ATHABASCA UNIVERSITY

EXAMINING THE OUTCOMES OF MOBILE LEARNING USED TO TRAIN ELITE LEVEL HOCKEY PLAYERS AS MEASURED BY KIRKPATRICK'S EVALUATION MODEL

BY

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A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
DEGREE OF DOCTOR OF EDUCATION IN DISTANCE EDUCATION

CENTRE FOR DISTANCE EDUCATION

ATHABASCA UNIVERSITY
JANUARY, 2015

Approval of Dissertation

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"Examining the Outcomes of Mobile Learning Used to Train Elite Level Hockey Players as Measured by Kirkpatrick's Evaluation Model"

Submitted by

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In partial fulfillment of the requirements for the degree of

Doctor of Education

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Dedication

I dedicate this dissertation to my parents Ken and Joan, without whom I would have never accomplished this feat. My mother and father instilled the values of learning, dedication, commitment and hard work into both myself and my sister throughout our lives. Without these qualities I never could have completed this work. I will be forever grateful.

Acknowledgments

A number of people have their finger prints on this dissertation and I would like to acknowledge their contributions. Most importantly I need to acknowledge and thank Dr. Martha Cleveland-Innes my doctoral supervisor for all her help, support, encouragement, guidance, and for her uncanny sense of knowing what I needed to hear at certain times through the process. I need to acknowledge my doctoral committee for all their help, challenges and guidance, it was exceptional and I feel privileged to have had them as a committee overseeing my work . Dr. Mohammed Ally and Dr. James Eldridge, I was fortunate to have you as committee members besides your help and guidance you challenged me to dig deeper both into myself and into my work, I am most grateful.

I need to acknowledge my son Alex. There have been many times over the years where he had to be understanding and considerate beyond his years. As well, I need to acknowledge a handful of people I worked for over the years who got me started on this journey and in cases supported my ability to carry it through. Wes Yeo, for seeing my potential in learning and education and setting me on the path. Prasad Puttagunta, who supported, encouraged and made sure my work hours were flexible enough to pursue higher education. Chris Shultz, who made pursuing this doctorate a possibility. Without their help and encouragement, this journey would have never begun. I owe you all a great deal of thanks.

Abstract

This is a quantitative study with a quasi-experimental design used to determine the outcomes of mobile learning using the first three levels of Kirkpatrick's evaluation model. A select population of 27 (N=27) elite level junior, college, university, and professional hockey players ages 18 to 26 were provided with access to sport-specific nutritional learning. They accessed the nutritional content via mobile devices over a four-week period. Responses from pre-and post-test, documented the reactions to mobile learning, described changes in nutritional knowledge, changes of behaviour and use of self-regulated learning strategies. In the examination of change in the learner's knowledge level several additional aspects were examined, looking for connections between learning with a mobile device and motivation, relevance, self-efficacy and self regulated learning strategies. Findings demonstrate an overall positive reaction to learning with a mobile device, that significant learning did occur ($p < .001$), and noticeable behaviour change as result of the learning was observed ($p < .05$). The participants perceived level of self-efficacy for learning with a mobile device did not appear to effect their motivation or learning. The relevance of the content for the participants was shown to be an important factor affecting their motivation to pursue the mobile learning. Future research should include more diverse population groups, further the examination of the connections between mobile learning and motivation, self-efficacy, relevance, and the use self-regulated learning strategies by mobile learners.

Key words: mobile learning, Kirkpatrick evaluation, motivation, relevance, self-efficacy, Bloom's taxonomy.

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Definition of Terms

M-learning – mobile learning, i.e., learning that takes place anywhere, anytime, by use of a handheld internet connected technology; for example: smart phones (Apple iPhone, Blackberry Torch, Motorola Android), and tablet PCs (iPad, Playbook).

Motivation – a force, stimulus, or influence that is acting on a person that generates an emotional reaction to move toward something.

Relevance – the more meaningful something is to a person's goals the greater the relevance it has.

Self-Efficacy – is the amount of confidence, or level of belief a person has in feeling they can accomplish something.

Andragogy – a learning theory that relates to adult learning, as was proposed by Malcolm S. Knowles and relies on six assumptions. These assumptions are described in detail in the "Background" section of this paper.

Distance education – learners are separated by time and/or distance from the course content and the teachers.

Learning objectives taxonomy – classification of levels of knowledge

Stream digital – video and/or audio-digital media transmitted over a network with no need to download a file in order to view and/or listen to the content.

