavioural outcomes (McDonald, 2015). One powerful mediator between goals and behavioural outcomes may be self-efficacy. In order to establish the importance of specificity and difficulty when providing a goal, Sarrazin and Famose (2005) examined the effect of different climbing goals on the self-efficacy and performance of novice climbers. The researchers therefore provided positive, neutral, and negative forms of verbal persuasion to participants. The researchers first established a baseline performance for 52 boys by asking them to complete a rock-climbing route as fast as they could. During three follow-up climbing sessions, the participants were randomly assigned to: a difficult goal ("complete the climb in 15 seconds"), a moderate goal ("complete the climb

in 45 seconds"), an easy goal ("complete the climb in 90 seconds"), or a control goal ("do your best"). The self-efficacy scores of the groups corresponding to the difficult and moderate goal increased after every session. Unfortunately, the researchers do not indicate what type of self-efficacy questionnaire was administered. Although every student performed similarly in the first climbing session, the performances of students assigned to the difficult and moderate goal improved significantly more on the second and third climbing sessions. The researchers of this study suggested that when a teacher verbally persuaded a student that she or he was able to complete a difficult climb, the student gained self-efficacy and in turn improved her or his performance.

Route rating manipulation. Climbers will often use the rating of a route[6] to set goals for themselves. In indoor climbing centers, the route setter usually assigns the route ratings for the route that he or she designed. Consequently, the rating given to a particular climb is often the subjective measure of one person. Before a climber undertakes a route, she or he will usually look at the rating and be "verbally persuaded" by the difficulty stated by the route.

Sandlin (2013) suggested that an inaccurate rating might impact the self-efficacy of climbers. According to Bandura (1997), "the same level of performance success may raise, leave unaffected, or lower perceived self-efficacy depending on how various personal and situational contributors are interpreted and weighed" (p. 81). Applied to the climbing context, a situational contributor can be the route rating. If a climber performs successfully on a route that they have interpreted as difficult (i.e., the climber's

[6] In North America, routes will predominantly be rated using the Yosemite Decimal System, which assigns the easiest routes a rating of approximately 5.4, intermediate routes a rating of approximately 5.10, and expert routes a rating above 5.12.

assessment of difficulty is highly influenced by the route rating), the self-efficacy of the climber may be increased following the climb.

Sandlin (2013) investigated the impact of route ratings by providing a pretest and posttest self-efficacy questionnaire to: (a) a control group (n = 30), shown an accurate route rating, (b) an experimental group (n = 30), told an underestimate of the actual route rating, and (c) an experimental group (n = 30), told an overestimate of the actual route rating. The questionnaire used, the Climbing Self-Efficacy Scale (CSES), was shown to be reliable and valid (Llewellyn et al., 2008). Although an increase in self-efficacy was found in all three groups, no group difference was found to be significant at the $p < .05$ level. The manipulation of route ratings therefore did not impact the self-efficacy of the climbers in this study.

Affective State. Affective states are not usually considered as powerful a source of self-efficacy as the previous three sources of self-efficacy (Bandura, 1994). However, in challenging activities that can create feelings of fear (e.g., climbing high walls), affective states can be an influential source of self-efficacy (Bandura 1997). Mental imagery can be an effective method of reducing such fears (Martin, Moritz, & Hall, 1999).

Imagery is a technique used effectively in several other sports such as golf and basketball (Martin et al., 1999). Imagery can make use of two sources of self-efficacy. First, it can be used as a way of mentally replicating mastery experiences. Secondly, imagery can be used as a method of controlling affective states.

Jones, Mace, Bray, MacRae, and Stockbridge (2002) provided a total of 70 minutes of imagery script training to an experimental group and low impact aerobic

exercises to a control group. All participants (n = 33) participated in four 1-hour sessions of rock-climbing. A questionnaire to evaluate the climbing self-efficacy of participants was administered prior to and after the intervention. The internal consistency of the questionnaire, designed to evaluate two subcomponents of climbing self-efficacy, however, was not ideal (α = .58). There was no significant difference in improvement on the climbing self-efficacy subcomponent to "climb to the best of her ability" between the two groups. However, the experimental group had significantly lower levels of perceived stress and higher levels of self-efficacy in their ability to execute the correct climbing techniques. This increase in self-efficacy may not have been adequate as it did not translate to an improvement in the overall performance of the experimental group.

Summary of the Literature Review

Abundant research has been gathered on improving rock-climbing performance through physical (e.g., Magiera & Roczniok, 2013) and psychological training (e.g., Giles et al., 2014). Medernach and colleagues (2015) found interval training to be the most effective method for improving climbing endurance. Hardy and Hutchinson (2007) found a moderate increase of anxiety may benefit performance most, and Giles and colleagues (2014) found experienced climbers might be better at coping with anxiety because they are aware of the risks involved.

The majority of rock-climbing teaching manuals focus on fundamental skills and strategies (e.g., Stiehl and Ramsey, 2005) and learning activities for younger students (e.g., Stiel and Chase, 2008). The investigation of a climbing program targeting more advanced rock-climbing skills and strategies is therefore warranted. The learning

activities and instructional strategies, available for teaching rock-climbing to more experienced climbers, are explored further in this study.

Studies investigating the impact of other physical activities, which can be compared to rock-climbing, have found significant improvements in self-efficacy. However, the adventure programs and ropes courses investigated have only been studied over a maximum of two-week long periods (e.g., Li et al., 2013). The examination of a prolonged program is therefore warranted.

The effect on self-efficacy of mastery experiences (e.g., Mazzoni et al., 2009), vicarious experiences (e.g., Harrison & McGuire, 2006), verbal persuasion (e.g., Sarrazin & Famouse, 2005), and affective states (e.g., Jones et al., 2002) has been well documented. However, no study has examined and compared the impact of the sources of self-efficacy within a rock-climbing program. Therefore, this study allowed the impact of a lengthier adventure physical activity program to be examined. The following chapter will address the methodology of this study.

Chapter Three

Methods

Design

A case study methodology was used to examine a self-contained and unique climbing program. A case study is described as a research approach to answer "how" and "why" questions within a bounded system (Yin, 2014). The focus of this approach is to study a contemporary phenomenon and its context. A single-case study design was used since it was expected to reveal information not yet documented in rock-climbing pedagogy research. Additionally, a case study design was used to examine a climbing pedagogy that takes place in an authentic environment, which unlike an experimental design does not constrain behavioral events (Shavelson & Towne, 2002; Yin, 2014).

According to Yin, a case study may utilize several qualitative and quantitative data collection methods. This study made use of a convergent parallel mixed-methods design. More specifically, the quantitative data and qualitative data were collected concurrently and the analysis of both sets of data was done separately (Thomas, Nelson, & Silverman, 2011). The interpretations of the results were merged to provide a more complete picture in the final stages of analysis (Creswell & Clark, 2011).

Case Description

Participants. Twenty-six high school students out of a class of 30 students, who had elected to take part in the rock-climbing program, volunteered to be included in this study. The participants had varying climbing abilities at the beginning of the study (i.e., the participants were composed of the following groups: novice, $n = 12$; intermediate, $n = 9$; and experienced rock-climbers, $n = 5$). The sample was composed of 16 female

students and 10 male students. The ages of the students ranged from 13 to 16 years old. The novice group was composed of six male and six female students. The intermediate group was composed of entirely female students. The experienced group was composed of one female and four male students.

The Instructors. The main teacher responsible for the rock-climbing program was a certified physical education teacher, who specialized in rock-climbing and outdoor education. Two additional instructors observed were a competitive professional rock-climber and a rock-climbing center manager.

The rock-climbing program. The rock-climbing program was an elective offered within the physical education program. Students were provided the opportunities to develop a strong foundation in climbing. For example, at the end of the program, students were capable of bouldering, top-roping, leading, setting routes, managing risks, and potentially obtaining a level one indoor rock-climbing instructor certification. The rock-climbing program lasted 75 minutes and took place every day of the week for 5 months.

Data Collection Methods

Consistent with case study methodology (Yin, 2014), I used the following data collection methods: (a) a self-efficacy questionnaire, (b) observations of the learning environment, (c) a program outline, (d) individual reflection journals, and (e) focus group interviews.

Self-Efficacy Questionnaire

A self-efficacy questionnaire, specific to climbing abilities learned in a typical rock-climbing program was administered to establish a baseline and monitor the change

in participants' measures of self-efficacy. The Victoria Climbing Self-Efficacy Questionnaire (VCSEQ; see appendix A) was based on a questionnaire that has been shown to be reliable and a valid measure of climbing self-efficacy (Llewellyn et al., 2008). The questionnaire was modified by the principal investigator to more adequately reflect the objectives of the climbing program. It is composed of 12 questions related to climbing that ask respondents to answer on a scale of 0 to 100. Administering a quantitative questionnaire to monitor change in climbing self-efficacy was created in order to compare the effect size of the change in self-efficacy with other related interventions (e.g., Sandlin, 2013).

Observations of the Learning Environment

An observation checklist was constructed a priori by the principal investigator, which helped identify the presence and frequency of different learning activities and instructional strategies used by the teacher (see Appendix B). As well, observations of the rock-climbing environment provided insights regarding behavioural aspects of self-efficacy such as verbal persuasion (Bandura, 1997). The purpose of these observations was to establish and later describe the learning activities and instructional strategies that took place in the rock-climbing program. The climbing self-efficacy of students was not monitored through observations.

Program Outline

A program outline and schedule of activities was obtained from the main teacher of the climbing program. This outline was used to compliment the observations, provide a thick description of the activities and instructional strategies, and prepare reflection journal questions.

Student Reflection Journals

Individual reflection journals allowed me to probe general themes regarding key sources of self-efficacy (e.g., mastery and vicarious experiences). Participants were provided, during 15 minutes of class time, with a journal to be completed bi-weekly as part of their climbing program requirement. Based on the four main sources of self-efficacy and the activities that took place in the preceding two weeks, open-ended questions guided these reflections. For example, one question asked students to "Describe any differences in [their] ability to climb when [they] are projecting a boulder problem by [themselves], as a class, or with partners." See Appendix C for additional sample questions.

Focus Group Interviews

I was able to probe deeper by complementing the individual reflection journals with three focus group interviews. The focus group interviews took place after 5 months of participation in the rock-climbing program. Focus group interview probing questions, culminating in a focus on the sources of self-efficacy, structured the open-ended questions. See Appendix D for the interview guideline. Focus group interviews were conducted to further explore the opinions of participants expressed in the individual journals. In addition, these focus groups allowed for group reflection and made the saturation of themes possible.

