Using the ADDIE Model to Create an Online Strength Training Program: An Exploration

Rebekah L. Brook

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John K. Burton, Chair
Brett Jones
Barbara B. Lockee
Ken Potter

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ABSTRACT

The purpose of this design and development research was to investigate whether the ADDIE model can be used to design online modules that teach psychomotor skills. The overarching research question was: How can the ADDIE Model of Instructional Design be used to create an online module that teaches safe and effective movement for psychomotor skills?

To examine the research question, an online strength program focusing on correct technique was designed and developed. The design phase involved creating storyboards and scripts for the development phase. The development phase involved creating videos, still, audio, and slides that were put together to form instructional sequences for each movement. A website was designed to accommodate the requirements of the course and all the instructional materials were uploaded to the website. This program was implemented using college students with no health problems. Each participant was assigned to either single joint movements or multiple joint movements. They recorded themselves pre and post instruction. Strength and conditioning interns overseen by a subject matter expert and a strength and conditioning enthusiast scored these videos.

The results of the implementation revealed that both beginners and advanced learners made improvements to their movements. It was concluded from the results that it was possible to teach correct movement online and that designers need to be aware of the interaction between type of learner and the specific movements rather than the type of movement.

Major themes that emerged were they were unsure if they were completing the movement correctly and preferred having a coach present to provide feedback, and several participants had trouble transferring the theory into practice.

Problems the reviewers had were that the videos were difficult to score due to camera angles and some issues with the rubrics. An analysis of the review process revealed there were problems with the consistency and reliability of the scoring.

An overall answer to the overarching research question was that it is possible to use the ADDIE model to create successful online instruction for strength movements. It was necessary to created guidelines for designers to follow when developing online psychomotor skills courses.

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CHAPTER 1: Introduction

Why Teach Psychomotor Skills?

Physical activity is a very important part of creating a healthy body. Engaging in physical activity can decrease fat in overweight and obese individuals and prevent fat gain in individuals in a healthy body composition range (Villareal et al., 2013; Donnelly, Blair, Jakici, Manore, Rankin, & Smith, 2009).

Physical activity has been found to have a preventive effect on diseases such as cardiovascular disease, diabetes, and cancer (Warburton, Nicol, & Bredin, 2006). A meta-analysis by Sallis, Patterson, Buono, and Nader (1988) found that cardiovascular risk factors were related to physical activity levels. More specifically, Oguma and Shinoda-Tagawa (2004) found that the risk factors for cardiovascular disease in women were reduced by physical activity. Physical activity also has a role in the prevention of diabetes (see, e.g. Sigal et al., 2013). Similarly, physical activity has been shown to have preventative effects for certain types of cancer, another prevalent and deadly disease. Studies have found that physical activity is associated with reduced rates of cancers such as colon, breast, prostate, testicular, lung, endometrium, and ovarian (Friedenreich, 2001; Kushi et al., 2009; Warburton et al., 2006).

Along with its preventive effects for cardiovascular disease, diabetes, and cancer, physical activity also has a positive effect on the treatment of these diseases. Kohl (2001) and Warburton et al. (2006) found that physical activity provides faster recovery from cardiac events and lessens the symptoms and risk factors of cardiovascular disease. Similarly, LeMonte, Blair, and Church (2005) reviewed the research on diabetes

and physical activity and found that engaging in physical activity improved symptoms associated with diabetes. In terms of cancer treatment, Meyehardt, Tarnopolsky, Beckman, Felkey, and Hubbard (2007) and a meta analysis by Schmitz et al. (2005) found that physical activity improved the quality of life during treatment and recovery after treatment.

In a report for the Center for Disease Control (CDC) Hoyert and Xu (2012) reported that cardiovascular diseases, diabetes and cancer are in the top ten leading causes of death in the United States. If physical activity has the potential to aid in treatment and prevention of these diseases then it should be considered a priority for all individuals.

Other benefits of physical activity include improvements in mental health – reduction of anxiety, mania, and depression (Arent, Rogers, & Landers, 2001; Paluska & Schwenk, 2000), reversal of aging in skeletal muscles (Melov et al., 2007), and improvement of bone density reducing the risk of osteoporosis (Cousins et al., 2010; Hamilton, Swan, & Jamal, 2010; Janz et al., 2010).

There are clearly large benefits to engaging in physical activity. The problem comes in when people do not have access to appropriate facilities and programs to engage in physical activities. One way to disseminate physical activity programs is using prepare resources – such as videos, DVDs, and internet classes – and provide these to individuals to use in their own time. Many programs such as these exist (Insanity, P90X, Body Beast) as well as Online Physical Education courses for high school students and online classes for various types of fitness for higher education students. Little research has been

conducted however, in the area of distance/online physical activity courses and strength training has been particularly neglected.

Instructional Design Model for Teaching Psychomotor Skills Online

The ADDIE model was originally developed to be used to train personnel in the armed forces (US Air Force, 1970). Since that time it is has been adapted and used for a variety of instructional needs. This has generally focused on cognitive learning outcomes for a variety of areas such as training for employees (e.g. Mayfield, 2011), teaching traditional classes for many types of learners (e.g. Kilgore, 2003; Peterson, 2003; Lee et al., 2007), and creating successful online courses (e.g. Shelton & Saltsman, 2008; Wang & Hsu, 2009).

An extensive search of the literature revealed no studies demonstrating the use of the ADDIE model in designing lessons to teach psychomotor skills. While it is likely that many courses for teaching psychomotor skills have been developed using the ADDIE model, no studies have examined its effectiveness or any adaptation needed to make it appropriate for the use in teaching psychomotor skills let alone teaching psychomotor skills in an online environment.

Design and Development

Richey and Klein (2007) state that "product studies originate with the design and development of an instructional or non-instructional product or program" (p.9). Due to the lack of programs designed for physical education and strength training specifically, there is a need to establish whether traditional instructional design models can be used effectively to develop an online, strength-training instructional program. This design and development study used product development to focus on whether a common, prototypic

design model, the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model developed by Dick, Carey, and Carey (2009) could be used to create instruction for teaching safe and effective movements for psychomotor skills. The ADDIE model was followed with varying degrees of emphasis on each phase. The design, development, and evaluation phases of the instructional sequence were given the most amount of attention.

Purpose

The purpose of this design and developments research was to investigate whether the ADDIE model could be used to design an online module to teach safe and effective movements for psychomotor skills. Following the data collection and analysis, guidelines and suggestions for future program developments were created to aid instructional designers in the field of strength and conditioning in designing programs to distribute to distance learners. The module was designed and developed for a novice audience and was implemented using college students as trial learners.

Research Questions

1. How can the ADDIE Model of Instructional Design be used to create an online module that teaches safe and effective movement for psychomotor skills?

    1.1. What accommodations must be made to the model by way of guidelines?

    To study the necessary accommodations to ADDIE, and implementation of trial learners will be used. For these learners the following additional questions will be asked.

    a. Can the correct form for free-weight barbell strength exercises be taught in an online environment (no coaching presence during practice/learning)?

b. Does the program produce gains in learners between pre and post scores for safety and effectiveness for Beginners? For Advanced?

c. Is there a difference after program exposure in the safety and effectiveness scores between multiple joint and single joint movements overall?

d. Is there an interaction between the experience of learner and type of movement?

CHAPTER 2: Literature Review

The review of the literature is split into six sections: Principles of teaching psychomotor skills, online courses for psychomotor skills learning, online and at-home fitness programs, online physical education classes, online strength training, and the ADDIE model.

Principles of Training Psychomotor Skills

There are many ways proposed to teach psychomotor skills often contradicting each other (ACHPER, 2008; Baechle & Earle, 2008; Bushman & Battista, 2013; Schmidt & Lee, 2011). However, they all have several common features that almost all researchers and practitioners agree are important in the learning process. These features are demonstrations to aid observational learning, feedback, and cues.

Observational learning. When teaching a psychomotor skill it is often not appropriate for a learner to engage in physical practice initially because it is unsafe for the learner to attempt the movement. This is where observational learning comes into play. Observational learning is defined as learning a new behavior or increasing or decreasing the frequency of a learned behavior by watching the behavior of a model (Bandura, 1986).

In relation to learning psychomotor skills, there is strong evidence that observing a model demonstrate the movement to be learned has a positive effect on the acquisition of that skill (Blandin, Lhuisset, & Proteau, 1999). This type of learning is in evidence in a wide range of skills including pattern production (Carroll & Bandura, 1982), gross motor skills (Landers, 1975; Niemeijer, Schoemaker, & Smits-Engelsman, 2006; Southard & Higgins, 1987) and fine motor skills (Martens, Burwitz, & Zuckerman, 1976;

Stefanidis, Korndorffer, Heniford, & Scott, 2007). It is also evident in both children and adults (Blandin, et al., 1999; Niemeijer et al, 2006).

Due to the findings in these studies and many others like them, demonstrations of target movements are often the first step in teaching said movements. Recommendations in training manuals such as National Strength and Conditioning Association's (NSCA) *Essentials of Strength Training and Conditioning* (Baechle & Earle, 2008), and elementary school physical education teacher certifications manuals (ACHPER, 2008) include demonstrations as important and necessary components of teaching psychomotor skills from basic fundamental skills to complex lifting skills.

Feedback. Feedback is another important feature for teaching psychomotor skills. Stefanidis et al. (2007) define feedback in the skills literature as "return of performance-related information to the performer" (p. 204). This can take many forms but the most prevalent is verbal feedback – the instructor explaining to the learner good and bad aspects of their performance.

The timing of the feedback is important for it to be effective – it should be as soon as possible after the skill is attempted (Smits, Boon, Sluljsmans, & van Gog, 2008). The amount of feedback is crucial to the success of a learner becoming proficient in a skill. Stefanidis et al. (2007) examined second year medical students' learning of laparoscopic suturing using a simulator.

Three groups of students where given different combinations of the number of video tutorial views and instructor feedback. Participants in Group 1 viewed the video once and were given extensive feedback during practice, Group 2 viewed the video once and was provided with limited feedback, and Group 3 viewed the video several times and

was provided with limited feedback. It was found that Group 3 out performed the other two groups on time and number of repetitions to acquire proficiency. Those learners that repeatedly saw the skill being performed and had limited feedback resulted in the learners taking less time and less repetitions to become proficient in laparoscopic suturing. Extensive feedback actually impeded the acquisition of skills for learners in Group 1.

Winstein and Schmidt (1990) and Wulf and Schmidt (1993) hypothesized that poor performance is due to learners becoming too dependent on the feedback when it is too frequent. When frequency of feedback was reduced Wulf and Schmidt (1993) found that performance in psychomotor program learning improved.

Cues. The final all-important feature for teaching psychomotor skills is providing cues. Cues are verbal instructions (usually only one or two words) that focus the learner on a specific aspect of the movement. Cues are created between a learner and instructor as the learner is learning the movement. The instructor provides an explanation of each aspect of the movement between the learner's attempts and then provides the cue words and what they mean to the learner. The use of cues is dependent on the performance of the movement each time the learner executes it.

Niemeijer et al. (2006) found that cues were one of the most important features of programs designed to help children with Developmental Coordination Disorder (DCD) learn gross motor functions. Cues are considered important components in many training manuals for future strength and conditioning coaches (Baechle & Earle, 2008), personal trainers (Bushman & Battista, 2013; Coburn & Malek, 2012) and school teachers (ACHPER, 2008).

Online Courses for Psychomotor Skills Learning

Learning a musical instrument is a motor skill. Anderson and Ellis (2005) used their earlier studies to propose a set of instructional strategies for web-assisted music teaching and learning. Their proposal included strategies such as slow motion video, pause, forward, and rewind functions, and access to videos and materials for inter-lesson practice (Anderson & Ellis, 2005).

Learning dance is also a complicated physical skill. Two studies have looked at the dance teaching removed from an instructor-led environment. The first, Leijen, Admiraal, Wildschut, and Simons (2008) reported a study of a worldwide dance program that was run online. For assessment and feedback learners were asked to record a solo performance of their own choreographed dance. These were supposed to be sent to the instructor and returned to the learner with feedback. Many of the learners never sent their performances as they experienced problems sending their videos (the website did not allowed for upload so they had to send them via snail-mail) and the ones that did send them never got feedback. This course was more about teaching choreography rather than the movements.