Chapter 1: Introduction

Introduction

This chapter will explain the importance of validating mobile learning (m-learning) as a learning delivery method for sports nutrition to university and college elite (varsity) level ice hockey players. The background of m-learning, appropriate instructional design for adult learners, and the relationship of motivation, relevance and self-efficacy will be presented in this chapter followed by a deeper review in chapter two. This chapter will set the foundation related to the problem, purpose, limitations and delimitations of this study.

Background

University and college varsity level hockey players have full-time school studies, and further to these studies they devote a great deal of time toward hockey practices, off-ice training, games and travel. Nutrition is a vital component for them to be able to compete on the ice and in the classroom at or near to their potential (Burke, 2007). None of the colleges or universities in this study had a formal nutrition program for their athletes. The barrier to having a nutrition program, as relayed by each team's head coach was the limited amount of time these athletes have beyond the already extensive commitment they make to both school and hockey. Mobile learning (m-learning) could allow the student athletes to learn about sports nutrition while traveling to and from games, or during other opportune times. This would enable student athletes to accomplish learning sports nutrition at a time they would otherwise not be performing school studies or direct hockey related activities.

Mobile technology is defined simply as mobile computing combined with wireless network access (Alexander, 2004). Mobile learning can be defined as learning that occurs by using wireless mobile technology. Wireless mobile technology provides learners with the ability to access learning materials and information at anytime they choose and from any location they choose (Ally, 2009). Examples of mobile technology are smart phones, tablets, and Personal Digital Assistants (Shih & Mills, 2007). Research on mobile learning is fairly new with the first M-Learn Conference held in Rome during 2004. The concept of m-learning is clearly described by Ally, as follows:

> Mobile learning through the use of wireless mobile technology allows anyone to access information and learning materials from anywhere and at anytime. As a result, learners have control of when they want to learn and from which location they want to learn. Also, all humans have the right to access learning materials and information to improve their quality of life regardless of where they live, their status, and their culture. Mobile learning, through the use of mobile technology, will allow citizens of the world to access learning materials and information from anywhere and at anytime. Learners will not have to wait for a certain time to learn or go to a certain place to learn. With mobile learning, learners will be empowered since they can learn

> whenever and wherever they want. Also, learners do not have to learn what is prescribed to them. They can use the wireless mobile technology for formal and informal learning where they can access additional and personalized learning materials from the Internet or from the host organization (2009, p. 1).

The large scale application of m-learning that Ally (2009) alluded to is that it could be used to provide basic education to people anywhere in the world. The United Nations have stated in their United Nations Decade of Education for Sustainable Development webpage that

> …on 1 January 2005, and extend(ing) to the end of the year 2015… coincides with the Millennium Development Goals which state that by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling and that girls and boys will have equal access to all levels of education (UNDESD, 2005).

From the United Nations Education webpage it is put forth that the United Nations feels "[E]ducation is a powerful tool by which economically and socially marginalized adults and children can lift themselves out of poverty and participate fully as citizens" (UNESCO, 2012). M-learning, therefore, has the potential to play a significant role in addressing this problem. For example, Africa is the second most populace continent in the world. It is emerging from being known as the *dark continent*. For Africa, education is the key to its growth and potential prosperity. It is vital for Africa's continued progress to be able to increase the capacity of its

technology related to education (Butcher, Latchem, Mawoyo, & Levey, 2011). Further research of m-learning will add to the body of knowledge and thereby potentially contribute to mobile learning being applied in some manner as part of the solution to reaching marginalized citizens of the world with basic education.

Traxler (2007) felt the concept of mobile learning is uncertain, whether it can be used for wide scale formal learning, and how it will evolve is undefined. One place where m-learning is growing and evolving is in the workplace. Fifteen per cent of businesses currently use some form of m-learning, ten per cent are developing m-learning, and 40 % are considering its application in their workforce (Wentworth & Green, 2011). In surveying businesses it was found there was a strong correlation between high performing companies and the use of m-learning. Businesses are starting to see the value of having employees being able to learn anywhere, anytime, such as while waiting for a meeting to start, or during business travel (Wentworth et al., 2011). The future of m-learning will continue to grow and evolve with each new study and application.

A few examples of m-learning being successfully applied are found in the following:

- to improve English language pronunciation by those whose first language was not English (Ally & Tin, 2009)
- to teach literature (Shih, et al., 2007)
- to provide medical training in rural locations (Vyas, Albright, Walker, & Zachariah, 2010)

- for instruction in an undergraduate course in Information and Communication Technologies (McCombs, 2010).