Procedures

Prior to my research, I obtained the approval of the human research ethics board of the University of Victoria (see Appendix E) and the school board of the high school

under study (see Appendix F). Before any data collection occurred, assent forms were provided to the participants (see Appendix G) and consent forms were provided to their parents or guardians (see Appendix H).

Self-Efficacy Questionnaire

The VCSEQ was administered to the participants in the first week of the study (late September) and toward the end of the semester (mid-January). The questionnaire was administered after the participants and their parents or guardians had signed the consent forms. Allowing two weeks before completing the self-efficacy questionnaire allowed the climbing novice participants to become acquainted, by being immersed in the class, with the climbing-specific terminology used in the questionnaire.

Observations of the Learning Environment

An observation checklist was used to help identify the presence and frequency of different learning activities and instructional strategies being used. The observations commenced when the consent forms of the teacher and instructors had been signed. The teacher and principal investigator informed the students verbally that observations were being done on the instructional strategies and not on the students. The 75-minute lessons that were observed took place daily throughout the 5-month long semester. In the first two weeks of the program, the observations took place daily. For the remaining ten weeks, observations occurred twice a week. The observations were conducted by the principal investigator.

Student Reflection Journals

Participants were provided with a journal to be completed as part of their climbing program requirement. Based on the preference of the teacher, students were

allotted time during class (approximately 15 minutes) to complete these journals. Since the experienced group was composed of only five students, five student journals were transcribed and analyzed from each of the three student groups in order to avoid the overrepresentation of the novice students' voice.

Focus Group Interviews

The focus group interviews took place in the last week of the rock-climbing program (late January). Yin's (2014) depiction of the "shorter interview" influenced the design of the interview. The interview was "open-ended and [assumed] a conversational manner", however it followed the pre-established protocol questions more closely than a "prolonged case study interview" (Yin, 2014, p. 110). Students were asked to tell me about the learning activities and instructional strategies that were used throughout the program. These interviews took place during class time that was most convenient for the participants and the teacher. The focus group interviews lasted on average 30 minutes and were held in groups of five-seven students in a quiet area of the rock-climbing gym. The principal investigator audiotaped the interviews and took notes of any pertinent non-verbal communication. Based on the recommendations by Stewart and Shamdasani (1990), groups were separated based on experience level in order to avoid distorting the opinion of novice students.

Data Analysis

Quantitative data analysis. Initially, descriptive statistics of the questionnaire results were computed. The mean and standard deviations were computed for the pretests and posttests of the female students, male students, and overall class. The mean and standard deviations were analyzed with a dependent t-test using the statistical package

SPSS (Field, 2013). Initially, data was screened for any outliers and abnormalities. To allow a comparison of the difference in scores between the pretest and posttest, a significance level of $p < .05$ was reported as well as an effect size. The VCSEQ was analyzed retrospectively to ensure the reliability of the questionnaire.

Qualitative data analysis. Prior to data analysis, the data emanating from the focus group interviews, student journal entries, observations, and course outline were transcribed into Microsoft Word and uploaded to the qualitative data management software, NVivo 11. The audiotaped focus group interviews were transcribed and compared to any written notes that emphasized non-verbal communication. The 26 journal entries were transcribed and were separated by group affiliation based on the students' experience level (i.e., novice, intermediate, or experienced groups). The observations, and course outline were transcribed verbatim.

The robust and systematic framework of qualitative thematic analysis was used to identify codes, patterns, and themes within the qualitative dataset (Braun & Clarke, 2006). Specifically, a semantic level analysis was deemed most appropriate, as opposed to a latent level of analysis. The semantic level of analysis was accompanied by the epistemology of an essentialist approach (Braun & Clarke, 2006). In other words, the statements made by students were analyzed at face value and no themes were developed based on statement inferences. Braun and Clarke (2006) advocated that thematic analysis be done systematically through the following six phases: Phase one: Familiarize yourself with the data; Phase two: Generate initial codes, Phase three: Search for themes; Phase four: Review themes; Phase five: Define and name themes; Phase 6: Produce the report.

In phase one, observations, journal entries, focus group interviews, and the course outline were transcribed into Microsoft Word. The transcription process allowed me to familiarize myself initially with the data and allowed me to read and re-read the data set (Braun & Clarke, 2006). During this phase, I actively read the data by taking note of potential themes, which recurred throughout the dataset. These notes were reviewed during phase three.

In phase two, the entire dataset was uploaded to NVivo and coded. Each statement in the qualitative dataset was read and assigned a code, the most basic structural element of thematic analysis (e.g., some of the codes were 'being watched' and 'nervousness'). If a statement did not align with a preexisting code, a new code was provided for it. If a statement corresponded to a preexisting code, it was assigned to that coded group. This phase was complete once all statements were assigned to at least one code.

In phase three, codes were gathered into preliminary themes. A combination of inductive and theoretical thematic analysis was used. Two major themes were created inductively based on the culmination of codes emanating from the entire qualitative dataset. A third major theme was deductively based with the purpose of identifying the four sources of self-efficacy (Bandura, 1997).

In phase four, major themes were refined through discussions with an expert in qualitative thematic analysis. This discussion process culminated with a more accurate and thorough description of the three major themes and allowed all codes to be assigned to one of the three major themes.

In phase five, I revisited statements to redefine themes to fit the data more appropriately. In addition, certain statements were re-allocated to more appropriate themes. The data within each theme was paraphrased in order to obtain clear and concise descriptions of each theme.

Phase six consisted of producing the report of themes. Evidence of the themes, as recommended by Braun and Clarke (2006), was provided through narrative data extracts. These data extracted vignettes reflected the overall themes of statements. The qualitative portion of chapter four consists of this report.

Monitoring the Quality of the Quantitative Portion of the Research

Validity. Validity involves measuring the appropriate concepts needing to be studied (Thomas, Nelson, & Silverman, 2011). In this research, threats to validity were mitigated by the use of a climbing self-efficacy questionnaire that reflected the course outline and the teacher's program objectives. The teacher of the program and two pedagogy experts further reviewed and revised the questionnaire. In addition, multiple sources of evidence with convergent lines of inquiry were used (Yin, 2014).

Reliability. Reliability ensures that a similar study could be replicated with similar results. Using a questionnaire with elevated reliability mitigated threats to internal reliability. According to Field (2014), a reliable scale should have items that correlate well with the overall score of the scale. Indeed, all items correlated well with the overall scale (i.e., each item had a corrected item-total correlation above .4). In addition, considering that the reliability value of Cronbach's $\alpha = .7$ is accepted as appropriately high for psychological constructs, The Victoria Climbing Self-Efficacy Questionnaire had high reliability, Cronbach's $\alpha = .91$.

Establishing Trustworthiness for the Qualitative Portion of the Research

Comparable to the validity and reliability assessments for the quantitative portion of the study (Yin, 2014), trustworthiness of the qualitative portion was maintained with the consideration of four major components of trustworthiness. The following strategies were used in this study to promote trustworthiness:

1. Triangulation of information through multiple data collection methods was used (i.e., statements were collected from journaling entries, observations, a course outline, and focus group interviews).
2. Peer review and discussions were conducted with two experienced qualitative researchers.
3. An in-depth description of the environment was provided.
4. Prolonged engagement was used. I was engaged in the data collection stage for approximately 5 months and I interacted with the teacher, instructors, and students a minimum of twice a week during this time. One testament to the relationship that was built with the participants was a letter of appreciation written by the students.
5. I examined and restructured themes until all cases fit within the final major themes.

Credibility. Credibility requires that the "participants and the setting of a study are accurately described" (Thomas, Nelson, & Silverman, 2011, p. 364). The participants and the case are described in the methods chapter.

Transferability. Similar to the concept of generalizability in quantitative methodologies, transferability allows the reader to determine if the results of this study

can be applied to other similar settings (Thomas, Nelson, & Silverman, 2011). I provided a description of the case and learning activities in chapter four, which allow readers to determine if their teaching context is similar.

Dependability. Dependability ensures that changes in methodology are dealt with appropriately (Thomas, Nelson, & Silverman, 2011). In the present study, no changes in methodology took place.

Confirmability. "Confirmability deals with the issue of researcher bias" and is similar to the concept of statistical reliability (Thomas, Nelson, & Silverman, 2011, p. 365). In line with this recommendation, I have provided the following researcher background.

Background of the Researcher

According to Yin (2014), the researcher is an important instrument in qualitative research. Therefore, the validity of this research relies heavily on my experience and skills that I bring to the study. As a certified climbing gym instructor and a certified physical and health education teacher, I value the importance of promoting healthy and active lifestyles for youth. I have maintained a consistently physically active lifestyle myself throughout my childhood. Although I have, at times, participated in organized team sports, I have developed a strong preference for engaging in adventure physical activities (e.g., rock-climbing, skydiving, and kayaking). Through negotiating risks involved with participation in adventure physical activities, I have developed an understanding of self-efficacy and how it influences my behaviour. Namely, I have found that when my self-efficacy is highest, I make stronger attempts in climbing and may be willing to take additional risks.

According to Starks and Trinidad (2007), researchers "must be honest and vigilant about [their] own perspective, pre-existing thoughts and beliefs, and developing hypotheses [...] engage in the self-reflective process of 'bracketing', whereby they recognize and set aside (but do not abandon) their a priori knowledge and assumptions, with the analytic goal of attending to the participants' accounts with an open mind" (p. 1376). In order to avoid bias, I engaged in the bracketing technique of memoing advocated by Cutcliffe (2003). Specifically, I included in my observation checklists a section for personal reflection throughout data collection.

Chapter Four

Results

The purpose of this study was to explore the effectiveness of learning activities and instructional strategies utilized by teachers in a school-based rock-climbing program on students' climbing self-efficacy. This chapter has been divided into quantitative and qualitative results to achieve this purpose. The quantitative section examines the change in climbing self-efficacy and includes an exploration of the data, a test of reliability for the VCSEQ, and a t-test for dependent samples. The qualitative section provides evidence, through three themes, to support the answers to the research questions through observation and outline excerpts, journal entries, and interview statements.