The second dance study looked at the effectiveness of teaching country line dancing using videos alone versus traditional instructor-led groups (Courtney, Velasco, & Vilaplana, 2010). The traditional class spent 30 minutes learning a dance after which they were required to perform the full dance. The researchers recorded the dance and an expert analyzed it for correct sequence of moves.

The individual video group watched an instructional video for the same dance as the traditional group. They were able to watch the video as many times as they liked and practice. They were given 30 minutes to learn the steps and then the expert watched

them perform the dance, again looking for the correct steps in the correct sequence. Courtney et al. (2010) found that the individual video group performed better than the instructor-led group however the difference was not significant. This study looked more at psychomotor skill learning than the previously discussed dance study.

Online and At-Home Fitness Programs

Commercial programs for fitness endeavors are extremely popular and widespread. Instructors create videos and resources that they send to learners or make available online for a price. These programs are generally fad workouts that come and go depending on what is popular in the fitness world at any given time. A Google search revealed a vast of number programs, most of which were aimed at fat loss (e.g. Insanity, P90X) and a handful aimed at strength and muscle building (e.g. Body Beast).

The online program *Daily Burn* along with DVD workouts such as *10 minute trainer, Insanity, and Insanity: The Asylum* are a few programs that have immense popularity currently. Other programs in existence that have fallen to the background behind these new fad workouts include *P90X, P90X2, Focus T25, Les Mills Body pump* and *body combat* (these programs are offered in group exercise classes at many gyms), *Thrive 90, Rushfit, Body Beast,* and *Turbo Five* just to name a few. Also becoming popular are online personal trainers. *FitOrbit* offers programs for fat loss and *Hitchfit* offers a variety of programs ranging from fat loss to strength training. According to their websites many of these programs are designed around sport science research (Insanity, n.d.; Insanity: The Asylum, n.d.; Body Beast, n.d.; P90X, n.d.; Les Mills Pump, n.d.).

The concern about these programs has to do with learning safe movements – learners never get external feedback and no one monitors their form. Insanity's creator

describes these types of workouts as “balls to the wall” (Insanity, n.d.). Learners do not develop the technique for the skills they will perform they are just thrown right in. The only evidence of the effectiveness of these programs is testimonials with before and after pictures with praise for the program from the learners. An extensive search revealed that there is no data on injuries and other bodily problems such as muscle imbalances that these programs could potentially cause.

While these programs are largely based on sport and exercise science, their creators do not report any scientific evidence that the programs are safe and effective when administered at a distance with no feedback, cues, or movement instruction.

Online Physical Education Classes

While the online and at-home fitness programs discussed above are generally commercial endeavors, school districts have also been creating and implementing Online Physical Education (OLPE) classes with the aim of offering these classes for students to fulfill graduation requirements (Buscher, 2006; Moiser & Lynn, 2012; NASPE, 2007). Several reviews of the availability and state of OLPE have been conducted and have found many problems with the current situation (Buscher, 2006; Daum & Buscher, 2012; Moiser & Lynn 2012; NASPE, 2006; 2010; 2012).

In a report release in 2006 by the National Association for Sport and Physical Education (NASPE) it was reported that twelve states offered OLPE classes. Only half of these classes met all of the NASPE standards. The following report by the NASPE in 2010 reported 22 states offering OLPE classes. Only six of these met all of the NASPE standards and only 10 required qualified PE teachers. The latest report from NASPE (2012) reported 30 states offering OLPE classes. The number of states meeting the

NASPE standards was not reported but it was noted that only 17 states required qualified PE teachers.

An analysis of OLPE classes by Daum and Buscher (2012) found that it was more widespread than the NASPE (2006, 2010, 2012) reports suggested. Of the programs they looked at only one-fourth of the courses met the NASPE's guideline of 225 minutes a week of physical activity. In fact, they found that six of the programs did not require any physical activity.

Mosier and Lynn (2012) analyzed a Virtual Physical Education (VPE) course to see if it matched up with the NASPE (2007) guidelines for OLPE. They reported that students had no way to demonstrate their proficiency. According to the guidelines demonstration of proficiency should be required for a student to enter an OLPE course. Mosier (2010) looked at the characteristics of students in a VPE. Interestingly, retention was a problem with a 52 percent completion rate and 40 percent of registered students never activated their account (Mosier, 2010).

With this rise in the prevalence of OLPE courses the NASPE (2007) made some initial guidelines for administering OPLE. The guidelines cover everything from prerequisites for students, teachers, and curriculum and instruction, to assessment, class size, time allocations, availability of facilities, equipment and technology systems, program evaluation, and students with special needs (NASPE, 2007). These guidelines were not created from research data and the NASPE (2007) called for research to be conducted so that evidence-based programs can be created. So far it seems this call has not been heeded.

Futrell (2008) looked at online instruction for high school student performance and found that, by the end of the course, participants had increased scores for all of the physical tests from the beginning of the course. These tests included a one mile run, sit and reach exercises, shoulder stretches, trunk lift exercises, curl-ups, and push-ups. All of these exercises are body weight exercises and pose no significant risk to participants. This means no special training was needed pre-participation.

Online Strength Training

Daum and Buscher (2012) sent out surveys to forty-five online high school teachers and with the thirty-two responses found that thirteen weight training classes were being offered. There has been no research on the effectiveness or appropriateness of teaching high school students weight training online. There has however, been one research study conducted in a higher education setting with undergraduate students enrolled in traditional, hybrid, and online weight training classes. (McNamara , Swalm, Stearne, & Covassin, 2008).

The traditional class received lectures and took quizzes in a classroom setting and completed their practice during class with an instructor monitoring and correcting improper technique. The hybrid class also completed their practice during class with an instructor present and had access to all lecture materials, videos, and quizzes online as well as completing lectures in class. The students in the online class were taught correct technique and were required to demonstrate correct technique. When they were able to do this they were allowed to practice unsupervised in their own time.

All classes were given the same workout schedule. Strength in upper body (bench press) and lower body (back squat) was assessed at the beginning and end of the course

and strength gains were determined. McNamara et al. (2008) found that while all groups made gains, there was a significant difference between the traditional and hybrid classes and the online class. Students in the online class made little gain in both upper and lower body strength, which McNamara et al. (2008) hypothesized that this was due to low motivation of the participants and lack of attention from instructors.

If the purpose of OLPE and various at-home programs is to reach those who cannot access, or feel uncomfortable in, traditional fitness classes then this on-line program missed a large component. Participants in the online class were required to learn and demonstrate safe movements in a face-to-face setting before they were allowed to lift by themselves. Participants in the targeted populations would need to be able to learn the weight lifting techniques and movements without that face-to-face instruction.

The ADDIE Model

An early version of the ADDIE model was developed to aid the US Army, followed by the rest of the armed services to train personnel in a variety of tasks (Branson et al., 1975). This early version was based on an earlier Instructional Design (ID) model developed by the US Air Force (1970).

The ADDIE model follows the process of analyzing, designing, developing, implementing, and evaluating an instructional sequence. While earlier versions were static and considered a linear process, later developments altered the model to become a more dynamic and iterative process (Dick et al., 2009; van Merriënboer, 1997).

The analysis phase of the model requires the designer to determine the need for the instruction, the needs of the target audience – the learners – and the critical components of the job or other performance requirements (Dick et al., 2009). The design

phase involves the designer developing behavioral objectives, criterion-referenced tests, and determining the sequence for the instruction (Dick et al., 2009). The development stage involves the construction of the learning materials based on the sequence of events identified in the design phase (Dick et al., 2009). The fourth phase is where the instruction is implemented and tested or used by the target audience – this is the implementation phase (Dick et al., 2009). Finally, the evaluation phase involves the designer evaluating the effectiveness of the instruction, and using the data collected to revise the instructional sequence accordingly (Dick et al., 2009).

Why ADDIE? There are many ID models available for use including, but not limited to: ARCS (Keller, 1987); ASSURE (Heinich, Molenda, Russell, & Smaldino, 1996); Rapid Prototyping (Piskurich, 2006); Morison, Ross, and Kemp Model (Morison, Ross, & Kemp, 2004). The reason for choosing the ADDIE model over the other available models for this study was due to its extensive use in the ID field and many of the newer models are based on the basic tenets of the ADDIE model (Dick et al., 2009). The ADDIE model is well known in the ID field and is therefore a good starting point for the unique ID problem addressed in this study.

CHAPTER 3: Method

The study was a development studied and the method involved following the ADDIE model. The method section is divided into each phase of the model: Analysis; Design; Development; Implementation; and Evaluation.

Analysis

The analysis phase involved determining the objectives and the learners for the proposed module. Two main objectives were determined. The first objective was for the learners to be able to demonstrate safe movements using free weights for biceps curls and triceps extensions or back squat and bench press. Safety was defined as movement that does not have the potential to cause injury. The second objective was for the learners to be able to demonstrate effective movements using free weights for biceps curls and triceps extensions or back squat and bench press. Effectiveness was defined as movement that has the greatest range of motion and therefore, the most use of the muscles involved in the movement.

It was determined that the module would be designed for novice lifters. Novice lifters are those learners who have little to no experience with weight lifting techniques and terminology.

Design

The design phase involved creating storyboards for the instructional sequence. The important aspects of each movement were identified from the *Exercise Technique Manual for Resistance Training* (*ETMRT*, Baechle & Earle, 2008). Other important aspects of lifting were determined – these included the equipment that would be required, how to use the equipment, how to determine the weight to use, and using a spotter, the

joint and muscles used in the movements, and brief explanations of the safety and effectiveness. Storyboards were created to determine the most appropriate medium for each aspect and how it would all fit together. Videos with enhancements would be used for the movements with still images for the top and bottom of each movement. Slides with pictures would be used to show the equipment needed as well as the muscle and joints involved in the movements. The National Strength and Conditioning Association (NSCA) videos would be used for the videos and creation of the still images. Audio would be created to accompany all videos and slides. Scripts for the audio were created by going through each part of the storyboards and determining what needed to be included.

Development

Rubrics. Rubrics for assessing safety and effectiveness were derived for each of the four exercises from *ETMRT* (Baechle & Earle, 2008). Each exercise was divided into different aspects of the movement: the starting position; concentric motion; eccentric motion; and finishing position. Each aspect of the movement that was considered to be important to the NSCA was included in the rubrics. A Likert-type scale was used to score each aspect. The safety scale ranged from 0-not safe to 3-safe and the effectiveness scale ranged from 0-not effective to 3-effective. An example of each rubric can be found in Appendix C. The coordinator of strength and conditioning for Olympic Sports from the Virginia Tech Athletics Department, who served as the strength and conditioning expert for this study, reviewed these rubrics for their appropriateness for evaluating the safety and effectiveness of the movements. The initial rubrics were altered during the

review phase, as it was determined that certain aspects were too difficult to review from the videos.

Instructional materials. The rubrics and NSCA videos from the ETMRT (Baechle & Earle, 2008) were used to isolate teaching points for instruction targeted to those with little to no knowledge of terminology and techniques associated with strength training – the target audience. The videos meet NSCA standards and were closely paired with the rubrics so that the participants would be learning the movements in the same way they would be assessed.

Audio was stripped from the original four videos and the four videos were divided up into each part of the exercise. This resulted in a total of 16 videos. The audio was replaced with audio that gave simple instructions that were paired with enhancements on the videos.

The enhancements included lines that showed the correct bodily alignment, lines showing the direction of the motion, and color-coded lines and words to emphasize dos and don'ts of the exercise. The videos were also adjusted to walk the participant through each movement from a variety of angles. Video was slowed where appropriate to emphasize important features of the movement. A series of still images with the same type of enhancements as the videos were created to supplement the videos. These stills emphasize the parts of the motion that are temporarily paused – the transitions between concentric and eccentric motion.

The final lessons were created using Articulate Storyline and were focused around the videos and stills. The lessons begin with a quick introduction to the exercise and the basic anatomy involved in the exercise. This was follow by instruction on what

equipment to use, and some safety precautions. Finally, the instruction for the actual exercises was added. This included both the enhanced stills and enhanced videos. Each lesson ended with instructions for moving onto the practice phase.