Conversely, some other studies applying m-learning have not found success. Two such examples of unsuccessful m-learning interventions are: teaching high school math (Roberts & Vänskä, 2011), and teaching high school vocabulary (Redd, 2011). As m-learning continues to grow and evolve it needs to be examined to understand why and how it has been successful. Of equal importance this examination process will lead to understanding of why and how, when m-learning has been unsuccessful. This greater understanding of m-learning will come from performing evaluations of m-learning applications.

Conceptual Underpinnings of the Study

In order to gain a better understanding of mobile learning, this study has applied Kirkpatrick's four level model of evaluation (Kirkpatrick, 1959a; 1959b; 1960a; 1960b; 1998). Kirkpatrick's evaluation model has been used extensively over a number of decades to evaluate various learning programs. This study replicates the approach used in many of these studies, for example the dissertations of Chang (2010), Orlando (2009), and Wittenborn (2008). Kirkpatrick developed an evaluation model to evaluate the effectiveness of learning programs in achieving their intended outcomes. His evaluation model consists of four levels, as follows: a) reaction, b) learning, c) behavior, and d) results (Kirkpatrick, 1959a; 1959b; 1960a; 1960b; 1998). Each level's evaluation has an impact on the next and the levels become increasingly more difficult to measure as the evaluation process progresses (Kirkpatrick, 1998). Level one evaluates reaction as a measure of the participant's reaction to everything

about the learning intervention (Kirkpatrick, 1959a; Kirkpatrick, 1998). Level two evaluates learning as a measure of how much change resulted from the learning intervention to the participant's knowledge level, skill level, and/or if a change in attitude resulted (Kirkpatrick, 1959b; Kirkpatrick, 1998). Level three evaluates the extent to which a person's behavior changed as a result of the learning intervention (Kirkpatrick, 1960a; Kirkpatrick, 1998). Level four evaluates results, i.e., a measure of the positive benefits that came about as a result of the learning intervention (Kirkpatrick, 1960b; Kirkpatrick, 1998). The evaluation model has been applied to a learning intervention consisting of sports nutritional content delivered via mobile computing devices.

The m-learning in this study is designed for adult learners. Having the adults be successful in learning the nutritional content is central to this study. Knowles, Holton, & Swanson (2005) studied adult learners and posed several characteristics about adult learners. These characteristics involve relevance, motivation, experience, and autonomy. The adult learning theory proposed by Knowles et al. (2005) is examined to see how it can be applied to the m-learning instructional design used to develop the nutritional content. Complimenting Knowles et al. (2005) adult learning theory is a study by Hannafin, Hannafin, and Grabbitas (2009) who studied student-centered web-based learning, many of their findings overlap with Knowles et al. (2005) work, but in addition they found greater student involvement in the learning to be beneficial. Active student participation in the m-learning for this study will be discussed.

The Attention, Relevance, Confidence, Satisfaction (ARCS) model of Keller (1987) is examined. The aspects of Relevance and Confidence are directly related to questions asked in this study. The concept of Attention in learning design is based upon the idea of immediately grabbing the learner's interest and attention. By doing so the learner's motivation is increased leading to a more successful learning experience. The concept of gaining the learner's attention initially is considered for incorporation into the m-learning instructional design.

Kirkpatrick's model evaluates behavior change that occurs as a result of learning. Before a person changes his/her behaviour they must make a decision to change, this decision is born out of new found knowledge (Brehm, 2004). Initially a person will recognize that they may be better off with a change, as a result they weigh the pros and cons. Both pros and cons can come from new found knowledge. If the pros outweigh the cons then the person will start to make up strategies for making the change (Brehm, 2004). Behaviour change and its relationship to knowledge, self-efficacy, and relevance will be examined further in chapter two.

The intent of this study was to have the participants learn about nutrition and, based on that knowledge, make better nutritional choices, as opposed to the participants being given nutritional changes to make, and then blindly following the pre-made decisions of an expert. The latter might result in better nutrition, but not a deeper understanding of *why* by the participant. Using Kirkpatrick's evaluation model allows for the examination of the content and learning objectives prior to the learning intervention being undertaken. This increases the possibility that the learning will be of sufficient depth, resulting in the participants' acquisition of knowledge to make

nutritional judgments and decisions based on criteria, which then would enable the potential for behavior change.