Quantitative Results

Initially, data was input into IBM SPSS Statistics 24. Prior to analysis, the accuracy of data entry and the assumptions of parametric analysis were reviewed. Descriptive statistics were explored for any irregularities. All 26 consenting participants were included in the analysis and no cases were missing (i.e., all sections of the questionnaire were answered by all 26 participants). Sixteen of the participants identified as female and ten of the participants identified as male. The assumption of independence was met by having asked participants to complete their questionnaires independently. Considering that the assumption of normality in a paired-samples t-test should be applied to the differences between pretest and posttest scores, and not the scores themselves, I explored the normality of the differences in scores. The shape of the distribution of differences scores was examined visually through the use of a stem-and-leaf plot (see Table 2) for any abnormalities for normality and outliers. In addition, because the sample

size was small, a test of normality was applied (Field, 2014; Lumley, Diehr, Emerson, & Chen, 2002). The Shapiro-Wilk test has been recommended as the preferred method for evaluating normality because it has greater power than the Kolmogorov-Smirnov to detect if the distribution of scores in a sample is significantly different than that expected from a normal distribution (Ghasemi & Zahediasl, 2012). The difference in scores, $W(26) = .965$, $p = .497$, did not deviate significantly from normal.

Table 2

Stem-and-Leaf Plot of the Mean Difference in Pretest and Posttest Scores

Frequency	Stem & Leaf
1.00	-2 . 9
4.00	-1 . 1 1 1 4
4.00	-0 . 1 3 5 6
8.00	0 . 0 1 1 2 3 5 7 9
8.00	1 . 0 1 2 6 7 8 8 9
1.00	2 . 3

The pretest mean for all participants ($n = 26$) was 80.07 ($sd = 9.51$). The posttest mean for all participants ($n = 26$) was 83.43 ($sd = 10.65$). The pretest mean for female participants ($n = 16$) was 76.23 ($sd = 9.20$), and the posttest mean for female participants was 81.22 ($sd = 12.21$). The pretest mean for male participants ($n = 10$) was 86.23 ($sd = 6.47$), and the posttest mean for male participants was 86.96 ($sd = 6.65$).

The total mean improvement, for the entire sample was 3.35 ($sd = 12.71$). The difference in the self-efficacy scores of participants, 3.35, 95% CI [-8.49, 1.78], was, however, not statistically significant ($t(25) = 1.35$, $p = .190$). There was therefore no statistically significant effect observed between the average posttest mean scores and the average pretest mean scores of the entire sample. If the difference in average scores had

been significant it would have represented a small-sized effect, $d = 0.26$. The positive mean difference score for male participants ($n = 10$) was .73 ($sd = 6.95$). The positive mean difference score for female participants ($n = 16$) was 4.99 ($sd = 15.26$). The change in self-efficacy was not significantly different between the female and male participants.

Qualitative Results

The focus of this research was to investigate the characteristics of the rock-climbing program and determine which learning activities and/or instructional strategies may be most beneficial for improving the self-efficacy of high school students. Through a representation of the statements made in journal entries, focus group interviews, observations, and the course outline, this qualitative section will address the following three main research questions: (a) What are the activities that take place in the program?, (b) What are the sources of self-efficacy embedded in the learning activities and/or instructional strategies of the rock-climbing program?, and (c) How did the learning activities and/or instructional strategies impact the self-efficacy of high school students? Table 3 includes a summary of the themes and their components.

Table 3

Summary of Themes and their Components

Theme One: A Learning Environment Conducive to Developing Self-Efficacy	Theme Two: The Influences of the Sources of Self-Efficacy Embedded Within the Climbing Program	Theme Three: Learning Activities, "I would suggest doing them because it helped"
Physical facility	Mastery experiences	Goal setting
Social aspect	Vicarious experiences	Training
Informational expectations and safety responsibilities	Verbal persuasion	Technique-oriented learning activities
Being observed	Affective states	Peer teaching
	The downside of high expectations and high self-efficacy	

Theme One: A Learning Environment Conducive to Developing Self-Efficacy

This theme describes the complexity of the learning environment, which affected the climbing self-efficacy of students. The learning environment was comprised of a variety of components, each contributing in some way to changes in climbing self-efficacy and climbing performance. These components ranged from "features" to "being observed." The impact of certain climbing gym characteristics, such as the height of climbing walls, are described in the component "physical facility." The focus and impact of the social interactions, which took place within the climbing program, are described in the component "social aspect." The impact of safety and sharing beta are described in the component "informational expectations and safety responsibilities." Finally, the impact of observers is described in the component "being observed."

Physical facility. Whether they were climbing at different climbing centers, outside, or during a competition the difference in climbing wall structure or setting evoked differences in self-efficacy. The wall was organized in three separate areas. One

section was devoted to top-rope climbing, a second area was designated for bouldering, and a third area was designated for lead climbing. The difficulty of all routes was indicated on each route and ranged from novice (5.5 on the Yosemite Decimal System) to expert (5.13).

Overall, students indicated that climbing higher heights was more intimidating and reduced their climbing self-efficacy. An experienced climber wrote the following journal entry that exemplifies this theme. “Confidence was low at [the climbing center that we visited] because the walls were so high.” However, having climbed in a different or more challenging climbing gym may have improved the self-efficacy of some intermediate-level climbers, as can be seen in the following statements.

> *I gained confidence after lead climbing at [another climbing gym]*
> (Journal entry from intermediate climber)

> *Climbing in different gyms was really fun and makes me more confident.*
> (Journal entry from intermediate climber)

Following a fieldtrip visit to another climbing center, several students from the novice and intermediate groups indicated in their journal entries that route rating and the style of route affected their self-efficacy. The following excerpt is an example of one of these entries: “I feel more confident because of the different route styles in Vancouver.” Being unaware of the route difficulty levels benefited some students as it allowed them to attempt more difficult routes that may not have otherwise been attempted. The following statement describes how route rating increased a student’s desire to attempt different routes. “Sometimes here I know something that I don’t like so I won’t do it but at other gyms I don’t know so it’s easy to try everything.”

However, the following journal entry from an intermediate climber suggested that

not knowing the route could also negatively affect a climber's self-efficacy. "With the different grading systems and different types of routes it made it harder to find the correct route for your ability, which can lower your confidence."

Social aspect. The social nature of climbing was apparent throughout the program and the course outline objective of establishing a "supportive and diverse community" was achieved throughout the program. In the early stages of the program, one instructor encouraged the more experienced students to help their novice peers. The following journal entry from a novice level climber speaks to the collaborative nature of these social interactions. "Everyone was really encouraging, it's [grade] nine to twelve, but everyone was really nice and it worked together."

Throughout the program, students were most often climbing in pairs or in small groups. Some students, as demonstrated by the following interview statement from an intermediate level climber, preferred climbing in groups as it allowed them to benefit from the encouragement and advice of other students. **"**One good thing I've realized is that it is always positive, someone is always trying to help you."

Although the majority of students explained the collaborative nature of working in pairs, one student from the intermediate group discussed the motivational aspect of informal competitions that he had with his partner. He mentioned, "with a partner I will be more competitive and climb better." Other students explained that in certain situations, climbing individually was better for concentrating on their climbing. The following journal entry from an intermediate level climber demonstrates this preference: "I am able to better concentrate on my own but I better understand the problem in a group."

Through journal entries and interviews, several students alluded to the increased social nature of climbing activities such as bouldering.

> *When you are bouldering you are not usually alone, but when I do go alone it is pretty lame, you don't feel motivated to do it because no one is there to cheer you on or see you finish it and tell you, yeah you do it!*

Encouragements were bountiful throughout the semester. Students described the typical encouragements heard in the rock-climbing community and the affluence of these encouragements throughout their interviews and journal entries.

> *One of the most common words that I hear people chanting is "you've got this" and their names and "come on" it feels like you're doing the route with them and your happy when they get it.*

Through observations, the "*humor between student and teacher*" was apparent. Students described, in their interviews and journal entries, the pure enjoyment of climbing for its own sake. Teachers reinforced this emphasis on fun throughout the program. For example, one teacher, before the competition, told students, "focus on having fun, and don't worry about results." The following interview statement from a novice climber describes this atmosphere: "I liked climbing so it made it fun, it didn't really feel like a school class it felt more like a camp."

Informational expectations and safety responsibilities. Throughout the program, the safety of students was paramount. The course outline specified, among other criteria, that assessment would be based on *"*safety and risk management.*"* The following statements describe the importance of safety protocols rock-climbing:

[the teacher] taught us well and also helped us after to make sure we did everything correctly and safely

(Journal entry from experienced climber)

[…] at the beginning, in grade 9, I would still get scared of the belayer, and a little scared to lower, now the top rope is a breeze, I feel a lot more safe now […]

(Interview statement from experienced climber)

Within the rock-climbing community, it is often expected that, in addition to belaying one's climber, partners provide each other with information about the climbing route (i.e., beta). The following statements reflect the observations of students providing beta to each other throughout the program.

I was trying an orange route and [another student] *helped me with balance and how to hold a hold.*

(Journal entry from intermediate climber)

Helped tell me where to put my hands and legs.

(Journal entry from novice climber)

Being observed. Data from the observations indicated that certain activities were more prone to having students be observed. Although bouldering activities were most often done in partners, certain explanations were completed in larger group settings, where one student climbed and an average of four students and one instructor provided feedback and observed the climber. The availability of only two designated speed climbing routes allowed a maximum of two students to climb concurrently. During the speed climbing activities students waiting for their turn were therefore asked to observe the climbers. Students reported feeling most observed during the competition. Being

observed, while they were climbing, affected several of the students. Through journal entries and the interviews, students of all experience levels indicated that being observed made them nervous and led to hindered performances. Students indicated circumstances that made them more nervous, such as when several people were watching them or when observers were strangers. The following journal entry and interview statement from experienced climbers illustrates this increase in nervousness.

> *It was more stressful during the competition since there were a lot of people watching instead of just a few friends.*
>
> (Journal entry from experienced climber)
>
> *When others are watching, I am only going to do things that I will not fall off of and it makes [me] really nervous.*
>
> (Interview statement from experienced climber)

Additional nervousness arose when observers watched the climber without encouraging them. The next statement from the interview of an experienced climber exemplifies the notion of nervousness, arising from being watched.

> *When people are watching you, there is a big difference between people who are watching you and encouraging you and people who are just watching you and awkwardly sitting there.*

Although the vast majority of students indicated in their journals and during the interviews, that being observed had a negative effect on their performance; some students mentioned the neutral or motivating effects of being observed.

> *There was people watching from above, and I could see them while I climbed, the people were encouraging me and while it made me more nervous it also*

motivated me to get it because I knew it would feel good, it was scary and stressful and lots of pressure but I feel like it helped me to finish it.