Throughout the instruction form was emphasized over strength. The lessons were about five minutes in length if played from start to finish. They were designed to be interactive and the participants could replay any part they wished to and as many times as the participant determined was necessary.

A "cheat sheet" for each movement was created. These cheat sheets or aids summarized the lessons with the main cues and pictures. They also provided a guide as to how many sets and repetitions to complete for practice. This cheat sheet was created for the participants use while they practiced (see Appendix D).

A website was designed specifically for this study (https://www.online-strength-study.com). The idea of the study was to replicate an online environment in which learners could potentially find themselves in if they choose to participate in an online strength program. Due to IRB privacy requirements participants needed to be able to upload their videos without a personal identifier and only accessible to the research team (obviously their face was visible however no name can be associated with the video). The website was a secure site with only people with valid logins and passwords having access to any of the content. The website had two places for uploading videos – one for the pre-instruction videos (labeled "my before videos") and the other for the post instruction videos (labeled "my after videos). Each participant was given a login that allowed the participant to upload their videos with only their participant code as an

identifier. The website was divided into steps. Each step walked the participant through each phase of the study after the consent process.

Implementation

The implementation phase was a field test of the module. The field test involved determining the level of lifting experience of each participant, his or her physical ability to participate, and collecting demographic information.

Participants. The participants for this study were students recruited from the Blacksburg campus of Virginia Tech. The number of participants that signed up and went through the consent process was 16 males and 10 females aged between 18 and 35. The recruitment process involved distributing materials across campus via tablecards in dining halls, flyers, and the graduate school listserv. The recruitment document can be found in Appendix A. All participants that signed up had no medical conditions that effected or were affected by exercise.

Of the initial 26 participants 12 males and two females completed the field test. Two males and three females withdrew from the field test, and two males and five females did not respond after the consent process even after two follow up emails were sent.

Instruments. Three surveys were created with Qualtrics for this study. See Appendix B for copies of the surveys. The screening survey was designed to fulfill three purposes. Firstly, potential participants were asked questions to assess whether they had any medical problems that would make participating dangerous. These questions were based on the guidelines set out by Kurowski and Chandran (2000) for evaluating individuals before they participate in athletic endeavors. Secondly, to assess the level of

experience in lifting with questions about knowledge and experience with gym equipment used in free weight strength exercises. These questions were devised with the help of the strength and conditioning expert. A scoring system and cut off score were determined and were used to evaluate participants as beginner or advanced lifters. The third purpose was to check whether the participants had access to the equipment that was required to participate in the study.

An initial survey was used to collect demographic information and information about the participants' experience with distance/online classes and, in particular, different types of exercise programs.

An exit survey was designed and administered to get feedback on the experiences the participants had during the study. This included what the participants found sufficient and insufficient about learning strength exercises online and their experiences with participating in the field test.

Design of field test. The participants were divided into different groups to see how the program works without interference or contamination from experience with another module. These groups corresponded to the type of movement - multiple joint and single joint. The groups were further divided up by lifting experience – beginner and advanced.

The multiple-joint group learned the flat barbell bench press and the back squat while the single-joint group learned the ezbar biceps curl and the lying ezbar triceps extensions. These movements were chosen due to the frequency at which they appear in workout plans. These four exercises are likely to be a part of most lifting programs. The

movement types were chosen to assess if there was a difference in the ability to teach basic (single joint) versus complex (multiple joint) movements.

The data collected were from the two objectives. The safety of the movement – this is if the technique used by the participant was not likely to cause injury – and the effectiveness of the movement – this was a judgment on the range of motion the participant has completed. The difference between the pre and post measures was used in analysis of the data.

This methodology was chosen, as the goal of the field test phase of the research was to evaluate whether safe and effective movements can be learned without a coach being present to teach and correct the movements. To do this, baseline recordings of where the participants started needed to be taken – the pre-instruction attempts. The difference between the pre-instruction scores and the post instruction scores give an indication of whether the instruction was successful in teaching the participants how to correctly perform the movements.

Breaking the participants into advanced and beginner allowed for an assessment of what groups of people could potentially benefit from this type of instruction. Individual items from the rubric can indicate parts of the movements that can be taught with ease as well as areas that are more challenging and potentially impossible to teach without a coach present.

Procedure. Potential participants were asked to complete the screening survey to determine their eligibility to participate. Those who were eligible were contacted via email to ask them if they wished to participate and, if so, to schedule a time

to go through the consent process. Prior to the consent process each participant was assigned to one of four groups.

Two groups were beginning lifting groups and two were advanced. Questions were included in the screening survey to determine if a participant was a beginner or advanced. Once the lifting experience was determined, each participant was randomly assigned to either the multiple-joint or single-joint movment. This gave the four groups beginner+multiple (1M), beginner+single (1S), advanced+multiple (2M), and advanced+single (2S). The codes for each group were used to create participant codes. For example, a participant in the beginner+multiple group was assigned a code beginning with 1M and then a number between 1 and 10. This resulted in a participant code of 1M5.

Each participant met with the researcher to go through the consent process and the instructions for the study. Participants were made aware of the physical risk that exists in the study and suggestions to avoid injury, the potential benefits, the steps taken to keep the participants' identities confidential, the compensation offered (fitness prizes from recsports), freedom to withdraw, and their responsibilities (see Appendix E for the consent form).

Participants were given an instruction sheet which contained their group assignment, the website, login details, file names for uploads, and survey links (see Appendix F for an example). They were instructed that they could take the initial survey at anytime during the study period. After the consent process there was no face-to-face interaction between the researcher and the participants. Participants were instructed to

contact the researcher via email if they had questions or if they wished to withdraw from the study.

Once the participant logged onto the website they were guided through the process. The first step was for the participants to watch a raw video of each exercise they were assigned to complete. This was so they could see what was expected of them. Next they recorded themselves attempting five to eight repetitions of each exercise. These videos were uploaded by the participant to the website under "my before videos" named as set out in the instruction sheet.

The participants then moved onto the instruction phase. They went through the lessons in their own time and had the freedom to review anything they need to at anytime. The participants were instructed to practice twice a week for two weeks after they had watched the instruction. They could go back to the instruction at anytime between practice sessions. Once they had completed all four practice sessions they recorded themselves doing five to eight repetitions of each assigned exercise and uploaded these to the website under "my after videos" named as set out in the instruction sheet. The final step was for the participants to take the exit survey.

Evaluation

The evaluation phase consistent of three parts: first, was feedback from participants about their experience with the field test; second was feedback from the reviewers and third was a review of all the feedback and results of the field test by the researcher.

Participant evaluation of the instruction. Responses that participants gave in the exit survey were used to evaluate the instruction. This included problems with the website as well as problems, issues, and suggestions on the instruction and the process.

Reviewer evaluation of the instruction. Two strength and conditioning interns from the Virginia Tech Athletic Department supervised by the Subject Matter Expert (SME) served as reviewers for the field test. The two interns collaborated to produce one score and that is they are considered to be Reviewer One. These reviewers and the SME were asked if they had any issues in the review and scoring of the videos. They were also asked if they had any suggestions for making the review and scoring process smoother and easier.

Reviewer Two for the field test was the researcher – a strength and conditioning enthusiast. Reviewer Two documented issues in reviewing and scoring the videos and looked for ways to improve upon the review process and instruction. The researcher examined problems with the scoring including consistency between participants and pre- and post- scores.

CHAPTER 4: Results

Video Scoring

After all the participants had uploaded their videos, the reviewers scored the videos. The process for the scoring differed between the reviewers. Reviewer One looked at the pre videos and then the post videos for each participant for each movement. They compared the videos to each other. There were a few exceptions to this due to some video viewing problems. Reviewer Two looked at all the pre videos for each movement then all the post videos for each movement. Randomly, pre and post videos were directly compared to check for consistency in the scoring.

Field Test Scores

The data for the field study are described in terms of the mean percentage difference between the pre and post scores. This was done to standardize the results. Each movement had a different possible total score so using raw scores would not have allowed appropriate comparison between the movements. These scores were calculated by calculating the mean in the difference in the raw scores then dividing the mean by the total possible score for the movement – (post-pre/total possible score x100). This was done for each of the movement – biceps, triceps, bench and squat. The mean percentage for each type of movement was calculated by adding the mean percentage for each movement together and dividing it by the number of movements – (mean percentage 1S + mean percentage 2S)/2, (mean percentage 1M + mean percentage 2M)/2. The mean percentage for each type of learner was calculated by adding the mean percentage for each movement for each type of learner and dividing it by the number of movements –

(mean percentage 1S + mean percentage 1M)/2, (mean percentage 2S + mean percentage 2M)/2.

No statistical tests were performed on the data and therefore any differences discussed are at the discretion of the researcher. Readers are encouraged to make their own judgments while examining the results.

Table 1

Mean Percentage of Pre-Instruction Safety Scores

	Beginner		Advanced	
	Reviewer 1	Reviewer 2	Reviewer 1	Reviewer 2
Biceps	55.56	63.06	71.56	73.78
Triceps	50.75	56.81	76.36	74.55
Single	53.16	59.94	73.96	74.17
Bench	62.32	61.84	67.39	73.91
Squat	55.56	57.54	56.55	58.93
Multiple	58.94	59.69	61.97	66.42

Table 2

Mean Percentage of Pre-Instruction Effectiveness Scores

	Beginner		Advanced	
	Reviewer 1	Reviewer 2	Reviewer 1	Reviewer 2
Biceps	55.56	63.06	70.89	72.89
Triceps	50.75	56.81	75.45	74.55
Single	53.16	59.94	73.17	73.72
Bench	61.35	61.84	67.39	73.91
Squat	54.76	56.75	56.55	58.33
Multiple	58.06	59.3	61.97	66.12

Tables 1 and 2 show the mean percentage scores for the pre videos for each of the movements and each of the groups. In terms of individual movements, triceps in the beginner group and squat for both groups had the lowest pre scores. Triceps and biceps in the advanced group have the highest pre scores.

Table 3

Percentage Difference Between Pre/Post-Instruction Safety Scores for Each Experimental Group

	Beginner		Advanced	
	Reviewer 1	Reviewer 2	Reviewer 1	Reviewer 2
Single Joint	19.57	16.95	9.15	9.59
Multiple Joint	8.93	7.88	9.06	8.23
Total Mean	14.25	12.42	9.11	8.91

Table 4

Percentage Difference Between Pre/Post-Instruction Effectiveness Scores for Each Experimental Group

	Beginner		Advanced	
	Reviewer 1	Reviewer 2	Reviewer 1	Reviewer 2
Single Joint	19.57	16.95	9.01	10.03
Multiple Joint	8.93	7.88	9.06	8.23
Total Mean	14.25	12.42	9.04	9.13

Safety and effectiveness scores for each experimental group. As shown in table 3, the beginner, single-joint group had the highest safety gains – 19.57% and 16.95% for reviewer one and two respectively. The beginner, multiple-joint group had the least gains with 8.9% and 7.88% for reviewer one and reviewer two respectively.

Table 4 shows there is a similar pattern for the effectiveness scores as there is with the safety scores with the beginner single-joint group having the highest gains – 19.57% and 16.95% for reviewer one and reviewer two respectively. The beginner multiple-joint group had the lowest gains with 8.93% and 7.88% for reviewer one and reviewer two respectively.

Safety and effectiveness scores for level of learner. Table 3 shows the beginner group had the highest safety gains with reviewer one scoring 14.25% increase and reviewer two scoring 12.42%. The advance group had the least gains with 9.11% and 8.91% for reviewer one and reviewer two respectively.

Table 4 shows the beginner group had the highest effectiveness gains with reviewer one scoring 14.25% increase and reviewer two scoring 12.42%. The advance group had the least gains with 9.04% and 9.13% for reviewer one and reviewer two respectively.