Learning enabled through mobile technology has not been evaluated against cognitive domain educational objectives expressed in well-known taxonomies. As a result, it is unknown if m-learning has resulted in complex levels of learning as described by the taxonomies of Bloom, Engelhart, Furst, Hill, & Krathwohl (1956), Krathwohl (2002), and Quellmalz, (1987). In order to assess depth of learning, Bloom et al. (1956) developed a taxonomy of educational objectives for the cognitive domain (Appendix A). Krathwohl (2002) revised the Bloom et al. (1956) taxonomy (Appendix B) from the original taxonomy that focused on six main categories, each of which contained sub categories. Krathwohl's (2002) revised version focused more on the sub-categories, which then more clearly describe the main categories. The Quellmalz Framework (Appendix C), (Quellmalz, 1987), is a modified version of the Bloom et al. (1956) original taxonomy. This educational objective taxonomy is similar to Bloom’s except this taxonomy only has five levels. All of these taxonomies allow for determining the degree to which a particular learning objective is learned and can be evaluated in terms of its depth or complexity to master. This study attempts to take the topic of sports nutrition, deliver it via m-learning, with learning objectives that reside at the complex learning level. In order for behavior change to occur, the learning will have to have been at the complex levels; as defined by the cognitive domain educational objectives stated in the aforementioned taxonomies. For example an athlete will learn what types of nutritional content they need to consume and at what times relative to exercise, beyond these facts, they will need to determine from their

available options which of those choices will provide them with those nutritional needs. Behavior change from simply recalling the facts will not be enough, as the content does not contain these type of simple facts.

In order to achieve these learning objectives, the learning processes must be well planned, fit for purpose, and be properly organized. The study examines the work on instructional approaches used in successful m-learning. For example, McCombs (2010) applied the use of podcasts for m-learning delivery involving 1,345 university students. Obstacles, difficulties and solutions encountered by others in designing and delivering m-learning are considered. Rekkedal and Dye (2007) found students taking an m-learning course had trouble viewing the course on the small screen of their mobile devices. These issues are reviewed in depth in chapter two with the intent of eliminating problems with the instructional design used for the m-learning in this study.

Statement of the Problem

After an extensive literature review the author could find no studies on m-learning that have applied Kirkpatrick's evaluation model. Using this model will provide valuable feedback on learner reactions to this type of learning method and on the use of the mobile technology used. It is important determine that knowledge was gained from m-learning, and that it resulted in a new behaviour as a result. Some feel no learning has occurred unless there is a resulting behavior change (Kirkpatrick, 1998). This comment is supported by Siemens (2005) who defines learning as "gaining actionable knowledge". The action would represent the behaviour resulting from the learning. It is therefore important to not only determine that knowledge was

gained from m-learning but that it resulted in a new behaviour, or actionable knowledge that could be applied by the learner as a result. Kirkpatrick's evaluation model provides feedback on learning (gained actionable knowledge) and the application of the new knowledge (new behaviour or change in behavior). This is vital to understanding the success or the non-success of learning - and in this case, will be applied to m-learning. Once the learning has been determined to have occurred in the study, evidence of resulting behavior change can be examined to measure whether or not it resulted from the gaining of knowledge from the m-learning.

Learner motivation is a key theme in studies involving m-learning. Vyas et al. (2010) noted that eager staff were instrumental in getting the m-learning program going. Redd (2011) observed low participation with m-learning by many students, and attributed this to lack of teacher supervision and admonition. Roberts et al. (2011) observed teachers who were able to encourage their students in the process were more successful with m-learning. Motivation, relevance, and self-efficacy all play an integral role in learning (Keller, 1987; Knowles, Holton, & Swanson, 2005). Using the measurements from Kirkpatrick's model, motivation , self-efficacy, relevance, and the use of self-regulated learning strategies are given a cursory examination. This examination's focus is to probe for connections, if any, between these elements and learning with a mobile device. The researcher searched well known education research data bases and found very little research in the specific area of m-learning and motivation. This study's brief examination of some aspects of this area are intended to help lead to more specific research in this area, as many research papers indicate mobile learning could be more successful with a better understanding of how

motivation relates to learning with a mobile device. Redd (2011); Roberts, (2011); and Vyas, (2010) are examples of such studies. Ciampa (2014) study on mobile learning and motivation, found it is important to understand how a mobile device can be used to enhance learner motivation. Ciampa found that challenge, curiosity, control, recognition, competition and cooperation can enhance learner motivation when using a mobile device to learn. The key, is how to exploit the mobile device to enhance these elements. Recognizing connections between mobile learning, motivation, self-efficacy, relevance, and the type and degree of use of self-regulated learning strategies, will help to better understand how to enhance mobile learner motivation.