Theme Two: The Influences of the Sources of Self-Efficacy Embedded Within the Climbing Program

Through the interviews and journals, several students have indicated that they are "a lot more confident then when [they] first started out" (Journal entry from novice climber). According to Bandura, four sources of self-efficacy may have accounted for this confidence or in some cases the lack of confidence. It is clear that these four sources were all embedded within the climbing program. Some students discussed mastery experiences as his or her key source of climbing self-efficacy. Although the verbal persuasion and affective states were enough to encourage or discourage a student from attempting a certain climbing problem, they needed to be accompanied by mastery experiences to be able to influence self-efficacy more thoroughly. This theme is a representation of the statements that students have made about the impact of mastery experiences, vicarious learning, verbal persuasion, and affective states on their climbing self-efficacy.

Mastery experiences. According to the course outline, active participation is worth 50% of the students' grades. The observations conducted confirmed this emphasis on practice, active participation, and mastery experiences.

Most students discussed through their journal entries and the interviews the importance of being challenged adequately through progressive steps. Once students had practiced a related, but easier task, such as top-roping, they were more confident to proceed with more challenging tasks such as lead climbing. The following statement

demonstrates how mastery experiences through progressively challenging activities increased self-efficacy.

> *I took a fall on the route and I thought it wasn't as bad as I expected, I feel that the teacher making me do it on top rope first showed me that I actually can do the route.*
>
> (Interview statement from experienced climber)

When asked for their inputs on methods of improving their confidence to climb, students suggested that practicing the activity would be the most helpful strategy for improving their self-efficacy. The following statement demonstrates the positive benefits on self-efficacy through the practice of dynos (i.e., dynamic climbing move) and lead climbing, which are the activities that most students found scariest.

> *I might overcome* [the fear] *by leading more and practicing falls.*
>
> (Journal entry from experienced climber)
>
> *When doing speed, the teacher got us to practice our dynos, we were terrified with doing dynos, but then when we were on the speed wall we were not scared anymore.*
>
> (Interview statement from intermediate climber)
>
> *I* [had] *actually have never fallen on a lead route, so I was always really scared of falling, and then we did this exercise where we had to do lead falls and I was forced to do them, and then when I was doing a lead route I knew it was not that bad to fall, and that really helped.*
>
> (Interview statement from experienced climber)

Following a prolonged absence from climbing activities, several students described

in their interviews and journal entries a lack of climbing ability and self-efficacy.

> *My confidence really increased throughout the semester, at the beginning I was kind of nervous, which is common when I haven't done it for a long time, near the end I was way better than I was.*
>
> (Interview statement from experienced climber)

Similarly, when students had not practiced a certain climbing activity, such as leading, for a prolonged period, they described being more nervous and having less self-efficacy for that specific skill or activity. For example, a novice climber mentioned, "after winter break, I got scared to lead climb because I hadn't done if for a long time." Similarly, an experience climber mentioned the following in their interview, "Leading is still scary, but I am more aware that it is a mental thing, whereas when I started, it's the same thing every year, having to get really good at climbing and then you don't do it for a long time and you suck and can't do this, knowing you physically can do it, is like a mental thing."

Vicarious experiences. In addition to providing information on the best path to take up a certain route (beta), observing other climber provided students with a positive and sometimes negative source of self-efficacy. Overall, students indicated that observing another climber successfully completing a prospective route increased their self-efficacy. The following statement is representative of these sentiments.

> *I get really nervous lead climbing, so I like to watch someone else do the route before, it also makes me realize it is possible and I can physically do it.*
>
> (Interview statement from experienced climber)

However, the following statement shows how watching a climber unsuccessfully attempt a route, resulted in less self-efficacy for climbing that particular route for the observer.

[…] if they don't get it I think if they can't do it I can't do it also.

(Interview statement from experienced climber)

It depends if the friend finished the route or not, if they struggle not even a quarter of the way in, it's like oh god! I know this route is going to be bad, but if they get passed a certain point, you become more confident and you can see where they mess up.

(Interview statement from intermediate climber)

When the observer perceived himself or herself to be similar in height, age or climbing proficiency as the model climber, the observer was more likely to be able to relate to the success of the model and develop self-efficacy for climbing that particular route. For example, an experience climber mentioned, "…watching people that are kind of my age, I think I can probably do that." However, as demonstrated by the following interview statements, some students identified the negative impact of watching a climber who is more proficient at climbing than them.

When the teacher was doing it and was literally wearing [non-climbing footwear], and he says just do a pull up, you're like great (student rolls eyes). But someone who is the same level of you, you can think Oh I hadn't even thought of that, and it really helps but when it's a stranger its either they are way better than me or I can actually climb stuff if there the same level as me.

(Interview statement from experienced climber)

If the teacher completes a route, you're like, okay it's just the teacher, but if your friend who is the same level as you, you think I can do it too.

(Interview statement from intermediate climber)

Verbal persuasion. Verbal praises were noted in observations as being used frequently by both teachers and students throughout the semester. The most frequently heard praises were "come on, you got this!" and "you can do it!" Students in their journal entries and interviews identified verbal praise as leading to increased confidence for doing more difficult routes. The following statements describe such instances.

> *One thing that a teacher says a lot is "come on." I feel it is comforting, when you're on the wall she is not telling you what to do exactly, I do appreciate that too, but when I am stuck on a move and I think I have an idea of how to do it and I start moving that way and she says "come on," I know that she knows that I can do it and it makes me feel better.*
>
> (Interview statement from experienced climber)
>
> *That's what I think climbing is about, you are doing it together, by me cheering them on, they hear oh yeah I can do this!*
>
> (Interview statement from experienced climber)

One common way that teachers used verbal praise was by telling students to attempt a more difficult route.

> *A teacher told me to climb a 5.11- and at that point I hadn't climbed anything more difficult than 5.10-, I almost managed to finish it and that showed me that my skill level is higher than I expected and [that] made me think I could climb more difficult routes.*
>
> (Interview statement from intermediate climber)

Although verbal praise improved the self-efficacy of some students, sometimes the verbal praise was not enough to improve self-efficacy.

Everyone tells you're strong enough for that and you can do that, it's just a mental block of what if I fall or slip.

(Interview statement from experienced climber)

[After my partner said] you can do it! I thought maybe I can, then I thought never mind, I definitely can't.

(Journal entry from experienced climber)

The frequently used verbal praise of "you can do it!" was beneficial for the self-efficacy of most students, however, the following statement demonstrates how one student had reservations about hearing verbal praises while they were climbing.

[…] it helps a lot, sometimes it pressures you and people are making you more nervous.

(Interview statement from intermediate climber)

Affective states. Anxiety from climbing harder routes or from lead climbing resulted in reduced performance and a reduction in self-efficacy for several students. The following two excerpts represent these sentiments.

I feel like it definitely is a barrier for me when climbing, if I wasn't so nervous I could be doing harder routes, I feel like some cases I am physically able to do the route but I am too scared to do it, I just get so nervous, so it is stopping me from reaching my full potential

(Interview statement from experienced climber)

I think [climbing is] a little harder when you are scared of falling, we were definitely strong enough to do it, but we just needed to get over it

(Interview statement from novice climber)

Feelings of anxiety or nervousness were frequently reported when students described their experiences with two climbing competitions. For example, an experienced climber mentioned, “I really hate the comp because it’s really stressful and I don’t feel like I climb my best under that pressure.”

However, some students experienced excitement and motivation from participating in the competition.

> *[I] Felt more determined to finish [the] route*
>
> (Interview statement from novice climber)
>
> *I did way better during comp, trusted myself way more*
>
> (Journal entry from intermediate climber)

Feeling scared also had a direct debilitating effect on the climbing performance of students as the following statement demonstrates: One experienced climber described this feeling as, “when I get nervous I get clammy hands, which is not good for climbing rocks when your hands are wet.” Other students have suggested that the affective state were attributed to a feeling of excitement or adrenaline. Some students suggested that a certain fear of falling helped them improve their performance. The following comments are examples of this feeling of excitement.

> *I am also nervous before I start a route but then the adrenaline kicks in and I get a mixture of nerves and excitement and you can’t decide which one it is and when you are on the route it is not as bad.*
>
> (Interview statement from experienced climber)
>
> *I thought it was easier because I did not want to fall as much, so I just held on*
>
> (Interview statement from novice climber)

Several students attempted to overcome this fear of heights or fear of falling through different strategies. Some students preferred to concentrate on the immediate climbing moves that must be done. The following statement from an experienced climber is an example.

> *When I am on the wall not looking up and starting to panic about what's coming and just climbing one move at a time I feel like I will be able to deal with it when I get there*
>
> (Interview statement from experienced climber)

Several experienced climbers described using a motivating talk from climbing partners as a strategy to overcome the fear associated with lead climbing (e.g. "[my climbing partner] and I have a pep talk before leading and repeat our mantra"). Several students explained how resting and 'chalking up'[7] helped them to reduce their nervousness. The following excerpt is a sample of these comments about their use of resting.

> *Now when I get nervous, I just don't pay attention to it, I just slow down instead of taking because I don't want to mess up the route by taking, so I just chalk and rest and before I would start shaking and ask for a take.*[8]
>
> (Interview statement from intermediate climber)

The downside of high expectations and high self-efficacy. Despite observations of the teacher frequently asking students to think about the "best of [themselves and] not

[7] Before and during a climb, rock-climbers will periodically insert their hands in a bag with chalk (i.e., magnesium powder) in order to keep her or his hands dry.
[8] Climbers will sometimes ask their belayer to secure the rope tightly and rest in their climbing harness if they need to relax or think about how he or she will approach the next climbing sequences.

compare [themselves] to someone else," several students held high expectations for their performance and demonstrated a fear of failure. The following statements describe such fear of failing and not meeting the perceived expectation of other people.

> *When I see people climbing before me, especially for boulder and the competition setting, watching people do it, if they got it I would be scared because there are high expectations for me to get it.*
>
> (Interview statement from experienced climber)
>
> *Even if you know that your confident in your climbing skills knowing that, they are a world class climber, they are going to think that you suck, but even when there are people who come here and they can only do one route, were not judging them but when others are watching, I am only going to do things that I will not fall off of and it makes you really nervous.*
>
> (Interview statement from experienced climber)

One student explained a situation that described a gain in risk-taking, which accompanied a gain in his climbing self-efficacy.