Table 5

Percentage of Difference Between Pre/Post-Instruction Safety Scores for Each Type of Movement

	Single Joint		Multiple Joint	
	Reviewer 1	Reviewer 2	Reviewer 1	Reviewer 2
Beginner	19.57	16.95	8.93	7.88
Advanced	9.15	9.59	9.06	8.23
Total Mean	14.36	13.27	9.00	8.06

Table 6

Percentage of Difference Between Pre/Post-Instruction Effectiveness Scores for Each Type of Movement

	Single Joint		Multiple Joint	
	Reviewer 1	Reviewer 2	Reviewer 1	Reviewer 2
Beginner	19.57	16.95	9.72	7.88
Advanced	9.01	10.03	9.06	8.23
Total Mean	14.29	13.49	9.39	8.06

Safety and effectiveness scores for type of movement. Table 5 shows the highest safety score gains were in the single joint movement with increases of 14.36% for reviewer one and 13.27% for reviewer two. The lowest score gains were in the multiple joint movement with scores of 9.00% and 8.06% for reviewer one and two respectively.

Table 6 shows the highest effectiveness score gains were in the single joint movement with increases of 14.29% for reviewer one and 13.49% for reviewer two. The lowest score gains were in the multiple joint movement with scores of 9.39% and 8.06% for reviewer one and two respectively.

Safety and effectiveness scores for each movement.

Biceps curls

Table 7

Percentage of Difference Between Pre/Post-Instruction Scores for Biceps Curl

Biceps	Safety		Effectiveness	
	Reviewer 1	Reviewer 2	Reviewer 1	Reviewer 2
Beginner	11.11	13.06	11.11	13.06
Advanced	5.56	6.44	6.22	7.33
Total Mean	8.34	9.75	8.67	10.2

Table 7 shows that safety scores for biceps curls increased by 8.34% and 9.75% overall. However, beginners increased by 11.11% and 13.06% while advanced only increased by 5.56% and 6.44%.

Table 7 shows that effectiveness scores for biceps curls increased by 8.67% and 10.2% overall. However, beginners increased by 11.11% and 13.06% while advanced only increased by 6.22% and 7.33%.

Triceps extensions.

Table 8

Percentage of Difference Between Pre/Post-Instruction Scores for Triceps Extension

Triceps	Safety		Effectiveness	
	Reviewer 1	Reviewer 2	Reviewer 1	Reviewer 2
Beginner	28.03	20.83	28.03	20.83
Advanced	12.73	12.73	12.42	12.73
Total Mean	20.38	16.78	20.23	16.78

Table 8 shows that safety scores for triceps extensions increased by 20.38% and 16.78% overall. However, beginners increased by 28.03% and 20.83% while advanced only increased by 12.73% and 12.73%.

Table 8 shows that effectiveness scores for triceps extensions increased by 20.23% and 16.78% overall. However, beginners increased by 28.03% and 20.83% while advanced increased by 12.42% and 12.73%.

Bench press.

Table 9

Percentage of Difference Between Pre/Post-Instruction Scores for Bench Press

Bench	Safety		Effectiveness	
	Reviewer 1	Reviewer 2	Reviewer 1	Reviewer 2
Beginner	11.11	8.21	11.11	8.21
Advanced	1.45	2.17	1.45	2.17
Total Mean	6.28	5.19	6.28	5.19

Table 9 shows that safety scores for bench press increased by 6.28% and 5.19% overall. However, beginners increased by 11.11% and 8.21% while advanced only increased by 1.45% and 2.17%.

Table 9 shows that effectiveness scores for bench press increased by 6.28% and 5.19% overall. However, beginners increased by 11.11% and 8.21% while advanced increased by 1.45% and 2.17%.

Back squat.

Table 10

Percentage of Difference Between Pre/Post-Instruction Scores for Back Squat

Squat	Safety		Effectiveness	
	Reviewer 1	Reviewer 2	Reviewer 1	Reviewer 2
Beginner	6.75	7.54	8.33	7.54
Advanced	16.75	14.29	16.67	14.29
Total Mean	11.71	10.92	12.5	10.92

Table 10 shows that safety scores for back squat increased by 11.71% and 10.92% overall. However, beginners increased by 6.75% and 7.54% while advanced increased by 16.67% and 14.29%.

Table 10 shows that effectiveness scores for back squat increased by 12.5% and 10.92% overall. However, beginners increased by 8.33% and 7.54% while advanced increased by 16.67% and 14.29%.

Participant Evaluation of Field Test

Collection of data consisted of several questions that the participants chose and answer along with two open ended questions. Of the 14 participants that completed the field test 13 completed the exit survey.

Participants were asked to rate on a scale of one to three – one being not well and three being very well – how well they learned the movement overall, the safety, and the effectiveness. The mean score for the overall movement was 2.77, the mean score for the safety of the movement was 2.54, and the mean score for the effectiveness of the movement was 2.23.

The second question the participants were asked was "What problems did you have in learning and executing the movement?" They were given the options: Understanding how to set up the weights; transferring the theory to practice; Unsure if correctly performing the movement; Unsure how much weight to use; Explanation of movements were unclear; Explanation of safety of movement was insufficient and/or unconvincing; Explanation of effectiveness of movement was insufficient and/or unconvincing. Participants had the option to select all that applied. Table 11 below shows the answers given by participants

Table 11

Problems with learning and executing the movements

Problems with instruction	Number of respondents	Percent of respondents
Set up of weights	0	0.00
Transferring theory to practice	4	30.77
Unsure if correctly performing movement	9	69.23
Unsure how much weight to use	3	23.08
Explanation of movements unclear	0	0
Explanation of safety insufficient/unconvincing	1	7.69
Explanation of effectiveness insufficient/unconvincing	4	30.77

Almost 70% of participants reported being unsure if they were performing the movement correctly. Around a third of the participants reported having a problem transferring the knowledge they learned in the instruction to the actual execution of the movement.

The third question the participants were asked was "Did you feel that the instruction without an instructor/coach/teacher present was sufficient for you to feel comfortable executing the movement?" Eleven of the 13 (85%) participants responded that they did feel comfortable executing the movement while only 2 (15%) did not feel comfortable without a coach being present.

The final part of the exit survey was two open-ended questions. These questions were asked so the participants could provide feedback on any part of the instruction and

field test. The first question was "Do you have any comments about your experience with the instruction and/or practice?" The second question was "Do you have any comments about your experience participating in this study?"

Participants reported finding the instruction clear as well as being sufficient to understand how correctly execute the movement. Typical comments included "The instruction went through the movement in well sectioned steps clearly showing how to execute the movement from beginning to end. The video was well narrated and clear to understand".

While the participants found the instruction clear and understandable many, were concerned about knowing if they were doing the movement correctly. Many stated that they would preferred to have a qualified person overseeing their practice phase to check if they were doing it correctly and to correct any errors. One participant said, "An advantage of having an instructor there, they give you immediate feedback, and correct you as you go." Another said "it was harder to tell if I was doing the movement correctly at the time without having someone there to correct any mistakes I made. It was a different experience trying to work on form while lifting without having a coach present."

A few participants suggested that they found their previous lifting experience with the movements they were assigned meant they were just refreshing what they knew. "I think my experience may have been biased from previous experience with these exercises. The videos confirmed my understanding of them though."

Others suggested that more practice performing the movement would have helped them improve their form further. "…more practice would have been helpful as well. I was already familiar with correct form for biceps curls but triceps extensions in this

manner were new to me and I felt that more practice would have helped for both exercises."

One participant was concerned that learning form with light weights would invalidate the results of the field test (and therefore the validity of this type of program. "I find that lifting form is easy to maintain when weights are light, but that maintaining form under heavy weight is much more difficult. I think the results will be highly skewed by the lack of weight."

The final piece of feedback directly related to the instruction was a suggestion to include an explanation of how to tell if you are executing the movement incorrectly. "The execution of the movement was easy to see, however it was not explained how to tell when you may be improperly executing the movement."

An interesting piece of feedback arose not in the answers in the exit survey, but rather in the withdrawal of two participants. This issue was related to the video recording of themselves completing the movements. One participant was concerned about her face being visible on the videos and the other said she felt uncomfortable recording herself.

There were two major technical problems that arose during the study that several participants encountered. It was reported by a number of participants that when they had logged onto the website and tried to access the videos they received a 404 error – the link was not found. It was determined that this issue was only when using Firefox. Participants were advised to use a different browser.

The other technical issue reported by participants was that they could not upload their videos to the website. It was determined that the file size allowance for uploads was set very low and this was fixed.

Reviewer Evaluation of Field Test

Due to the fact that participants were engaged in learning and executing the movements in a safe and effective manner, their feedback was in relation to the instruction and their experiences with the executing of the movement and with the field test overall. The reviewers were engaged in scoring the videos and therefore the feedback they provided was in relation to the review process including videos, rubric, and scoring. The reviewers were asked two questions. "What problems did you encounter while reviewing the videos?" and "Do you have any suggestions to make the review process more effective?"

A major issue that both reviewers came across was that many of the videos were filmed from angles that made it difficult to determine the quality of different aspects of the movement. Generally these angles cut off part of the body. "There were some aspects of the movement that were not possible to see so we had trouble scoring them." To address some of these issues the SME was consulted and two aspects of the bench press and one from the squat were removed due to that fact that they were impossible to score on almost all participants. A suggestion made by the reviewers to address this issue in future courses would be to provide instructions to the participants on the appropriate camera angle to capture the movement in its entirety and allowing each part of the movement to be easily reviewed.

Associated with difficulty viewing aspects of the movement is that some participants only recorded the movement from the start point to end point neglecting to record the setup, unracking, and reracking processes which were included in the instruction and an important part of the movement.

Another issue the reviewers had was that some of the videos opened in sideways and upside down orientations. This made it difficult to review as the reviewers had to reorient themselves. "We've had to turn our heads in all kinds of angles to get a good look. The one that was upside down was particularly difficult to see all the aspects we need to look at. Things look different upside down."

The reviewers also had issues accessing some of the videos. Initially reviewer one tried to use the Firefox web browser, which did not work as the website did not support Firefox as described in the previous section. Once that issue was addressed both reviewers found that there were several videos that did not open in regular video playback programs such as QuickTime and Windows Media Player. "It was frustrating to try to open these videos and have them not play. It threw off our review process and required additional effort that shouldn't have been necessary." These videos were in strange file formats that were not supported by these playback programs. Some of these videos converted into supported file formats while VLC player was required for the others.

The reviewers had some suggestions of alterations to the rubrics including removing some aspects of the movement as mentioned above. An alteration that was made by the SME during the review process was to change the scoring system from 3-safe (or effective)-perfect to 3-safe. This was done because "the movement is never perfect, there's always something that can be improved." The reviewers and the SME stated that it was important for any future courses or programs to include a score for the overall movement, not just to add all the components together. "People can do individual aspects of the movement well and we can give them a high score by looking at each

individual part but the entire movement may be flawed and performed poorly." Another alteration that was made by the researcher was to add a "not scorable" option for aspects that could not be seen.

The SME suggested that in a full course of this nature that videos needed to be evaluated in this manner every few weeks with the score sheets being given to the participants. They should also be given feedback that tells them how to fix or adjust to improve their movements. "The people participating in programs like this need to be given constant feedback in an effort to replace the immediate feedback that they would get with a coach present. It's the only way I could see this working well."

Reviewer One made the final suggestion and it was to have the participants only use the bar for their pre-instruction attempts. "You should tell the people they should only use the bar for their before videos. A lot of them have far too much weight on their bar and it is clearly affecting their form."

Examination of the Review and Scoring Process

In an effort to evaluate the review and scoring process to determine where it had flaws the researcher looked for any major discrepancies between the reviewers scores, between participants pre-instruction and post-instruction scores, and between participants scores for each movement. The researcher also watched Reviewer One score some videos. This was important as it gave some insight into the process the reviewers went through and the decision making process they went through as they scored each video and each participant.

Two major issues were identified during this evaluation. The first was that there was a problem with the consistency of scoring and the second was the accuracy of the scoring varied widely.

As mentioned above Reviewer One generally scored the pre videos and then the post video for each participant. For several participants this was not possible as they scored the pre videos and discovered they could not play the post video due to its file format. They rated these post videos when they had access to the videos. It was discovered by the researcher that one participant in particular lost around 35% from his pre to post scores. This seemed a sever drop and highly unlikely. The researcher requested that this participant's videos be rescored and the new scores showed a slight increase from the pre to post scores.