Given that there has been successful and unsuccessful studies completed on m-learning, it is important that the m-learning in this study be validated with an appropriate evaluation method. It is important to know if positive reactions to learning, and behavior changes or lack thereof was due to using a mobile device or other factors, and what role did motivation, relevance and self efficacy play in the m-learning. The problem this study faced, was that an m-learning course has not been developed, applied, and formally evaluated with Kirkpatrick's evaluation model. Little research has examined motivation, relevance, self efficacy and the use of self-regulated learning strategies in m-learning.

Purpose of the Study

This is a quantitative, quasi-experimental design study that uses Kirkpatrick's evaluation model to examine learner reactions, learning, and behavior change resulting from m-learning. Four research questions are posed;

1. What will the learner's reaction be to learning with mobile devices, as measured by Kirkpatrick's evaluation model (level one)?
2. Can m-learning result in knowledge gain as measured by Kirkpatrick's evaluation model (level two)?
3. Can m-learning result in behaviour change as measured by Kirkpatrick's evaluation model (level three)?
4. Are there connections between learning with a mobile device and motivation**,** self efficacy, relevance, and the use of self-regulated learning strategies?

Limitation and Delimitations

According to Thomas, Nelson and Silverman, "Limitations are possible shortcomings or influences that either cannot be controlled or are the result of the delimitations imposed by the investigator" (2005, p. 58). Delimitations are described as "limitations imposed by the researcher in the scope of the study: a choice the researcher makes to define a workable research problem" (Thomas, et al., 2005, p. 58). There are numerous delimitations and limitations to this study. An assumption of the study is that the delimitations and limitations present will not have a large enough effect to skew the results to the point that they are not of value. Delimitations of this study have been identified as: (a) The relatively small number of participants involved, as the number of participants is 27, a larger sample size would provide more validity and reliability to the study; (b) Only the sport of ice hockey is being considered, with participants from essentially the same environments, (c) Behaviour change is only being assessed following the m-learning intervention, whereas a

greater length of time would result in greater validity and reliability; (d) The participants only cover a narrow range of ages, (i.e., the participants are young adults between the ages 18 and 24); and, (e) Only athletes are being considered as there are no non-athletes participants in the study.

Limitations are a weaknesses of a study that cannot be controlled (Thomas et al., 2005). Limitations in this study are the participants who may have varying knowledge levels and experience with the use of mobile technology. As well, there will be varying degrees of interest in the m-learning topic of nutrition amongst the participants and this may have an effect on their motivation to learn and to apply what they do learn.

Summary

This chapter defines m-learning as learning using wireless mobile computing technology, allowing people to learn anytime and anywhere. M-learning is becoming firmly entrenched in the business world of learning and m-learning has been shown to have the ability to reach masses of people who currently do not have access to basic education. It needs to be demonstrated that m-learning can be successful in delivering complex learning objectives. It needs to be better understood as to what the connections are between m-learning and motivation, self-efficacy, relevance and self-regulated learning strategies. This study delivered training designed to result in complex learning objectives in the area of sports nutrition via an m-learning intervention. Kirkpatrick's evaluation model was applied to measure if learning occurred, if behavior changed resulted from the learning and what the participant's reactions were specific to the use of mobile technology, and of the learning content.

Motivation, self-efficacy, relevance and the use of self-regulated learning strategies were examined relative to the measure of the learning, to look for connections to m-learning.

Chapter 2: Literature Review

Background

This literature review begins with an examination of Kirkpatrick's four level evaluation model for learning programs, then proceeds to consider previous m-learning studies for efforts that were successful and for those that were unsuccessful. Success in this discussion is defined as learner's achieving their goals as a result of gaining and applying new knowledge. Findings in these studies suggest that motivation is a factor for the success and for the lack of success, and that relevance and self- efficacy are related to motivation and play a role in successful learning. Learning will be defined for this study, and learning taxonomies will be considered for judging the depth of learning.

Student learning strategies are considered in reference to m-learning. Once an understanding of the components of m-learning are reviewed, this section examines what behavior change is and how it occurs. In the review, it will be articulated how each of these elements relate to this study and Kirkpatrick's evaluation model. The instructional approach along with a brief overview of the nutritional content is presented along with technological obstacles to quality m-learning.