> *My confidence changed a lot for lead climbing, it changed in a good way and a bad way, because I started getting a bit cocky and started doing stupid things on the lead route, this one part I was just holding to the hold with one arm and clipping with the other hand with no feet on the wall. I would never do that again. In that moment it seemed right but now that I look back on it, it doesn't seem safe.*
>
> (Interview statement from intermediate climber)

Theme Three: Learning Activities, *"I would suggest doing them because it helped"*

As the excerpt from a student statement describes, learning activities were useful

for improving the climbing self-efficacy and performance of students. This theme describes the necessity of using different learning activities and instructional strategies for different periods of the learning process and for different experience levels. For example, near the end of term, learning was done more autonomously and peer teaching was made available to the more experienced students. The evidence for this theme is composed of the learning activities: goal setting, cross training, technique-oriented learning activities, and peer teaching, that were described in the student journals and interviews.

Goal setting. Goal setting as a learning activity was formally used once during the program. Observations and the course outline analysis showed that students were provided, during their fourth week in the program, with 20 minutes for preparing several goals following a SMART goal model. A SMART goal incorporates the five principles of making a goal specific, measurable, action-oriented, realistic, and within a timeframe (McDonald & Trust, 2015). A typical goal set for the novice climbers was, "finish all the [beginner level] bouldering routes" and the typical goal set for the expert climbers was, "climb [an intermediate level route on] lead without stopping." Despite the fact that these goals were not revisited during or at the end of the semester, the following statements demonstrate how some students felt they were successful at completing their goals.

I didn't have the goal in mind but I feel like I did the goal

(Interview statement from experienced climber)

I think I said that I wanted to climb lead, and I guess I did that

(Interview statement from novice climber)

In addition to the formal goal-setting activity, one student described how needing to meet the requirements for becoming a rock-climbing instructor was motivating.

> *Having a goal or a reason to do something helped me, for example I needed to climb a certain level of lead to get into the CGI*[9]
>
> (Interview statement from experienced climber)

Training. The cross-training component of the climbing program took place twice a week. These training sessions took place outside of the climbing gym area and included exercises such as planks, throwing medicine balls with a partner, and working on agility with stepladders. Several students commented on the performance benefits they felt originated from the cross training that was done. The following excerpt represents these comments:

> *In my first year I wasn't training as hard as I could have [this year] I tried really hard and went from doing a 5.10 and struggling to doing a 5.11 and actually finishing them, the training really helped, and I would suggest doing them because it helped.*
>
> (Interview statement from intermediate climber)

Another form of training was done on the rock-climbing walls. Endurance training, which focuses on improving stamina through prolonged climbing, was used extensively in the beginning of the semester. Several students explained in their journals and interviews how completing exercises such as down climbing helped them to develop climbing endurance:

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[9] The Climbing Gym Instructor level one course is sponsored by the Association of Canadian Mountain Guides and provides instructors with the skills and knowledge to teach people how to belay and climb on top-rope within an indoor rock-climbing gym setting.

Endurance has helped me build strength especially down climbing even though it's sort of terrifying.

(Journal entry from experienced climber)

We did the up down climbing that really improved my endurance.

(Interview statement from novice climber)

Technique-oriented learning activities. A variety of techniques for improving climbing performance were taught throughout the year. These techniques included heel-hooking, foot-matching, edging, taking appropriate rests, and sequencing.

The following statements are examples of how learning heel hooking, foot matching, and edging improved climbing self-efficacy and climbing performance:

Throughout the semester I start to think of techniques without realizing it, like heel hooking, I love doing it, I knew what it was but I didn't use it last year.

(Interview statement from experienced climber)

Heel hooking and toe hooking helped me become a more efficient climber.

(Journal entry from novice climber)

Foot matching was super important, when I first started climbing I knew nothing about it, this is 20 times easier because I used to have to jump and it was much more exhausting, it is more controlled now.

(Interview statement from intermediate climber)

Dynos [were] really valuable because just learning to trust yourself and trust your feet, in dynos there is a time that you are not touching and you would fall on the ground if you don't catch the next hold, and being able to apply that bouldering technique for lead and top rope, even if you do moves that are not a

dyno but it feels like one because you are so high, if you can't do them on the ground you won't be able to do it on the wall.

(Interview statement from experienced climber)

Straight-arm climbing [helped me develop] a more efficient climbing technique

(Journal entry from novice climber)

Another learning activity focused on taking rests in appropriate places on the route. Students were told to take a minimum of two rest periods in which they would reapply chalk on their hands and breathe slowly. The following interview statement represents how several students described the affect that this relaxation activity had on them:

They taught us how to rest on the wall, straight arms and breathe, it helped me a lot especially for lead climbing, not shaking out but doing it slowly in order to not send stress signals

(Interview statement from intermediate climber)

Several learning activities focused on teaching students to look at a route from the ground and decide how they will move up the wall. For example the "story telling" activity asked students "to create their sequence and tell the belayer every sequence they will do" before they started climbing. The following statements represent the thoughts several students had about route visualization and sequencing.

Helped me onsight and also finished routes faster and more efficient.

(Journal entry from novice climber)

Helps me understand different moves and makes me more confident as a climber and increases the chances of onsighting a route.

(Journal entry from intermediate climber)

Peer teaching. Observations of students providing each other with beta or teaching each other climbing moves were numerous throughout the semester. The following statement described one of the more memorable instances of the impacts of peer teaching on climbing self-efficacy.

We taught the other school how to top rope which kind of made us more aware of how to teach it to someone, top rope seems like a beginner thing, we already know how to top rope confidently and we even know how to teach it to other people, and it makes you feel so much better about yourself if your teaching someone how and you know exactly how to do everything.

(Interview statement from experienced climber)

Chapter four provided a description of the quantitative and qualitative results that emerged from this study. According to the quantitative analysis of the pretest and posttest VCSEQ, changes in climbing self-efficacy were not significant. However, the qualitative data provided details about the learning activities and instructional strategies used and their impact on climbing self-efficacy. The following chapter will discuss these results in the context of previous literature.

Chapter Five

Discussion

The purpose of this study was to explore the effectiveness of learning activities and instructional strategies utilized by teachers in a school-based rock-climbing program on students' climbing self-efficacy. This chapter will discuss the quantitative and qualitative findings by connecting the research questions and overall results to previous literature reviewed in Chapter 2.

Overall, results from the analyses in this study explain and extend previous research on self-efficacy and rock-climbing pedagogy. The climbing program's contributions to self-efficacy was most effective when learning activities and instructional strategies took place in a safe and collaborative environment, were meaningful, diversified, individualized, and progressively challenging. Theme one, "A learning environment conducive to developing self-efficacy" demonstrated the importance of maintaining a safe and collaborative environment. Theme two and three elaborated the need for meaningful, diversified, individualized, and progressively challenging activities for developing self-efficacy. In addition, all themes enabled the three main research questions to be answered. A discussion of the themes will address (1) the activities that took place in the climbing program, (2) the sources that encouraged self-efficacy that were embedded in the program, and (3) the learning activities and instructional strategies that were most beneficial for improving climbing self-efficacy in high school students.

Quantitative Discussion

The VCSEQ was administered to provide an overall picture of the changes in climbing self-efficacy associated with participation in the climbing program over a 5-

month period. A comparison of the pre and posttest measure of students' climbing self-efficacy resulted in no statistically significant improvement in self-efficacy. Had the improvement been significant, it would have corresponded to a small effect size of d = 0.26. Several reasons may have accounted for this non-significant change. First, students were excited to start climbing at the beginning of the program and they may have rushed through completing the pretest questionnaire more rapidly than the posttest, whereas, by the post-test, students might have spent more time thinking about the questions. Second, as the pretest scores of climbing self-efficacy were quite elevated, a ceiling effect may have prevented noticeable changes in scores. Given that these students were selected for this program, it is also likely they entered with high impressions of their climbing abilities. Following their investigation of a ropes course with 52 participants, Cordle et al. (2016) found a significant increase in task-specific self-efficacy of ropes courses. The current study of 26 participants may therefore have been underpowered and unable to detect a significant difference in climbing self-efficacy.

Future studies may want to utilize a control group, which does not participate in the climbing program at the same time. The lack of a significant change in self-efficacy observed in this study may have been a meaningful result if a control group had shown a significant decrease in self-efficacy during the same time frame. This possible decrease in climbing self-efficacy following a lack of climbing practice is further discussed under the "mastery experiences" component of Theme 2. To avoid a ceiling effect, future studies may also want to adapt the questionnaire for more advanced climbers. Finally, future research should consider using a larger sample size.

Theme One: A Learning Environment Conducive to Developing Self-Efficacy

Theme 1 demonstrated the importance of maintaining a safe and collaborative environment for climbing self-efficacy to develop. The learning environment will be discussed in regards to modification that can be made to allow for learning to be individualized and made progressively challenging. For example, teachers can provide visits to climbing facilities with higher climbing walls when they determine students to be ready for the challenge. Activities can also be designed to individualize and reduce the challenge involved with being observed.

Physical facility. Climbers in this study reported negative affective states when they were climbing at a gym with higher bouldering problems. This is consistent with the increased anxiety levels that followed alterations in heights discussed by Giles et al. (2014). Experiencing a variety of climbing facilities, however, improved the climbing self-efficacy of students when they returned to their school climbing facility. Sandlin (2013) investigated the impact of route ratings and found no significant difference in climbing self-efficacy of participants following route-rating manipulations. The statements made by climbers in this study however, suggested that not knowing route ratings could make "it harder to find the correct route for your ability, which can lower your confidence." In addition, not knowing a route rating enabled other students to attempt harder routes and consequently challenge themselves more. This adequate level of challenge could consequently result in an increased level of climbing self-efficacy. An optimal level of challenge prevents students from being bored by routes that are too easy or discouraged by routes that are too difficult.

Social aspect. In their review of the benefits of rock-climbing, Siegel and Fryer (2015) suggested that using rock-climbing in physical education programs can led to positive benefits in the social domain. It was apparent through the "social aspect" of this theme that a positive and collaborative learning environment existed within the program. According to the statements made by students in this case study, the variant of climbing that was predisposed most to positive social interactions was bouldering. This is not surprising because of the nature of bouldering, which does not require belayers and encourages climbers to discuss beta between short climbing intervals.

Informational expectations and safety responsibilities. Zakrajsek, Carnes, and Pettigrew (2003) emphasized a focus on safety in their climbing activity suggestions. A focus on rock-climbing safety and responsibility was echoed in a study of an indoor climbing program (Hansen & Parker, 2009). This is in accordance with the statements of students in this case study, which said that the teacher "taught [them] well and also helped [them] after to make sure [they] did everything correctly and safely." Woollings, McKay, and Emery (2015) emphasized that indoor rock-climbing is the safest form of rock-climbing, and this case study demonstrates that safety responsibilities can be taught and delegated to high school students.