Another discrepancy was scores for the earlier videos tended to be higher than those scored later in the review process. Reviewer One was asked to rescore a participant that was scored early on that seemed to have a higher score than was warranted. The initial score was higher than 80% of the other participants. The rescore was 80% lower than the other participants. The rescore was more consistent with the score assigned by Reviewer Two. These discrepancies suggested that the value assigned to each point on the likert scale changed over the course of the review.

The second major issue that was identified was there was a problem with the accuracy of scoring for each component of the movements. This issue was first seen in the scores for each aspect especially for those who performed the movement poorly. Watching the review process for reviewer one provided some insight into the way scores were assigned for each movement. The reviewers watched the movement and made a

judgment on the quality of the overall movement. Generally when the movement was poor they would go down and put ones for most of the aspects without looking specifically for the quality of each aspect. This resulted in some participants being scored low on things like grip and five-point contact – things that are consistently performed well.

CHAPTER 5: Discussion

The discussion section will address each of the research questions in turn and explain how each of the components of the results affect the design of the program and consideration that are necessary. The overall research question was how can the ADDIE Model of Instructional Design be used to create an online module that teaches safe and effective movement for psychomotor skills? To address this question the results of the trial learner results for the strength training module will be discussed. This will be divided into the sub-question: Can the correct form for free-weight barbell strength exercises be taught in an online environment (no coaching presence during practice/learning)? The accommodations to the model will then be discussed by answering the question what accommodations must be made to the model by way of guidelines? This will include the specific requirements for the strength program followed by guidelines for psychomotor movements in general.

Trial Learner Results

Can the correct form for free-weight barbell strength exercises be taught in an online environment? To answer this question there are three components to address: Firstly, are there gains made by beginners and advanced learners? Secondly, are there gains made for single and multiple joint movements? Lastly, is the interaction between the type of learner and type of movement?

Does the program produce gains in learners between pre and post scores for safety and effectiveness for beginners? For advanced? Beginners had higher overall gains than advanced lifters. Beginners improved their scores for safety and effectiveness by around 13% while the advanced increased their scores for safety and effectiveness by

around nine percent. This suggests that beginning learners benefited more than advanced lifters from the instruction and this showed in their performance of the movements. This could be due to the beginners having greater gains as their pre scores may have been lower than those of the advanced.

There seems to be some evidence that beginners are able to make bigger gains in the safety and effectiveness of the movements. There is no evidence that the program was ineffective for either type of learner. This means that this type of program could benefit both beginners and advanced lifters. The type of learner does not seem to be an important variable in the design of instruction when it is developed for learners that have little knowledge of lifting and when the learners are college students.

Is there a difference after program exposure in the safety and effectiveness scores between multiple joint and single joint movements overall? Participants performing single joint movements had higher overall gains than participants performing multiple joint movements. Participants performing single joint movements improved their scores for safety and effectiveness by around 14% while the participants performing multiple joint movements increased their scores for safety and effectiveness by around nine percent. This suggests that single joint movements can be taught more effectively than multiple joint movements. The argument that the greater gains in the single joint group may be due to the group having lower pre-instruction scores appears to have no weight as the pre scores for each group were within three percent of each other for both safety and effectiveness.

While the overall scores suggest that single joint movements are more effectively taught than multiple joint movements a closer examination of the individual movements

reveals a different pattern. Bench press had the lowest gains at around six percent, closely followed by biceps curls (nine percent) and back squats (11%). Interestingly, triceps extensions had gains of around 18%. This reveals that type of movements is not as important as the individual movements. When creating instruction it is important to consider the potential of each movement rather than the type of movement. It appears that some movements (triceps extensions) can be taught more effectively than others (bench press) however there was no evidence of movements that produce no gains.

Is there an interaction between the experience of learner and type of movement? Overall beginners had gains in safety and effectiveness of 13%. However, the distribution of the mean difference between pre and post scores varied depending on the type of movement. Beginners that engaged in single joint movements had gains of about 18% in safety and effectiveness while beginners that performed multiple joint movements had gains of around eight percent. Advanced lifters that performed single joint movements had gains of around nine-point-five percent for safety and effectiveness while advanced lifters that performed multiple joint movements had gains of around eight-point-five.

It appears that the only interaction that affected performance was beginners performing single joint movements with these participants making larger gains than the other three groups. However, a closer examination of the interaction between the type of learner and the specific movements reveal a different pattern. For beginners, bench press and biceps curls had similar gains (around 11%), with squat having little gains (seven percent) and triceps extensions having large gains of around 25%. For the advanced

lifters the lowest gains were in bench press (about two percent), gains for biceps around six percent, triceps around 13%, and the highest gains in the squat of around 15%.

It could be argued that the difference is gains could be attributed to the pre score being lower for the beginner groups. While this may be true for the single joint movements (there was around a ten percent difference in pre scores with advanced being the higher scorers for both safety and effectiveness) the multiple joint movements had very similar pre scores between beginner and advanced lifters (there was about a two percent difference in safety and about a five percent difference in effectiveness).

Clearly, it is important in designing this type of program to address the idea that different types of learners have differing amounts of gain depending on the type of movement they were performing. Even more important than the interaction between the type of learner and the type of movement is the interaction between the type of learner and the specific movement.

To answer the question "can the correct form for free-weight barbell strength exercises be taught in an online environment?" it would appear that, after examining all the results generated by the field test that the answer is yes. Several important factors that need to be considered when designing online strength programs were discovered. The first is that it is effective for both beginners and advanced lifters when designed for novices. Secondly, that the type of movement is not as important as the specific movements. Different movements have different potentials for being taught online and each movement does not appear to be correlated with other movements of the same type. For instructional purposes this means that it would be unwise to design simple single joint programs for beginners and complex multiple joint movements for advanced lifters.

Beginners have the potential to learn certain multiple joint movements and advance lifters can make gains in single joint movements.

What Accommodations Must be Made to the Model by Way of Guidelines?

To create a set of guidelines to aid designers in using the ADDIE model for the development of strength programs, information provided by the reviewers and the participants, and analysis of the review process by the researcher are combined. These guidelines include important factors that need to be addressed to make the review process smoother and more consistent, and necessary parts that need to be included in the instructional sequence.

The importance of using the instructional strategies associated with video playback and availability of instructional materials outlined by Anderson and Ellis (2005) was highlighted by the positive feedback provided by the participants on the quality and helpfulness of the video instruction. Participants had the ability to control the playback of the instructional videos and felt that it was beneficial to have the ability to access and review all of, or parts of, the instruction at their own leisure. When designing an online strength program control over playback of videos and continuing access to the videos and other instructional materials is a necessary component.

The difficulty in reviewing videos was related to two parts, the first was the camera angles and incomplete recording and the second was the inability to play some videos in standard video playback programs.

To address the problem with camera angles and incomplete videos the best camera angels should be determined. Participants should be given a set of instructions on these camera angles. This should include how to set up for the angle. It may be

necessary for participants to record their execution of the movements from several angles to allow for a complete review. They should also be instructed to record and upload their videos in a common video file format such as .mp4. Failure to comply with these instructions should result in the videos not being scored and the learners should be made aware of this condition. Designers of strength programs should be aware that this is extra instruction they will need to prepare. The instructions needs to be clear and detailed instructions so the learners can easily follow what is required of them.

The second issue with the video – the inability for the reviewers to open some of the videos due to their file format not being supported by standard video playback programs – can be addressed by instructing the learners to record and upload their videos in a common video file format such as .mp4. Designers should be aware that they may need to provide instructions on how to record in one of these formats or how to convert the video they have into one of these file formats. Further investigation into this aspect of the instruction is needed to determine the extent of this instruction.

The feedback from the reviewers, the SME, and the analysis of the review process revealed problems with the rubrics. The initial problem was there were aspects of the movements that could not be viewed on any of the videos. These aspects were removed during the review process. The scoring values were also changed; three was changed from safe (or effective) – perfect to safe (or effective). This was done as the SME felt that no movement was perfect and it gave the reviewers a larger range of scores to work with. One other scoring value was added – not scorable – so that the reviewers had an option for parts of the movement they could not see. Without this addition the reviewers

would have had to make a best guess at the participant's performance or score him/her a 0 – not safe (effective) – stop movement.

An addition that needs to be made to any rubric used for assessing strength movements is an overall score for the movement in its entirety. While each part of a movement may be executed well, the movement as a whole might be executed poorly. This happens because, while each individual part is done correctly, the combining of each part is executed poorly. This addition to the rubric is extremely important.

A potentially beneficial alteration to the scoring system that could improve the gains made by learners is to simplify the rubrics for participants with poor initial form. It could work by scoring the learners with the initial rubric. If they scored below a certain point they would be switched to the simplified rubric. This simplified rubric would focus on big movements ignoring the finer details. Once they mastered these big movements they would be switched back to the more complex rubric. This simplified rubric would give participants general feedback on the completion of the movement without overwhelming them with the finer details of the movement. This is a similar principle to the cueing that occurs in face-to-face sessions – this would just be a delayed version. There would need to be further research to determine if this strategy would be beneficial.

A recommendation by the SME that is crucial for the success of a full program is to have the learners record themselves and have the video reviewed every two weeks. The idea behind this is to give the participants regular feedback on their performance. While the literature suggests that immediate feedback is the most beneficial in psychomotor skill learning, this is not possible in an asynchronous program (Smits et al., 2008). Providing feedback every few weeks, as suggested by the subject matter expert,

may be a good alternative alternative. The feedback provided in this manner is to replace the feedback that the learners would get in a face-to-face program.

Feedback is an important and crucial part of learning any psychomotor skill and needs to be included in any online program. It also allows the participants to track their progress and addresses the concerns that several of the participants had about being unsure if they were correctly performing the movement.

The feedback the learners would receive should consist of the scoring rubrics – so they can see where they are doing well and not so well – as well as written feedback about how to improve on their movements. There should also be an opportunity for the learner to contact the instructor to ask questions, discuss the feedback, and get clarification on anything they do not understand.

The nature of the feedback should be as minimal as possible (see Stefanidis et al., 2007) Excessive feedback can overwhelm the learners and that can result in learners not knowing what to focus on when practicing the movement. Excessive feedback can also result in the learner becoming too reliant on the feedback when performing the movement (Winstein & Schmidt, 1990; Wulf & Schmidt, 1993). This could result in the learner being unable to perform the movement correctly when the course is over and there is no further feedback. The learner and the instructor should use the feedback to create cues that the learner can use when practicing the movement.

The evaluation of the scoring process revealed major problems with the quality, consistency, and accuracy of the scoring. There are three possible ways in which to address these issues for future programs. The first is to provide training to those who will serve as reviewers. Even people trained in strength movements had trouble being

consistent. The training would involve teaching the reviewers what each value of the scale equates to and providing methods for checking that their scoring is consistent between participants and over time for the same participants. The training would also teach the reviewers how to evaluate each aspect of the movement without it being tainted by their judgment of the movement as a whole.

A second method for ensuring consistency and reliability of the scoring is to have a moderator. This would be a second reviewer with the same training as the first looking at and reviewing a few videos that the reviewer has already scored. The moderator would be looking for anything that seemed inconsistent and looking at any differences between their scores and the original viewers scores. If there were major inconsistencies the videos would need to be watched again and the reviewer examined.

A third method to ensure the reliability of the scoring could be to have a set procedure of conducting the reviews. This procedure would consist of the reviewer watching all the pre-instruction videos first. This is necessary so that the learners can receive the feedback on their performance before they continue with their practice. Review of subsequent videos could be reviewed either stand alone or by comparing them to the previous videos. Whatever the process that is chosen should be followed. This set procedure for reviewing videos is particularly important for courses and programs that have more than one reviewer as it will ensure consistency across reviewers.

The final but by no means the least important factor to consider when designing online strength training programs is the qualifications of the instructors and reviewers. To ensure the best possible instruction and feedback for the learners both the instructors and the reviewers should be qualified as strength and conditioning coaches, personal

trainers, physical education teachers, or anyone with similar backgrounds. While it may be possible to train people in what to look for in the movements for scoring on the rubric, feedback on how to improve the movement is a specialized skill only possessed by qualified individuals.