Kirkpatrick's Evaluation Model

As stated by Kirkpatrick (1998), an evaluation on a learning program should be done to determine its effectiveness. Effectiveness of learning is defined as the degree to which the learning program contributes to learner success. Considerable forethought and planning should be put into the development of a learning program to begin with, in order to have as an effective program as possible from the outset,

starting with the planning and implementing stages, during which the following factors should be considered:

1. A learning needs analysis.
2. A definition of learning objectives.
3. What should be included in the learning content.
4. Determine who the target audience will be.
5. Consider what schedule will work best, and how the use of technology can be used advantageously to make scheduling of learning more flexible.
6. The best choice for instructors/facilitators.
7. Selection of learning aids, and technology to be used.
8. Administration aspects of coordinating the program.
9. Evaluation of the program.

For a learning program to be effective it must meet the needs of the learners. There are several ways to determine the learning needs. One of these methods or a combination of the methods could be used: (a) the students to be used could be surveyed, (b) the students' superiors could provide what they see as the needs, or (c) others who are very familiar with the needs of the students could provide input. Testing, or some type of performance analysis, could be performed to determine the gaps that a learning program could fill (Kirkpatrick, 1998).

This study uses an inventory which assesses the knowledge, skills and attitude required (Kirkpatrick, 1998). The resulting inventory for this study focused on the knowledge elite ice hockey athletes need in the area of nutrition to be nutritionally prepared for practice and competition throughout a season. The learning is designed to

meet these determined needs. The analysis and inventory were created by a baccalaureate-prepared registered dietician who holds a degree in nutrition, and her staff, who have the same qualifications and varying degrees of experience. This team acts as nutritional consultants to a National Hockey League (NHL) team. The researcher provided the educational inventory framework while the team of dieticians provided the nutritional knowledge required to fill the learning inventory gaps.

Learning objectives are established once the needs of the learners have been ascertained. The objectives are set to handle three aspects of learning (Kirkpatrick, 1998). First —what knowledge, skills, and/or attitudes do the students need to acquire? Next—what results are expected from the learning? (In this study, players with a better of understanding of what, how much and when to drink and eat.). Lastly—what are the results that the learning is expected to produce? In this study, the results of the behavior change would result in better choices of beverages to drink, better timing of fluid intake, and in general, better overall nutritional choices.

The subject content is designed to meet the learning objectives. Subsequently, the learning content will determine what topics should be covered. Knowing the topics and the depth in which they need to be covered guides the level of qualifications required by the presenter/instructor (Kirkpatrick, 1998). For the purposes of this study, it was determined degree-holding registered dieticians with experience at the elite level of ice hockey would be required.

Kirkpatrick (1998) discusses four elements regarding the selection of participants:

1) Who could benefit from the learning?

2) Is the course required by law?

3) Is this learning that should be compulsory, or voluntary?

4) Is there a need to segregate students for any reason?

In considering these elements for this study, all the participants were recruited on a voluntary basis as dictated by ethics for this type of research. The learning is not required by law. The participants were segregated by gender as one part of the nutritional content deals strictly with female athletes. The target audience for this study are elite level ice hockey players the content has been specifically designed for them. Having the content specifically designed for this target audience will result in the participants benefiting from the learning.

In determining the best schedule for delivering the training Kirkpatrick (1998) identifies three concerns to take into consideration: (a) a schedule that is the best for the teacher, (b) a schedule that best suits the students and (c) what are the best conditions for learning. He further identifies a preference for spreading a course out over time to provide maximum flexibility for everyone involved in the learning (1998). Using mobile technology allows everyone involved to take the learning or support the learning in an environment they feel is best for them. This meets Kirkpatrick's requirement for creating the best conditions for learning.

An important decision regarding conditions for learning is the selection of the learning facility. The learning environment should be convenient and comfortable for the learners. The furniture should be comfortable, the room an adequate size, the room temperature comfortable, and noise and other distractions minimized. There should be adequate breaks, and there should be access to food and beverages for the students;

choices that the students desire (Kirkpatrick, 1998). By using mobile technology as the delivery method, all these concerns can be individually addressed by the participants to meet their specific requirements.