Information on holds or techniques to use on a route (i.e., beta) was frequently shared among students throughout the program. The students' understanding of movement reflects what Fallis, Säfvenbom, Haugen, Bulie, and Lloyd (2014) termed an "expanded movement consciousness" (p. 576). Namely, students in this case study demonstrated an understanding of climbing movements and were able to communicate

this to her or his climbing partner. For example, students told each other how to help "with balance and how to hold a hold."

Being observed. Although no research has investigated the effects of being observed on rock-climbing performance, Giles et al. (2014) suggested "performance of new tasks with an audience negatively affected difficult skills, which had not yet been mastered, whereas for well known or simple skills it helped performance" (p. 110). Indeed, climbers in this study discussed being nervous when practicing the new task of speed climbing while being observed by other students. In addition, climbers in this study reported feeling nervous during the competition because of the audience watching them.

One experienced student's statement provided support for the findings of Hardy and Hutchinson (2007), which suggested that a moderate increase in anxiety can be associated with maintained or improved climbing performance. This finding is in line with the processing efficiency theory, which stipulates that higher levels of anxiety may lead to higher levels of effort and improved performance.

Although Giles et al. (2014) suggested that experienced climbers have a stronger ability to cope with higher levels of anxiety when climbing, results of this study indicated that students of all experience levels felt anxious when being observed. This discrepancy might be the result of different terminology for what constitutes an experienced climber. Specifically, this study referred to students who have taken part in the climbing program for 10-15 months as experienced climbers, which is less than the climbing history of an average elite climber.

Theme Two: The Influences of the Sources of Self-Efficacy Embedded Within the Climbing Program

Theme 2 described the relative effectiveness of the four sources of self-efficacy within a rock-climbing program environment. Bandura (1997) postulated mastery experiences to be the most influential source of self-efficacy. The results of this study demonstrated that mastery experiences indeed played the most influential role on students' climbing self-efficacy. The most effective use of mastery experiences was implemented through the presentation of progressively challenging activities. Although vicarious experiences and verbal persuasion were effective for encouraging students to challenge themselves, they were inadequate for maintaining climbing self-efficacy if they did not match the mastery experiences of students. Overall, affective states acted as an influential, but debilitating source of self-efficacy.

Mastery experiences. In their mixed methods study of a ropes course, Cordle et al. (2016) identified mastery experiences as the most influential source of self-efficacy. Similar findings were echoed in this study. Students claimed that practicing specific climbing techniques and being successful at easier climbing drills or activities allowed them to attempt more challenging routes. The following statement describes one such instance, where practicing dynamic moves allowed the climber to be confident for the more difficult speed climbing-designated wall.

> *When doing speed, the teacher got us to practice our dynos, we were terrified with doing dynos, but then when we were on the speed wall we were not scared anymore.*

According to Giles et al. (2014) no previous study has investigated the effectiveness of fall therapy. Fall therapy in this case study was used to allow students to acquire mastery experiences and progressively become accustomed to taking falls. The following statement described how fall therapy was useful for developing self-efficacy for taking safe falls.

> *I* [had] *actually never fallen on a lead route, so I was always really scared of falling, and then we did this exercise where we had to do lead falls and I was forced to do them, and then when I was doing a lead route I knew it was not that bad to fall, and that really helped.*

Stiehl and Ramsey (2005) suggested that rock-climbing activities should be made deliberately challenging to avoid boredom, yet easy enough to avoid discouraging students. It was apparent through the emerging themes that students in this study were challenged optimally to have mastery experiences, which consequently improved their climbing self-efficacy. Not surprisingly, students also reported feeling less confident when they had not practiced certain types of climbing for a prolonged period. This theme component predominantly explained a lack of self-efficacy that followed a holiday school break. A decline in climbing self-efficacy could perhaps be mitigated if students are made aware of this possibility and are encouraged to maintain their climbing practices autonomously outside of school. In addition, students could be encouraged to resume tackling more difficult climbing more gradually.

Vicarious experiences. Bandura (1997) suggested that observing a model being successful at a task was an effective source of self-efficacy, which is in accordance with the findings of this study. Students indicated that observing another climber successfully

complete a prospective route increased their self-efficacy. Conversely, when students observed a climber who was unsuccessful on a climbing route, students were more likely to think, "if they can't do it, I can't do it also."

Harrison and McGuire (2006) found no significant difference in the improvement in self-efficacy when taking into account the participants' perceived similarity to the model. However, Bandura (1997) posited that vicarious experiences are most influential when the model is similar in ability and characteristics to the observer. It was apparent in the themes that perceived similarity to the model was an important aspect of vicarious experiences for improving self-efficacy. For example, an experience climber mentioned, "[…] watching people that are kind of my age, I think I can probably do that." However, students mentioned that if the person being observed was the teacher or a more experienced climber, it did not improve their climbing self-efficacy as much.

Verbal persuasion. In a similar environment to rock-climbing, Cordle et al. (2016) found that verbal persuasion contributed to improved self-efficacy. Similar statements were echoed in the present study. For example, one student suggested, "That's what I think climbing is about, you are doing it together, by me cheering them on, they hear oh yeah I can do this!" In addition to encouragements said while students were climbing, verbal persuasion was used when teachers encouraged students to attempt more difficult routes.

However, verbal persuasion was not always effective at improving self-efficacy. Specifically, the climbing self-efficacy of a climber was diminished when their mastery experience did not match the fact that they were told, "you can do it!" One student even described a scenario in which verbal praise can make you "even more nervous."

Affective states. Bandura (1997) stated that in the context of challenging activities, which can create feelings of fear, affective states could be an influential debilitating or beneficial source of self-efficacy. This is in accordance with the statements made by students in this study, such as, "I feel like some cases I am physically able to do the route but I am too scared to do it, I just get so nervous, so it is stopping me from reaching my full potential." Common strategies used by students against the debilitating effects of anxiety included: "climbing one move at a time," repeating a positive mantra, and resting efficiently. In line with the processing efficiency theory (Hardy & Hutchinson, 2007), anxiety allowed some students to feel "more determined to finish [the] route."

The downside of high expectations and high self-efficacy. A fear of failure, which resulted in lowered self-efficacy, resonated with several experienced climbers. According to Elison and McGrath (2014), fear of failure is mostly fear of looking bad in front of other people" (p. 123). This was mirrored by a student who said, "watching people do it, if they got it I would be scared because there are high expectations for me to get it." Fearing failure can, over time, undermine one's experience base and confidence (Elison & McGrath, 2014).

According to Llewellyn and Sanchez (2008), male climbers with high self-efficacy were more likely to take greater risk. In addition, Llewellyn et al. (2008) found climbers with higher climbing self-efficacy were more likely to engage in medium and high-risk forms of climbing more frequently. In accordance with the findings of these studies, one student explained a situation that described a gain in risk-taking that accompanied a gain in his climbing self-efficacy:

My confidence changed a lot for lead climbing, it changed in a good way and a bad way, […] *In that moment it seemed right but now that I look back on it, it doesn't seem safe.*

Theme Three: Learning Activities, "I would suggest doing them because it helped"

A diversity of learning activities and instructional strategies were applied throughout this 5-month long climbing program. Most climbing self-efficacy interventions and climbing programs were short in duration (e.g., Sandlin, 2013), however, the program I observed was implemented over an entire school semester, allowing for very real skill development of the learners. In addition, my prolonged engagement allowed a more in-depth exploration of the learning activities and instructional strategies that can influence climbing self-efficacy. The impact on self-efficacy was most influential when learning activities and instructional strategies were meaningful, individualized, and progressively challenging. A prolonged and time-intensive (i.e., 5 days/week) climbing program was necessary for providing these meaningful, individualized, and progressively challenging learning activities and instructional strategies.

Goal-setting. In this study, students completed a goal setting activity at the beginning of the semester; however, the goals were not formally revisited. Students explained that the formal goals set at the beginning of the program were, for the most part, inadvertently accomplished. However, one student suggested that a meaningful goal of completing the requirements to become a climbing gym instructor candidate pushed him to complete more challenging routes. To increase the effectiveness of goal setting activities, Baghurst, Tapps, & Kensinger (2015) suggested that progress and summary

reports should be available to students. For example, the goals set could have been revisited and modified in the middle of the program and evaluated at the end of the program. Results of this study indicate the importance of setting meaningful and individualized goals that will motivate students to challenge themselves. To improve the effectiveness of the goal setting activity in a climbing program, it is important that a formal follow up activity be scheduled in the course outline. These follow-up sessions, could, for example, allow for the creation of progressively challenging goals.

Training. In line with the findings of Mermier et al. (2000), the training aspect of this rock-climbing program was an important component for developing climbing performance and self-efficacy. Although students found the cross-training and endurance training activities grueling and sometime even "terrifying," students commented that it "really improved [their] endurance." The cross-training, which took place twice a week, and the climbing endurance training were individualized for the needs of students and was meaningful since it focused on improving components required for improving climbing performance.

Technique-oriented learning activities. Climbing techniques were taught in a progressively challenging method throughout the program. In the first month of the program, fundamental skills, such as those emphasized by Stiehl and Chase (2008) were taught to novice climbers (e.g., maintaining three points of contact on the wall, keeping a climber's weight on his or her feet, and resting effectively on the wall). More advanced techniques such as heel hooking were taught later in the course and students stated, "Heel hooking and toe hooking helped me become a more efficient climber." These

progressively difficult techniques were most meaningful as students encountered progressively challenging routes that required specific techniques to be overcome.

Another learning activity that led to improved self-efficacy focused on route finding. Jones and Sanchez (2017), suggested route finding, or visually inspecting the route, ahead of starting a climb was a crucial skill for climbing successfully. Similar findings emerged from this study. One student said, route finding and practicing the sequence "Helps [him] understand different moves and makes [him] more confident as a climber."

Peer teaching. The more experienced climbers had the opportunity to share their knowledge with novice climbers. Being able to convey one's knowledge led a student to state that, "it makes you feel so much better about yourself if you're teaching someone how and you know exactly how to do everything." Experienced students suggested peer teaching was a meaningful activity, which allowed them to share climbing knowledge. Peer teaching was an effective method of introducing diversity, contributing to a safe collaborative environment, and individualizing learning activities.

Chapter Six

Conclusions, Teacher Implications, and Future Considerations

This chapter will summarize the major research findings of this study; provide insights for future research on rock-climbing pedagogy, and practical instructional ideas for teachers. The potential physical, cognitive, and affective benefits of integrating rock-climbing activities within school curricula are numerous. The purpose of this study was to explore the effectiveness of learning activities and instructional strategies utilized by teachers in a school-based rock-climbing course on students' climbing self-efficacy.