Recommendations for Designing Online Psychomotor Skills Programs

The discussion thus far has focused on the implementation and evaluation of the field test for a strength training module. To answer the overarching research question, the application of the guidelines established for the strength training program need to be considered for psychomotor skills overall. The recommendations for applying the evaluation of this study to the design of other psychomotor programs are discussed. These recommendations are intended as additions and/or modifications of the ADDIE design process.

Practical implications. Several of the issues that arose during the implementation phase were related to practical use of the technology. Designers need to consider the technology they are asking instructors, reviewers, and learners to use. It is necessary to have a way for instructors or reviewers to see the learners perform the skill. The learners must have a way to record themselves and instructors or reviewers must have access to this. Access to recording equipment must be a prerequisite for learners to take an online psychomotor skills course.

In order for the instructor or reviewer to make an accurate review of the performed skill they must be able to see all aspects of the movement. This means that the recording equipment used by the participants must be set up in a certain way to optimize

the view of the movement. From a designer's perspective, this means that instructional materials that teach the learner where to place the recording equipment must be created.

The videos must also be accessible to the reviewers. This means that the learners must be able to send their videos to the reviewer. A suggestion for doing this is to have some type of drop box for the learner to upload their videos to and that the instructor or reviewer has access to also. This requires the designer to make this available by using software that makes this possible or a website designed to allow this. In addition to making the videos available to the instructor or reviewer, the video must be viewable. In other words the file format needs to be common so that it can be played on common video play back software. The designer needs to include directions to the learner so they will record and upload their video in a viewable format.

The instruction that teaches the learner the actual psychomotor skills needs to include the performance of the skill to support observational learning. The most appropriate format for this is to show the movement in a series of videos. These videos should apply the instructional strategies outlined by Anderson and Ellis (2005). The designer should make sure the videos and instructional materials are accessible to learners at all times. The videos should be designed so that the learners have control of the playback features such as slow motion, rewind, fast-forward, and pause.

The designer should create the instruction to have multiple assessment points where the learner is require to record their movement, upload it, and have the instructor or reviewer score it and give feedback. This should occur several times throughout the course to aid the students learning through feedback. There should also be a feature for the learner to contact the instructor – this could be email, skype, or some similar program.

This will allow for a discussion and clarification of the feedback and for the instructor and learner to establish cues that the learner can use during their practice phases.

In terms of the review side of the instruction, several considerations and instruction need to be made. The study revealed several issues with the scoring. To address this, instructors and reviewers need to be trained to assure the quality of the reviews. This training should include teaching the reviewers the value of each rating score, how to be consistent and accurate with their scoring, and to consider each aspect of the movement as well as the movement overall. They should also be taught a procedure for conducting the reviews over the course of the class. The suggestion for this procedure would be to view all learners' pre-instruction videos and the compare their new videos with the previous one. The designer would need to create the instruction for the reviewers to keep it consistent with what they will be expected to do for the course. The study reveal that is difficult even for experts in a given area to be consistent in their scoring and therefore, it is important for the reviewers to be qualified in the area as well as having the reviewer training.

The final recommendation for instructional designers developing online courses for psychomotor skills is to be aware that the type of movement does not seem to be as important as the individual movements. Designers should be vigilant that the instruction they design may work for one movement but not another. They should conduct evaluations throughout the courses to determine which movements work and which ones may need further adaptations to work.

Concluding Thoughts

This design and development research has examined the possibility of using the ADDIE model to create and implement online psychomotor skills training programs. The field test and subsequent evaluation has suggested that it is possible to create instruction that is successful in teaching college students with varying levels of lifting experience correct technique for performing safe and effective movements using free-weights.

The evaluation of the field test reveal several issues that need to be addressed to improve the effectiveness of the instruction and future programs including cleaning up rubrics and training reviewers.

The suggestions for improvement discussed above are necessary components that need to be strictly implemented to ensure the viability and success of any online psychomotor skills training program particularly those focusing on teaching technique.

The field test showed some success in teaching college students. The instruction needs to be tested on other populations to examine if success is possible with other types of learners and if other accommodations need to be made for these populations.

This type of program can be used for either teaching people correct technique so they can go it alone in the gym. However, it is recommended that this instruction be part of a larger course that starts with perfecting form, moves on to improving strength, and ends with teaching learners how to construct programs to reach their strength goals. This could be a similar strategy for any psychomotor skills that require the learning of technique before its application to a real world situation or progression to something more complicated.

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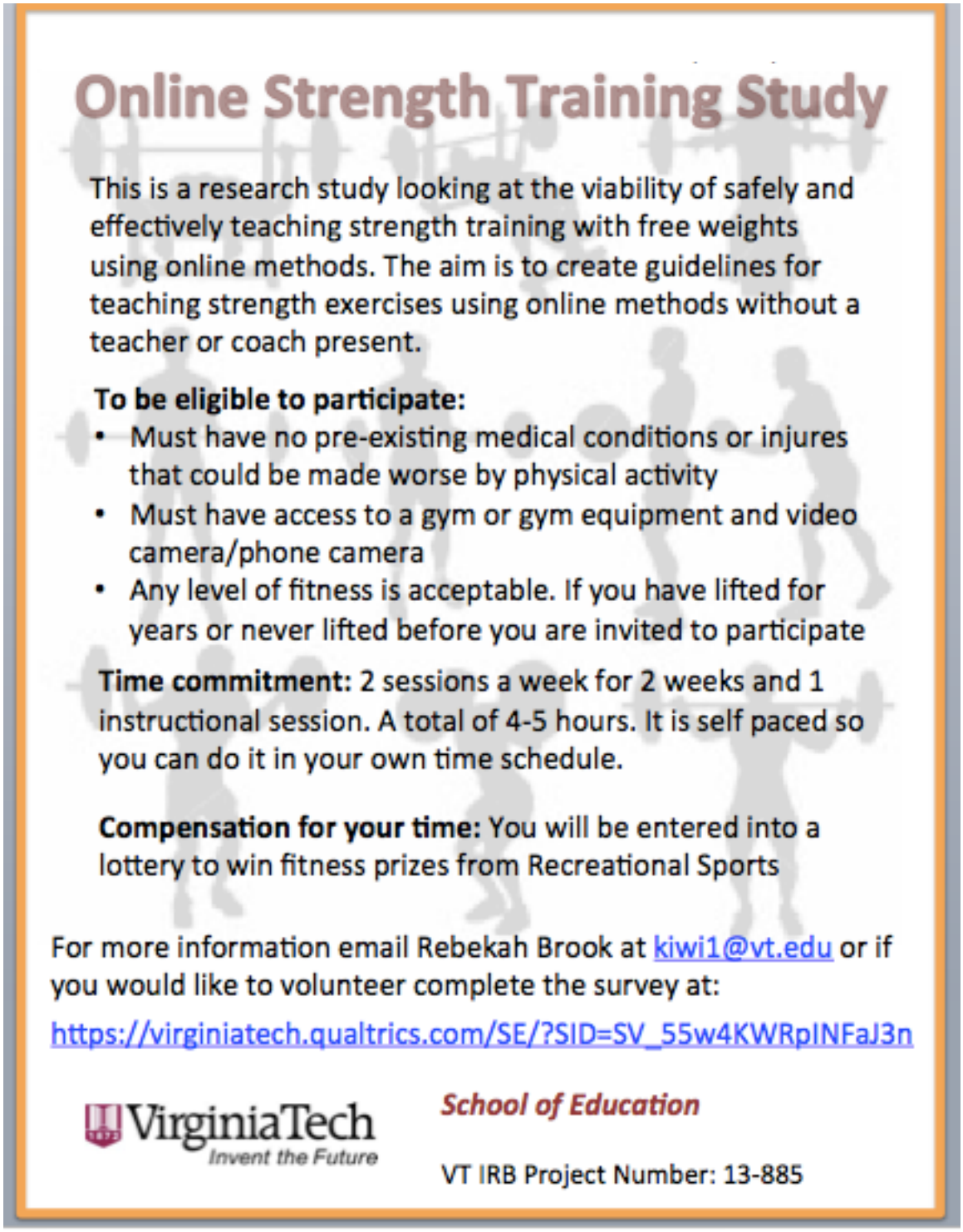
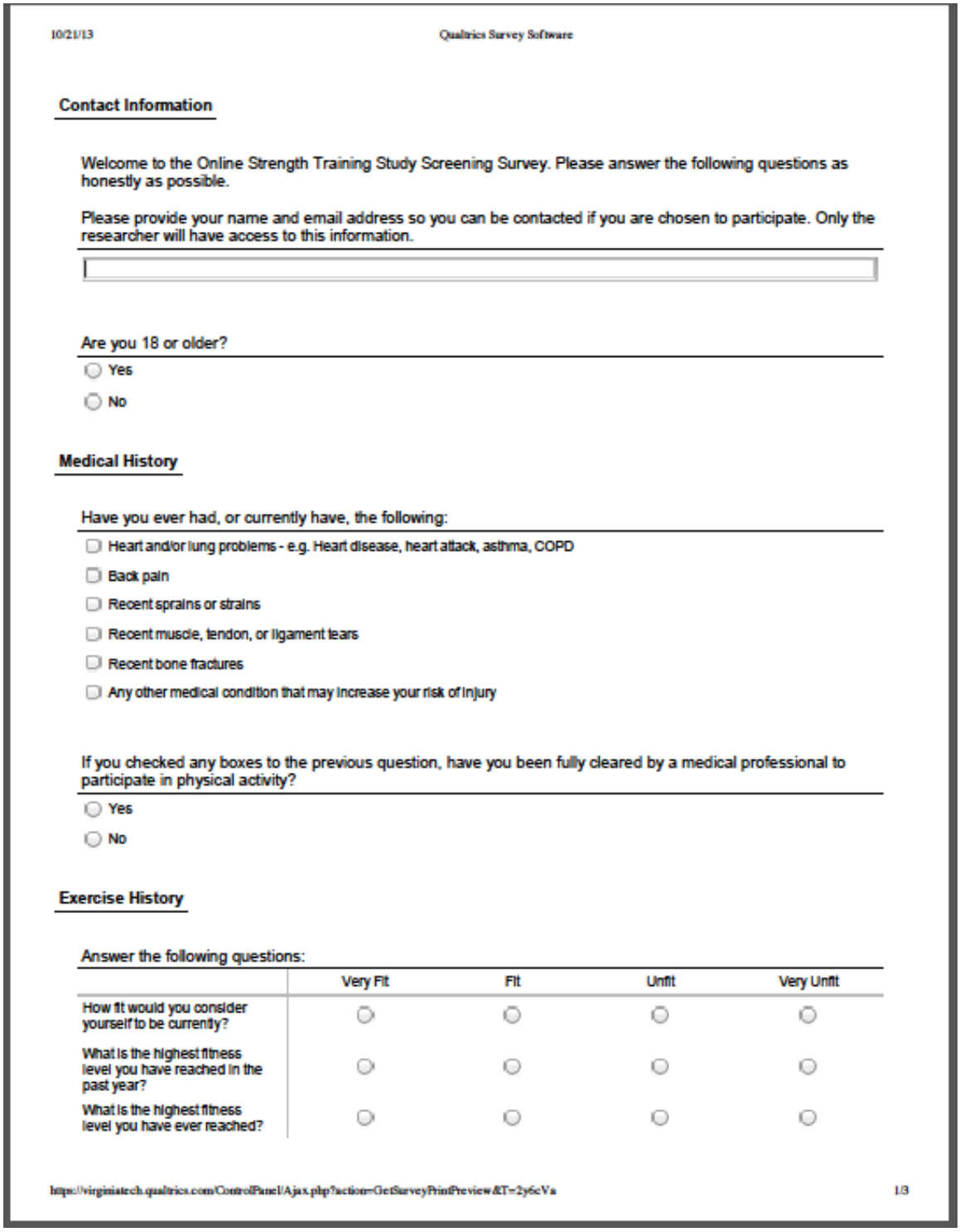
Appendices

Appendix A: Recruitment Document



Appendix B: Surveys

Screening Survey



10/21/13 Qualtrics Survey Software

Contact Information

Welcome to the Online Strength Training Study Screening Survey. Please answer the following questions as honestly as possible.