Selecting the appropriate instructors is critical to the success of the learning program. The instructors need to be good communicators, be motivated to teach, and be knowledgeable of the subject matter. The instructors should have a desire to meet the learners' needs and have a genuine desire to want to help the students (Kirkpatrick, 1998). In this study, the instructors will be registered dieticians who are very knowledgeable of the content and who have made careers out of helping people learn more about nutrition. The researcher will provide coaching on delivery of the content and will provide the instructional design.

Audiovisual aids should be used to communicate and maintain interest. They can be used to create interest and entertain as well. An entire learning program can be an audiovisual package (Kirkpatrick, 1998). This study will use this type of approach.

Kirkpatrick (1998) describes how the coordination of the administrative aspects should be handled. These considerations will be covered in the methodology section. The following paragraphs discuss Kirkpatrick's final factor in the planning and implementation stage—the evaluation.

Kirkpatrick developed his evaluation model to evaluate training programs (1959a; 1959b; 1960a; 1960b; 1998). Kirkpatrick's evaluation method uses four levels to evaluate the effectiveness of learning programs, labeled as reaction, learning, behavior, and results. Each level's evaluation has an influence on the next and the

levels become increasingly more difficult to measure as the evaluation process progresses up through them (Kirkpatrick, 1998).

Level one, which evaluates reaction, is a measure of the participant's reaction to everything about the learning intervention. Reaction feedback is important as it provides comments and suggestions for improving the learning. It sends the message to the learners that the instructors care and desire feedback to help them better. It can provide data showing learner satisfaction with the content and delivery. The data from the reactions can be used to set standards for how well future learning should be received. The reaction feedback is typically gathered via survey sheets shortly after the learning program concludes (Kirkpatrick, 1959a; Kirkpatrick, 1998). Kirkpatrick (1998) provides the following considerations for reaction surveys:

1. Determine what it is you want to find out to focus your questions.
2. Design a survey form that will quantify the results you seek.
3. Encourage written feedback (comments and suggestions).
4. It is best to have the participants complete their reaction survey form immediately at the end of the course.
5. It is best to get a 100% participation rate, versus sampling.
6. It helps to keep reaction surveys anonymous to promote honest feedback.
7. Use the results to improve the program.

Level two evaluates learning, which is a measure of how much of a change resulted from the learning objectives to the participant's knowledge level, his or her skill level and/or if a change in attitude resulted. In level three no change in behavior can be expected if none of the learning objectives were reached. This is why it is

important to measure learning first and then the behavior (Kirkpatrick, 1959b; Kirkpatrick, 1998). Kirkpatrick (1998) provides the following considerations for measuring learning:

1. Determine if it is practical to use a control group.
2. Use before and after tests to measure learning.
3. Use a written type test to assess knowledge and/or attitude change.
4. Use a performance test to measure skill change.
5. It is best to get a 100% participation rate, versus sampling.
6. Use the results to improve the program.

Level three evaluates the extent to which a person's behavior changed as a result of the learning intervention. The behavior change or *the taking action* as a result of the learning is the important outcome of a learning program. It is important not to skip level one and two evaluations and jump directly to a level three evaluation. The participants may have positive reactions to the learning and they may have gained a great deal of knowledge. However a learner's behavior may not change as a result of barriers in the situation where he or she would be expected to apply the learning. For example, a coach forbids drinking a particular fluid after games, but the athlete learned and knows that that fluid is good to drink after games. As a result the athlete did learn, but a barrier prevents them from changing their behavior to match their new knowledge. It is important to know where to focus an investigation should the behavior change not occur (Kirkpatrick, 1960a; Kirkpatrick, 1998). Kirkpatrick (1998) provides the flowing considerations for measuring behavior change:

1. If it is practical use a control group.

2. Test for behavior change before and after the learning.
3. Allow time for the change.
4. Interview and/or survey those in a position to observe the change.
5. It is best to get a 100 % participation rate, versus sampling.

Level four evaluates results, identified as a measure of the positive benefits that came about as a result of the learning intervention. A level four evaluation is the most difficult of the four levels to measure. It is not easy to determine the tangible benefits of a learning program, because in many cases evidence cannot be determined that can be accepted as hard proof (Kirkpatrick, 1960b; Kirkpatrick, 1998). Kirkpatrick (1998) provides the following considerations for measuring results:

1. If it is practical use a control group.
2. Allow for enough time for the results to show.
3. If practical, measure before and after.
4. If proof doesn't exist, be satisfied with just evidence.