Conclusions

The quantitative portion of this study revealed an increase in climbing self-efficacy that was not significant. The thematic analysis provided insight into: (a) the type of learning environment conducive to improving climbing self-efficacy, (b) the influence of the sources of self-efficacy, and (c) the activities that were more efficient for developing student climbing self-efficacy. Climbing self-efficacy was enhanced when learning activities were meaningful, diversified, individualized, progressively challenging, and took place in a safe and collaborative environment.

Implications for Teachers

The findings of this case study have the potential to inform the designers of physical education programs to better meet the needs of students interested by rock-climbing or other adventure physical activities.

Providing a diversity of learning activities and instructional strategies. A diversity of new activities can be provided, which challenge students outside of their comfort zones. For example, students can be provided with the opportunity to visit

outdoor climbing areas or a variety of climbing gyms. In addition, a diversity of complimentary instructional strategies can be used. For example, a teacher could provide students with a demonstration of a particular climbing move and then encourage opportunities for peer teaching.

Providing meaningful learning activities. Striving to provide meaningful objectives allows students to practice techniques that are useful for the type of challenge they are currently confronted with (e.g., teachers should provide activities to work on heel-hooking only when students are climbing difficult overhanging climbing routes).

Individualizing learning activities and instructional strategies. Individualizing learning activities increases the likelihood that the needs of more climbers will be met. For example, more experienced students can be encouraged to attempt more difficult lead climbing routes and share their knowledge with novice climbers. Instructional strategies should also be individualized. For example, a teacher could decide to provide prolonged assistance to a student that he or she notices is more anxious on a particular day.

Providing progressively challenging learning activities. Providing learning activities to students in a progressively challenging format will allow mastery experiences and consequently increases in self-efficacy. For example, students should be provided opportunities to fall on top-rope before attempting progressively larger falls on lead.

Creating a safe and collaborative learning environment. Finally, situating the entire climbing program within an expectation of collaboration and safety will allow all students the opportunity to thrive in the learning environment. Emphasis in the beginning of a climbing program should be placed on safety. In addition, groups should be

monitored and encouraged for promoting collaboration (e.g., providing each other with beta and encouragements).

Future Considerations

This study advanced theoretical knowledge by exploring how sources of self-efficacy can be translated into learning activities and instructional strategies. Mastery experiences were the most influential source of self-efficacy in this program. Affective states were an influential and mostly debilitating source of self-efficacy within this rock-climbing program.

Higher levels of self-efficacy may lead to greater motivation for continued participation in rock-climbing (Gómez et al., 2007). This could be indicated by participation in climbing activities outside of school hours. A future study may investigate the effect of participation in climbing programs on motivations to pursue climbing independently. Future research may also investigate how climbing self-efficacy can translate to generalized self-efficacy.

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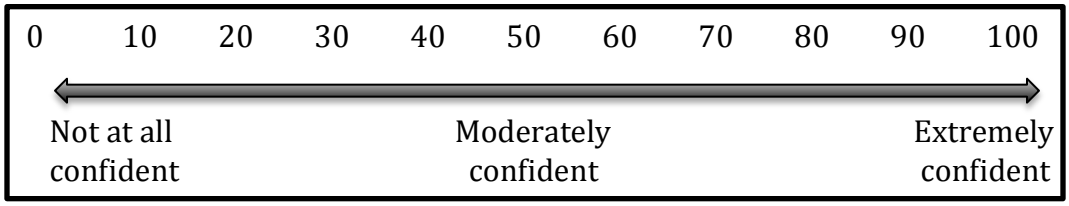
Appendix A: Victoria Climbing Self-Efficacy Questionnaire

University of Victoria

Instructions:

Please rate how confident you feel about your climbing abilities at the moment. In each case rate your degree of confidence from 0% (Not at all confident) to 100% (Extremely confident) using the scale given below:



My confidence in my ability to:

1. Create and maintain my own training plan _____%
2. Communicate well with my climbing partners _____%
3. Belay my climbing partner safely while on top rope _____%
4. Belay my climbing partner safely while on lead _____%
5. Climb safely while on lead _____%
6. Use good footwork _____%
7. Use the appropriate hand holds _____%
8. Climb efficiently (with as little effort as needed) _____%
9. Create climbing goals for myself _____%
10. Relax and breath properly when climbing _____%
11. Use adequate rest positions _____%
12. Visualize the path that I will take up a route before I start climbing _____%

Scale adapted from: Llewellyn & Sanchez, (2008).

Appendix B: Observation guideline for a sample activity

Time of observation:
Date:
Who is present:
Observer:
Length of activity:

Observation cues	Descriptive notes	Reflective notes
What course activities are occurring? What is the level of physical activity? How are the participants interacting with each other? With the teacher? Do the participants seem motivated? Do they seem to be enjoying the class? What kinds of organizational practices are evident? (roles, authority, rules)		

Observation cues	Descriptive notes	Reflective notes
What is unique in the setting? How am I being perceived? What activities are incorporating mastery experiences? What activities are promoting vicarious learning? How is verbal persuasion integrated? Are affective states discussed or integrated within activities?		

Appendix C: Sample journaling activity with open-ended questions

October 26, 2016

1) Describe one technique (for example: “heel hooking”, “using your edge”, or something else) that you practiced this semester.

Were you successful at this technique? Yes, No or Partial. Explain why.

2) Describe a time when you felt anxious or scared of doing a route or boulder problem this semester.

Describe strategies/actions you have used (or continue to use) to overcome this fear.
OR
If you have not yet overcome this fear, describe how you might overcome it in the future.

Appendix D: Facilitation questions for focus group interviews

Main query: Please tell me about the different activities that helped you feel more competent about your climbing ability

-Tell me more about how your ability to _____ has developed over the term
Probe (if time) – rate yourself from 1-10 (1 being not confident/skilled -10 being really confident) ---why?
-Top-roping
-Lead Climbing
-Bouldering
-Specific techniques (e.g., drop knee, straight arms, edging, heel-hooking)
-Falling
-Visualizing/dancing a route
-Training (work-outs)
-Belay top-rope (for visiting students)
-Belay lead

INSTRUCTIONAL STRATEGIES: There are instructional strategies (e.g. giving a demonstration or quiet feet) that the teachers have used with you this semester to help you learn…
-Tell me more about something they did or said that helped you learn
-Tell me more about your confidence in being able to do a climb before and after these activities

Emotional
-Tell me about climbing situations that made you excited or nervous:
-Were there times that your emotions (e.g. excited or nervous) discouraged you from climbing or times that it encouraged you to do more?

Competition
-Tell me about the competition before the Holidays…
-In the journal entries, I have noticed that some people felt confident and excited and some people felt less confident and stressed, can you tell me more about that?

Seeing other students (vicarious)
-How does watching other climbers "climb" impact your own climbing? (e.g. give you ideas? Impact your own confidence?

Getting encouragements (verbal)
-When you are climbing – are there certain verbal comments that are helpful? Encouraging? Discouraging?

Goal-setting
-Do you remember the goal you wrote in your journal at the beginning of the term?
-Were you successful at achieving your goal?

-How was setting a goal useful/not useful for you? Did it motivate you or discourage you?

Additional Probes

Tell me more
I don't quite understand, can you explain to me what you mean by…
Group:
Is this anyone else's experience?
Does anyone have an example of that?
Does anyone have a similar or different experience?

Appendix E: University of Victoria certificate of approval

University of Victoria | Office of Research Services | Human Research Ethics Board
Administrative Services Building Rm B202 PO Box 1700 STN CSC Victoria BC V8W 2Y2 Canada
T 250-472-4545 | F 250-721-8960 | uvic.ca/research | ethics@uvic.ca

Certificate of Approval

PRINCIPAL INVESTIGATOR:	**Patrick Boudreau-Alguire**	**ETHICS PROTOCOL NUMBER** Minimal Risk Review - Delegated	**16-186**
UVic STATUS:	**Master's Student**	ORIGINAL APPROVAL DATE:	02-Jun-16
UVic DEPARTMENT:	**EPHE**	APPROVED ON:	02-Jun-16
SUPERVISOR:	**Sandra Gibbons**	APPROVAL EXPIRY DATE:	01-Jun-17

PROJECT TITLE: **An exploration of a rock-climbing program's impact on self-efficacy**

RESEARCH TEAM MEMBER Sandra Gibbons (UVic)

DECLARED PROJECT FUNDING: **Masters Tri-Council Grant**

CONDITIONS OF APPROVAL

This Certificate of Approval is valid for the above term provided there is no change in the protocol.

Modifications
To make any changes to the approved research procedures in your study, please submit a "Request for Modification" form. You must receive ethics approval before proceeding with your modified protocol.

Renewals
Your ethics approval must be current for the period during which you are recruiting participants or collecting data. To renew your protocol, please submit a "Request for Renewal" form before the expiry date on your certificate. You will be sent an emailed reminder prompting you to renew your protocol about six weeks before your expiry date.

Project Closures
When you have completed all data collection activities and will have no further contact with participants, please notify the Human Research Ethics Board by submitting a "Notice of Project Completion" form.

Certification

This certifies that the UVic Human Research Ethics Board has examined this research protocol and concluded that, in all respects, the proposed research meets the appropriate standards of ethics as outlined by the University of Victoria Research Regulations Involving Human Participants.

16-186 Boudreau-Algu

Appendix F: School board certificate of approval

School District No. 63 (Saanich)
Saanich Schools
2125 Keating Cross Road, Saanichton, BC, Canada V8M 2A5 (250) 652-7300 Fax: (250) 652-6421

June 27, 2016

Patrick Boudreau-Alguire
[redacted]

Dear Patrick,

I am pleased to confirm that your request for research proposal entitled "An exploration of a rock-climbing program's impact on self-efficacy" in School District 63 (Saanich) has been approved, subject to the following conditions:

1. Completion of all research protocols from the sponsoring university, including ethics review approval;
2. Benefit to professional staff related to their practice;
3. Benefit to students further to the outcomes of the research study;
4. Positive or neutral effect on the learning environment, with minimal impact on instructional time;
5. That participation be on a voluntary basis;
6. A valid Criminal Record Check is provided to the district prior to commencing;
7. That the identity of all participants be kept confidential; and,
8. That the results of the research project be shared with School District 63 by way of written report and possible presentation.

Best of luck with your research.