Please provide your name and email address so you can be contacted if you are chosen to participate. Only the researcher will have access to this information.

Are you 18 or older?

- ○ Yes
- ○ No

Medical History

Have you ever had, or currently have, the following:

- ☐ Heart and/or lung problems - e.g. Heart disease, heart attack, asthma, COPD
- ☐ Back pain
- ☐ Recent sprains or strains
- ☐ Recent muscle, tendon, or ligament tears
- ☐ Recent bone fractures
- ☐ Any other medical condition that may increase your risk of injury

If you checked any boxes to the previous question, have you been fully cleared by a medical professional to participate in physical activity?

- ○ Yes
- ○ No

Exercise History

Answer the following questions:

	Very Fit	Fit	Unfit	Very Unfit
How fit would you consider yourself to be currently?	○	○	○	○
What is the highest fitness level you have reached in the past year?	○	○	○	○
What is the highest fitness level you have ever reached?	○	○	○	○

https://virginiatech.qualtrics.com/ControlPanel/Ajax.php?action=GetSurveyPrintPreview&T=2y6cVa 1/3

How familiar are you with the following gym equipment?

	Regularly use	Have used	Know what it is but have never used	Don't know what it is
Squat Rack	○	○	○	○
Weight Bench	○	○	○	○
Straight Bar	○	○	○	○
Ez Bar	○	○	○	○
Weight Plates	○	○	○	○
Dumbbells	○	○	○	○
Barbells	○	○	○	○
Safety Clips	○	○	○	○

What is your experience with weight lifting?

- ○ Never lifted weights
- ○ Have lifted weights but not in the past year
- ○ Have lifted weights in the past year but not currently
- ○ Currently lift weights

Have you ever been shown how to lift weights by a professional? (such as a strength and conditioning coach or a personal trainer)

- ○ Yes
- ○ No
- ○ I don't know

Have you ever been shown how to lift weights by a non-professional? (such as a friend or family member)

- ○ Yes
- ○ No
- ○ I don't know

Access to Equipment

Do you have access to a video camera, camera phone, or other device with video recording capability?

- ○ Yes
- ○ No

Do you have access to a gym or gym equipment?

- ○ Yes
- ○ No

Initial Survey

Demographic Information

Age

- ○ 18-25
- ○ 26-35
- ○ 36-45
- ○ 46+
- ○ Prefer not to answer

Gender

- ○ Male
- ○ Female
- ○ Transgender
- ○ Prefer not to answer

Race/Ethnicity

- ○ White/Caucasian
- ○ Black/African American
- ○ Hispanic/Latino
- ○ Other - Please specify
- ○ Prefer not to answer

Year in school

- ○ Freshman
- ○ Sophomore
- ○ Junior
- ○ Senior
- ○ Graduate Student
- ○ Faculty/Staff

Online Learning History

Have you taken any classes online?

- ○ Yes
- ○ No

If you answered yes to question previous question, how many online classes have you taken?

- ○ 1-3
- ○ 4-6
- ○ 7-10
- ○ 11+

Have you ever used a home fitness programs such as P90X, Insanity, or anything on DVD (yoga, zumba, aerobics etc.)

- ○ Yes
- ○ No

Exit Survey

Study Evaluation

How well did the instruction teach you:

	Very well	Well	Not well
The movement overall	○	○	○
Safety of the movement	○	○	○
Effectiveness of the movement	○	○	○

What problems did you have in learning and executing the movement?

- ☐ Understanding how to set up the weights
- ☐ Transferring the theory to practice
- ☐ Unsure if correctly performing the movement
- ☐ Unsure how much weight to use
- ☐ Explanation of movements was unclear
- ☐ Explanation of safety of movement was insufficient and/or unconvincing
- ☐ Explanation of effectiveness of movement was insufficient and/or unconvincing

Did you feel that the instruction without an instructor/coach/teacher present was sufficient for you to feel comfortable executing the movement?

- ○ Yes
- ○ No

Do you have any comments about your experience with the instruction and/or practice?

Do you have any comments about your experience participating in this study?

Appendix C: Rubrics/Score Sheets

Participant:_____ Pre_____ Post____

BACK SQUAT

Back Squat - high bar		Safety score	Effectiveness Score
Start Position	Rack bar at armpit height		
	base of neck, hips and feet under bar		
	Bar above posterior deltoids		
	Grip - pronated, slightly wider than shoulder width		
	Even grip/position of bar		
	Raised elbows		
	Hips and knees extend to lift bar off rack		
	Step back		
	Feet hip to shoulder width apart		
	Toes pointed slightly outward		
	Shoulders back		
	Head tilted slightly back		
	Chest up		
Downward movement	Flat or slightly arched back		
	Knee + hip flexion under control		
	maintain flat or slightly arched back		
	Heels stay on ground		
	Knees aligned over toes		
	Stops when either: thighs parallel to floor, trunk rounds of flexes forward, or heels rise off floor		
	Body tight and in control		
Upward Movement	No bounce or relaxing at bottom		
	Extend hips and knees		
	maintain flat or slightly arched back		
	Head tilted slightly back and chest up		
	Feet remain in contact with the floor		
	Hips under bar		
	Knees aligned over feet - no inward/outward movement		
	Return to start position after each repetition		
Rerack	Step forward to the rack		
	Flex hips and knees until bar is on rack		
	Total		

Safety Scale	
	0 = Not safe - Stop movement
	1 = Not safe - Needs teaching points
	2 = Safe - Room for improvement
	3 = Safe - Perfect
Effectiveness Scale	
	0 = Not effective - Stop movement
	1 = Not effective - Needs teaching points
	2 = Effective - Room for improvement
	3 = Effective - Perfect

Participant:_____ Pre_____ Post____

BENCH PRESS

Bench Press		Safety Score	Effectiveness Score
Start Position	Flat on bench with 5 points of contact		
	Eyes below racked bar		
	Even grip on bar		
	Grip - closed, pronated slightly wider than shoulder width apart		
Unrack	Extend arms to lift bar by pushing up/spotter lift		
	Move bar above chest		
Downward Movement	Lower under control to chest		
	Elbows past torso slightly away from body		
	Wrist stiff		
	Forearms perpendicular to floor		
	Forearms parallel to each other		
	Bar remains level		
	Lightly touch chest around nipple level		
	No bounce		
Upward Movement	Maintain 5 point contact		
	Bar up + slightly backward		
	Maintain 5 point contact		
	Wrist stiff		
	Forearms perpendicular to floor		
	Forearms parallel to each other		
	Return to start position after each repetition		
	Bar remains level		
	Elbows fully extended but not locked		
Rerack	Move bar back toward rack/ spotter assistance		
	Bend elbows to place bar on rack		
	Total		

Safety Scale	
	0 = Not safe - Stop movement
	1 = Not safe - Needs teaching points
	2 = Safe - Room for improvement
	3 = Safe - Perfect
Effectiveness Scale	
	0 = Not effective - Stop movement
	1 = Not effective - Needs teaching points
	2 = Effective - Room for improvement
	3 = Effective - Perfect

Participant:_____ Pre_____ Post____

BICEPS CURL

Bicep Curl		Safety Score	Effectiveness Score
Start Position	Grip - Even, closed, supinated		
	Width - arms touch torso and outside of hands touch thighs		
	Bar at thigh level		
	Feet shoulder or hip width apart		
	Knees slightly flexed		
	Torso erect		
	Shoulders back		
	Eyes ahead		
	Full elbow extension		
Upward Movement	Raise bar in arc - bending at elbows		
	Wrists stiff		
	Upper arms stationary against torso No forward or outward movement		
	No body swing		
	No shoulder shrug		
	No hyperextension of neck		
	No extension of knees		
	No rising on toes		
	Bar near anterior deltoids		
	Bar remains level		
Downward movement	Lower bar under control		
	Wrists stiff		
	Upper arms stationary against torso No forward or outward movement		
	Maintain stationary body position		
	Feet flat on floor		
	Elbows fully extended but not locked		
	Bar remains level		
	No bounce of thighs		
	No forward flexion of torso		
	No extension of knees		
	Return to start position after each repetition		
	Total		

Safety Scale	
	0 = Not safe - Stop movement
	1 = Not safe - Needs teaching points
	2 = Safe - Room for improvement
	3 = Safe - Perfect
Effectiveness Scale	
	0 = Not effective - Stop movement
	1 = Not effective - Needs teaching points
	2 = Effective - Room for improvement
	3 = Effective - Perfect

Participant:_____ Pre_____ Post____

TRICEPS EXTENSION

Lying Barbell Triceps Extension		Safety Score	Effectiveness Score
Start Position	Flat on bench with 5 points of contact		
	Grip - even, closed, pronated		
	Bar above chest, elbows extended and facing toward knees		
	Forearms parallel		
Downward movement	Lower in an arc under control		
	Wrists stiff		
	Upper arms perpendicular to floor		
	Upper arms parallel		
	No movement in shoulder joints		
	Elbow point toward feet not out to sides		
	Bar almost touches head or face		
	Keep 5 point contact		
	Bar remains level		
Upward movement	Raise in a controlled manner by extending elbows		
	No movement in shoulder joints		
	Upper arms and elbows stationary		
	Keep 5 point contact		
	Wrists stiff		
	Upper arms perpendicular to floor		
	Upper arms parallel		
	Elbows extended but not locked		
	Return to start position after every repetition		
	Total		

Safety Scale	
	0 = Not safe - Stop movement
	1 = Not safe - Needs teaching points
	2 = Safe - Room for improvement
	3 = Safe - Perfect
Effectiveness Scale	
	0 = Not effective - Stop movement
	1 = Not effective - Needs teaching points
	2 = Effective - Room for improvement
	3 = Effective - Perfect

Appendix D: Cheat Sheets

BENCH PRESS CHEAT SHEET AND SET/REP GUIDE

1. Equipment:

- Bench with a rack and barbell
- Weight plates and clips (optional)

2. Setup:

FIVE POINTS OF CONTACT

THE GRIP –

- Slightly wider than shoulder width apart.
- Hands placed evenly on bar facing out

3. Unrack the bar with the help of a spotter

4. Down and Up Movements

- Elbows begin and end straight
- Elbows down/up past body
- Forearms perpendicular to floor
- Forearms parallel to each other
- Body stays in 5point contact position

5. Bottom of the Movement

- Bar lightly touches chest around nipple level
- Don't bounce off chest
- Don't rest on chest

GUIDE FOR YOUR PRACTICE:

Week 1:

	Session 1 -sets			Session 2 -sets		
Reps	6	6	6	6	6	6
✔						

Week 2:

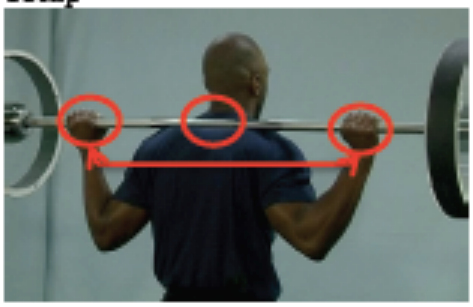
	Session 1 -sets			Session 2 -sets		
Reps	8	8	8	10	10	10
✔						

BACK SQUAT CHEAT SHEET AND SET/REP GUIDE

1. Equipment Needed

- Squat rack with barbell
- Weight plates and clips (optional)

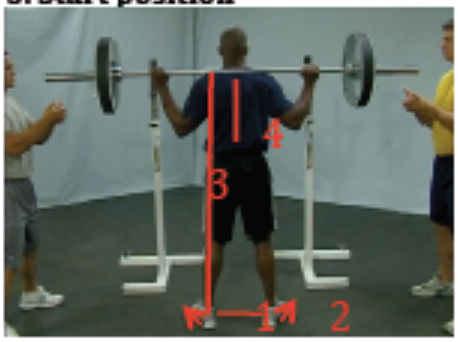
Setup



- Rack bar at chest height
- Middle of bar on base of neck
- Hands evenly placed on bar facing out