Sincerely,

[redacted]

Shannon Davies
District Executive Assistant
Office of the Superintendent of Schools

Saanich Schools
Great Places to Learn & Safe Places to Be
Visit us at our website: www.sd63.bc.ca

Appendix G: **Student assent form**

University of Victoria

Student Assent Form

An exploration of a rock-climbing program's impact on self-efficacy

You are invited to participate in a study entitled an exploration of a rock-climbing program's impact on self-efficacy that is being conducted by Patrick Boudreau.

Patrick Boudreau is a graduate student in the School of Exercise Science, Physical and Health Education at the University of Victoria and you may contact him if you have further questions by email at pboudrea@uvic.ca or by telephone at [redacted].

As a graduate student, I am required to conduct research as part of the requirements for a Masters of Arts in Physical Education. It is being conducted under the supervision of Dr. Sandra Gibbons. You may contact my supervisor by email at sgibbons@uvic.ca or by telephone at [redacted] or ask your teacher about this study.

Purpose and Objectives
The purpose of this research project is to examine how several instructional strategies are implemented in a rock-climbing course. In addition, these strategies will be assessed by their effectiveness in helping you (the student) develop confidence in your rock climbing skills.

Importance of this Research
Research of this type is important because rock-climbing has increased in popularity and has become a very accessible lifelong physical activity. Because of the complex nature of rock-climbing, it is important that teachers know which strategies will help students develop the confidence to be engaged in the physical activity.

Participants Selection
You are being asked to participate in this study because you are enrolled in a rock-climbing-course at [redacted] Secondary School.

What is Involved
If you consent to voluntarily participate in this research, your participation will involve (a) completing a short questionnaire (b) allowing the bi-weekly journal entry that you have completed (already part of your coursework) to be anonymously analyzed by the researcher and (c) participating in an audio-taped focus group interview toward the end of the term. In addition, the researcher will be present during certain classes in order to observe the instructional strategies used by the teacher.

Inconvenience
Participation in this study may cause some inconvenience to you, including time devoted to the focus group interview. It is anticipated that this interview will be approximately 30 minutes in length. The interview will be schedules during a lunch hour, spare block or after school (whichever is most convenient for the participants).

Risks
There are no known or anticipated risks to you by participating in this research.

Benefits
Participating in this research will allow you to reflect on what gives you more confidence to rock-climb. In addition, this research may help your teacher to understand how to improve your self-confidence in future rock-climbing classes.

Voluntary Participation
Your participation in this research must be completely voluntary. If you do decide to participate, you may withdraw at any time without any consequences or any explanation. If you do withdraw from the study your data will not be used without your explicit written permission and all data both electronic and written will be destroyed.

On-going Consent
To make sure that you continue to consent to participate in this research, I will outline the requirements of participation in the study both verbally and through this consent form. I will also remind you several times throughout the term that you can withdraw from the study at any time with no consequence to you.

Anonymity
Your identity will be kept secret for this research by the use of codes known only by your teacher. In addition, when this study will be published, it will use a fake name to represent you. Your identity will only be known during the interview, since the interview will be done with 3-5 other students. However, all participants will be told to avoid discussing the interview responses with people outside of the study.

Confidentiality
The journal entries and the interview answers that you provide will be kept private and will be protected by password for computer files, a locked cabinet for hard copies, and the destruction of data five years after completion of the research.

Dissemination of Results
It is anticipated that the results of this study will be shared with others in the following ways: published article in a journal and a thesis available on the University of Victoria website.

Disposal of Data
Data from this study will be disposed of five years after completion of the research. Electronic data will be erased and paper copies will be shredded.

Contacts
Individuals that may be contacted regarding this study include the principal investigator Patrick Boudreau, his supervisor Dr. Sandra Gibbons, or your teacher. Contact information is listed at the beginning of this form.

In addition, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca).

Your signature below indicates that you understand the above conditions of participation in this study, that you have had the opportunity to have your questions answered by the researchers, and that you consent to participate in this research project.

Name of Participant	*Signature*	*Date*

Visually recorded images: Provide your initials only if you consent to photos of you being taken for use in the dissemination of results (for example, showing the results with photos at a conference).

Initials

A copy of this consent form will be left with you, and the researcher will take a copy.

Appendix H: Consent form for parents and guardians

University of Victoria

Parent Consent Form

An exploration of a rock-climbing program's impact on self-efficacy

Your son or daughter is invited to participate in a study entitled an exploration of a rock-climbing program's impact on self-efficacy that is being conducted by Patrick Boudreau.

Patrick Boudreau is a graduate student in the department of Exercise Science, Physical and Health Education at the University of Victoria and you may contact him if you have further questions by email at pboudrea@uvic.ca or by telephone at [redacted].

As a graduate student, I am required to conduct research as part of the requirements for a Masters of Arts in Physical Education. It is being conducted under the supervision of Dr. Sandra Gibbons. You may contact my supervisor by email at sgibbons@uvic.ca or by telephone at [redacted] and your son or daughter's teacher, [redacted] rbraun@sd63.bc.ca)

Purpose and Objectives
The purpose of this research project is to examine how several instructional strategies can be implemented in a rock-climbing course. In addition, these strategies will be assessed by their effectiveness to provide students with the confidence that they can be more successful at rock-climbing.

Importance of this Research
Research of this type is important because rock-climbing has increased in popularity and has become a very accessible lifelong physical activity. Because of the complex nature of rock-climbing, it is important that teachers know which strategies will allow for students (your son or daughter) to develop the confidence to be engaged in the physical activity.

Participants Selection
Your son or daughter is being asked to participate in this study because he or she is enrolled in a rock-climbing focused physical education course.

What is Involved
If your daughter or son agrees to voluntarily participate in this research, his or her participation will involve (a) completing a short questionnaire (b) allowing the bi-weekly journal entry that you he or she has completed (already part of the coursework) to be anonymously analyzed by the researcher and (c) participating in an audio-taped focus group interview toward the end of the term. In addition, the researcher will be present during certain classes in order to observe the instructional strategies used by the teacher.

Inconvenience
Participation in this study may cause some inconvenience to your son or daughter, including time devoted to the focus group interview. It is anticipated that this interview will be approximately 30

minutes in length. The interview will be scheduled during a lunch hour, spare block or after school (whichever is most convenient for the participants).

Risks
There are no known or anticipated risks to your son or daughter by participating in this research.

Benefits
The potential benefits of your son or daughter's participation in this research include providing insight on how students develop more confidence rock-climbing and will allow the teacher to adapt certain instructional strategies in order to help students feel more competent in future rock-climbing classes.

Voluntary Participation
Your son or daughter's participation in this research must be completely voluntary. If he or she does decide to participate, he or she may withdraw at any time without any consequences or any explanation. If he or she does withdraw from the study his or her data will not be used without his or her explicit written permission and all data both electronic and written will be otherwise destroyed.

On-going Consent
To make sure that your son or daughter continues to consent to participate in this research, I will outline the requirements of participation in the study both verbally and through this consent form. I will also ensure that he or she is aware that he or she can withdraw from the study at any time with no consequence.

Anonymity
In terms of protecting your son or daughter's anonymity, pseudonyms will be assigned to each participant and to the school at the data collection stage and will be used in the dissemination of results. Anonymity is limited because of the nature of the focus groups as each participant is aware of each other's responses. Participants will be told to avoid discussing the nature of the focus group responses with people outside of the study.

Confidentiality
Your son or daughter's confidentiality and the confidentiality of the data will be protected by password for computer files, a locked cabinet for hard copies, and the destruction of data five years after completion of the research.

Dissemination of Results
It is anticipated that the results of this study will be shared with others in the following ways: (a) a published article in a journal and (b) a thesis available on the University of Victoria website.

Disposal of Data
Data from this study will be disposed of five years after completion of the research. Electronic data will be erased and paper copies will be shredded.

Contacts
Individuals that may be contacted regarding this study include the principle investigator Patrick Boudreau his supervisor Dr. Sandra Gibbons, or [redacted] Contact information is listed at the beginning of this form.

In addition, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca).

Your signature below indicates that you understand the above conditions of your son or daughter's participation in this study, that you have had the opportunity to have your questions answered by the researchers, and that you consent to participate in this research project.

_____	_____	_____
Name of Participant	*Signature*	*Date*

Visually recorded images: Provide your initials only if you consent to photos of your son or daughter being taken for use in the dissemination of results (ex: showing the results at conferences).

_____
Initials

A copy of this consent form will be left with you, and the researcher will take a copy.

Appendix I: Glossary of rock-climbing terminology

Adapted from (Phillips et al., 2015)

Beta: Information about a route or problem, such as a description of the holds to use and the most efficient sequence to grab these holds.

Bridging: A position used when the body must be kept close to the rock wall while the feet are in opposition wide to either side, requiring extreme hip abduction and external rotation.

Campus: The act of climbing without one's feet. This maneuver can be beneficial in certain situations but places considerably greater stress on the upper body than normal climbing.

Crossover: A maneuver during which one hand maintains its position while the other hand reaches up and over the stationary hand.

Deadpoint: A dynamic move in which the hold is grabbed at the apex of upward motion. This technique places minimal stress on both the hold and the arms.

Dyno: Abbreviation for dynamic movement: a jumping motion that requires the climber to produce vertical momentum to reach a hold, which is otherwise out of reach

Extremity jams: Placing a body part in a crack for the friction it produces to support a share of body weight. For example, hand jams, finger jams, foot jams, and toe jams are commonly used.

Flag: The act of extending, adducting, or abducting a free leg to alter the center of mass of the body. Flagging during a climb can help maintain balance and or counterbalance a movement to keep one's self on the wall.

Heel hook: A maneuver that uses the heel of the foot to hook onto holds and around corners. The hamstring musculature is used to pull the climber closer to the wall or up over an edge. This same concept can be used with a toe hook

Knee bar: A maneuver that wedges the knee or thigh under an edge or roof to hold oneself to the rock. This requires an intense isometric contraction of the major leg muscle groups but is very beneficial for helping the upper body recover and assisting with its workload.

Mantle: A maneuver used when getting up over an edge or top out. The climber transitions from pulling up over a horizontal surface by internally rotating the shoulder and extending the elbow to translate the body vertically (Figure 1h).

Onsight: To complete a route in the first attempt without any prior information about the route.

Smearing: Using the friction of the climbing surface and one's climbing shoes to maintain a position on the wall. This compensates for the lack of footholds.

Stemming: Technique of using the arms and legs on both sides of the body to push outward on opposing walls. This technique is used on dihedrals.