2. Unrack the bar with the help of spotters

3. Start position



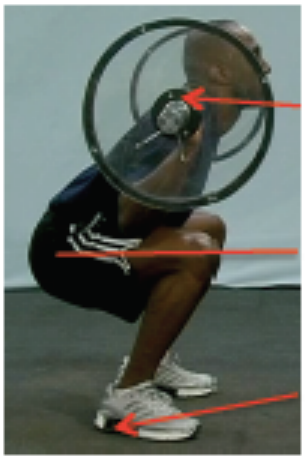
1. Feet between hip and shoulder width
2. Feet turned slightly out
3. Body erect
4. Back flat or slightly arched

4. Down and Up Movements

1. Push hips back and bend knees
2. Back flat or slightly arched. Don't lean forward
3. Weight over middle and heels of feet. Heels don't rise off ground
4. Knees over toes but not in front

5. Bottom of the movement

The bottom of your squat is when one of the following happens:



Back rounds or torso leans forward

Thighs are parallel to the floor

Heels rise off ground

GUIDE FOR YOUR PRACTICE:

Week 1:

	Session 1 -sets			Session 2 -sets		
Reps	6	6	6	6	6	6
✔						

Week 2:

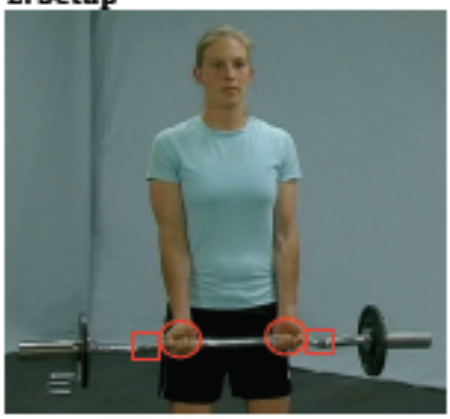
	Session 1 -sets			Session 2 -sets		
Reps	8	8	8	10	10	10
✔						

BICEPS CURL CHEAT SHEET AND SET/REP GUIDE

1. Equipment Needed

- Ez Bar
- Weight plates and clips (optional)

2. Setup



THE GRIP

- Palms facing out.
- Either wide(squares) or narrow(circles)

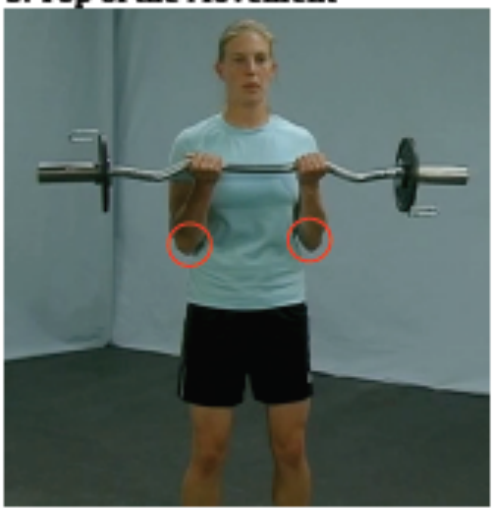
- Elbows straight, touching torso
- Pinkies touching thighs
- Knees slightly bent

3. Lift the bar off the ground

4. Up and Down Movements

- Elbows stay touching sides
- Upper arms don't move throughout movement
- Forearms stay parallel to each other

5. Top of the Movement



- Elbows in contact with body
- Elbows not moving forward
- Bar parallel to the floor

GUIDE FOR YOUR PRACTICE:

Week 1:

	Session 1 -sets			Session 2 -sets		
Reps	6	6	6	6	6	6
✔						

Week 2:

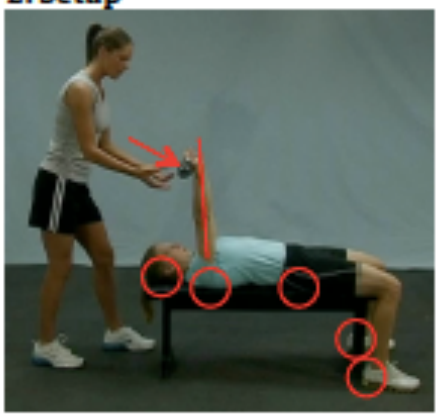
	Session 1 -sets			Session 2 -sets		
Reps	8	8	8	10	10	10
✔						

TRICEPS EXTENSION CHEAT SHEET AND SET/REP GUIDE

1. Equipment Needed

- Bench and Ez Bar
- Weight Plates and clips (optional)

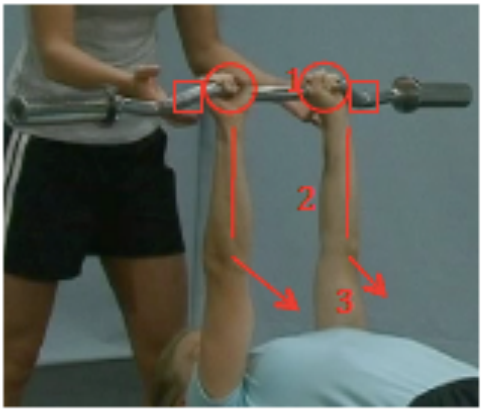
2. Setup



- Establish 5 point body contact position (circles)
- Spotter hands you the bar from behind (arrow)
- Elbows straight with bar above the chest (line)

3. Down and Up Movements

- Bar moves toward then away from head/face
- Upper arms remain perpendicular to the floor
- Shoulders should remain still
- Elbows point toward feet not out to the sides



1. Hands grip bar on either wide (squares) or narrow (circles) grip strips.
2. Forearms are parallel to each other
3. Elbows point toward feet

4. Bottom of Movement

- Bar almost touches face of head
- Remain in 5point body position
- Elbows point toward feet

GUIDE FOR YOUR PRACTICE:

Week 1:

	Session 1 -sets			Session 2 -sets		
Reps	6	6	6	6	6	6
✔						

Week 2:

	Session 1 -sets			Session 2 -sets		
Reps	8	8	8	10	10	10
✔						

Appendix E: Consent Form

Consent Form

Viability of Safely and Effectively Teaching Strength Training with Free Weights Using Online Methods

The researcher in this study is Rebekah Brook, a PhD student in Instructional Design and Technology at Virginia Tech. The study is being overseen by Dr. John Burton, a professor in the School of Education at Virginia Tech.

I. Purpose of this Research Project

We invite you to participate in this research study aimed at investigating if safe and effective movements using free weights can be taught using online methods. Following the data collection and analysis, guidelines (if possible) will be created to aid instructional designers in the field of strength and conditioning in designing programs to distribute to distance learners. This Research study will involve 20-30 participants. These participants will be drawn from students, faculty and staff members from the Blacksburg campus of Virginia Tech.

II. Procedures

After completing the consent form please go to https://virginiatech.qualtrics.com/SE/?SID=SV_24EpiILTXO3CO5D to complete a survey for demographic information collection. You have been assigned to one of four groups. Each group will be assigned two free weight movements. You have been informed of the group you are in and the movements you will be asked to complete. You will be asked to record yourself doing these two movements using a video camera, phone or other device with video capabilities and upload the videos to the website (https://www.online-strength-study.com). Strength and Conditioning staff from the Virginia Tech Athletics Department will evaluate these videos for safety and effectiveness using rubrics developed by the researcher and the strength and conditioning staff. You will then be given two lessons – one for each movement provided through online methods. You will then use cheat sheets to practice the movements two times per week for two weeks. Each session will last around 45 minutes to 1 hour for a total time commitment of 4-5 hours. You will need to have access to the equipment needed – in most cases this will be a gym. After you have has completed the instruction and practice sessions, they will be asked to record themselves again (the same as the initial phase) and upload that to the website. The strength and conditioning staff will also evaluate these final videos. The last thing you will be asked to do is to complete a final survey. This survey can be found at https://virginiatech.qualtrics.com/SE/?SID=SV_a4qeNKNDCaRLY2x

Virginia Tech Institutional Review Board: Project No. 13-885
Approved October 22, 2013 to October 21, 2014

III. Risks:

Due to this research study being physical nature, there is a risk of physical injury. To minimize this risk potential you will be screened for medical issues that will affect you during the study. You are advised to use very light weights – if you have never lifted before you are advised to use the lightest bar available and have a spotter to help you on the first few repetitions. If you have lifted choose a weight that you are able to lift with ease. The instruction in this study is designed to reduce the risk of injury and improve the safety of free weight lifting.
In the event that a participant must seek medical services as a result of participating in this study, neither the Primary Investigators nor the University have funds to pay for such services, and the participant must pay the cost of such services.

IV. Benefits

By participating in this research study you have the potential benefits of learning correct lifting techniques, improved health, and improved strength gains. This research study will also have the potential to have larger societal benefits in that, by creating guidelines for developing instruction for lifting, a large number of people can be reached with safe and effective ways to learn weight lifting.
No promise or guarantee of benefits have been made to encourage you to participate.

☐ Please check this box if you would like to receive a summary of the research results when they are available

V. Extent of Anonymity and Confidentiality

In an effort to provide the utmost confidentiality only the researchers and the strength and conditioning staff will have access to participant information and raw data. To provide additional confidentiality, the strength and conditioning staff will only have access to participant codes and videos. Only the researchers will be able to identify each participant by name. The participant codes will be assigned based on the group. Each group will have a number and a letter code. Additionally each participant in the group will be given a number at the end of the group code, e.g. If participant John Smith is assigned to group 1M. His participant code may be 1M3. You have been assigned your participant code.
Raw data including video and identifying codes will be destroyed at the completion of the data analysis.
It is possible that the Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

Virginia Tech Institutional Review Board: Project No. 13-885
Approved October 22, 2013 to October 21, 2014

VI. Compensation

You will be entered into a lottery to win fitness assessment prizes from Virginia Tech's Recreational Sports Department. These prizes include: Fitness Assessment, BodPod, Functional Movement Screens, and Personal Training Sessions. Depending on the final number of participants, the odds of winning a prize will be between 1 in 2.5 and 1 in 3.75.

VII. Freedom to Withdraw

You are free to withdraw from the study at any time without penalty. If you withdraw you are still eligible to win prizes in the lottery. You are free to choose not to answer any questions in the initial survey. You are also free to complete the instruction and practice when and where you choose.

VIII. Participant's Responsibilities

I voluntarily agree to participate in this study. I have the following responsibilities:

1. To complete each stage of the instruction and practice.
2. To upload initial and final videos in a timely manner.
3. To immediately contact the researcher by email if I have chosen to withdraw from the study.

IX. Participant's Permission

☐ Please check this box if you agree to allow the answers you provided in the screening survey to be used as study data.

I have read the Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent

Signature:_____ Date:_____

Printed Name: _____

Please direct any questions you have about this study to Rebekah Brook. If you feel your questions have not been answered please contact Dr. Burton.
Contact information for Rebekah Brook kiwi1@vt.edu
Contact information for Dr. John Burton jburton@vt.edu

If you should have any questions about the protection of human research participants regarding this study, you may contact David Moore, Chair Virginia Tech Institutional Review Board for the Protection of Human Subjects,
Phone: (540) 231-4991; Email: moored@vt.edu

Virginia Tech Institutional Review Board: Project No. 13-885
Approved October 22, 2013 to October 21, 2014

Appendix F: Example Participant Information Sheet

1. Take Initial Survey – demographic info
   → https://virginiatech.qualtrics.com/SE/?SID=SV_24EpiILTXO3CO5D

2. Movement assignment → Multiple Joint

3. Log on to website:

Participant Code/username: → → 1M11
Password: → → → → → participant87_13

4. Watch movement videos
5. Record yourself doing movements 4-6 reps – front or side view
6. Upload to website – file format is → 1M7_bench-pre
   1M7_squat-pre
7. Take instruction
8. Practice 2x per week for 2 weeks
9. Record yourself doing the movements
10. → Upload to website – file format → 1M7_bench-post
    1M7_squat-post
11. → Take exit survey
    https://virginiatech.qualtrics.com/SE/?SID=SV_a4qeNKNDCaRLY2x

Website – www.online-strength-study.com