Kirkpatrick (1998) says level four of his evaluation model is the most difficult to measure, and that the practitioner may need to accept evidence to support the claim the learning was responsible for an improvement, as proof may not be possible to obtain. Stokking (1996) agrees, saying that getting quality level four measurement is difficult as learning is not the only relevant causal factor. Pasquale (2009) states the reaction level cannot take into account all the variables that influence the end results. This would almost certainly be the case in this study as so many factors have a direct and indirect influence on the performance of a hockey player and on the team. There is no way of knowing what effects daily on-ice practice are having, or the

psychological effects of the team's performance to date, nor how personal relationships are affecting morale, or how subtle changes that may have occurred with respect to sleep patterns or off-ice training have influenced matters, and so on. As such, this study will not attempt the level four evaluation measurement.

M-learning Studies

A successful m-learning study was conducted by Ally et al. (2009) in which the researchers used cell phones to help people whose first language was not English to help improve their English pronunciation. The students from Alberta, Canada, liked being able to use the m-learning anytime and anywhere, for example, while commuting to work. The students gave very favourable feedback on being able to learn using the audio combined with video. The lessons could have just as easily been done using a computer, but the students found the advantage was being able to complete two tasks simultaneously, namely, be in the process of commuting, or simply being somewhere without computer access but having the time to learn; m-learning enabled that *anywhere* learning ability. The *anytime* component is equally important, as it provided the access to the correct pronunciation whenever and wherever the student wanted to access that information. The study left the impression that the students were eager and motivated to improve their English pronunciation skills. While this one study was quite successful in achieving its learning outcomes, it did have motivated students who were immersed in English language in their communities. The success of this study demonstrates the possible potential of m-learning.

Tufts University in the United States and Christian Medical College (CMC) in India collaborated in an educational endeavor whereby existing e-learning was adapted for use with mobile phones. This was done to enhance medical training for diverse and remote medical locations across India. The developed m-learning content consisted of down-loadable materials, interactive cases, diagnostic images, and video, lectures, quizzes, and a discussion tool. The m-learning development focused on four keys (Vyas et al., 2010):

1. M-learning was to complement paper based materials.
2. M-learning was to initiate online discussion about real cases related to the m-learning.
3. It would help to build and support networking among peers and the faculty.
4. It would provide online guidance for QI projects.

Vyas et al., noted that "the team successfully met its key goals to enhance clinical training at remote training sites using mobile technology" (2010, p. 219). The observation made by Vyas et al. (2010) was that it was the eager faculty who were the early users. In this case keen (motivated) faculty got the program moving.

Redd (2011) explored using mobile devices (iPads) to determine if the vocabulary of high school students could be improved. Gaming theory was studied and applied in building a gaming application (app) to teach vocabulary via the mobile technology. Students played the gaming app on their iPads, then their vocabulary was assessed by pre-test and post-test techniques. The gaming app was geared toward improving vocabulary based around the 250 most common words used in SAT tests. Redd (2011) found that student motivation is a major consideration in using mobile

learning. The students were out of the classroom with no supervision. As a result, a large number of students spent little time using the gaming app on the mobile device, which may explain why many of the students showed no improvement in the post test vocabulary results. Redd (2011) did find the students all liked the m-learning approach with its anytime and anyplace flexibility.

Learner Motivation

Ally et al. (2009) seemingly had motivated students, Vyas's eager students got the others on board (2010), and in Redd's study, motivation was clearly an issue (2011). Student motivation appears to be an important factor to be considered in an m-learning course. For this reason, motivation needs to be further examined for this study involving mobile learning. In this study the students are adults (18 to 26 years of age). In the sixth edition of Knowles, Holton III, and Swanson's book *The Adult Learner* (2005), the authors explain the theory of adult learning, which Knowles referred to as *andragogy* in his book *The Adult Learner: A Neglected Species* (1978*).* From the theory, the authors describe characteristics of adult learners, and explain how to enable and support adult learners. The basis for the andragogy learning theory rests on six assumptions of adult learners, paraphrased from Knowles et al. (2005).

1. The need to know — adult learners need to know why they need to learn something before undertaking to learn it.
2. Learner self-concept —adults need to be responsible for their own decisions and to be treated as capable of self-direction.
3. Role of learners' experience —adult learners have a variety of experiences in life, which represent the richest resource for learning.

These experiences are however imbued with bias and presupposition.

4. Readiness to learn —adults are ready to learn those things they need to know in order to cope effectively with life situations.
5. Orientation to learning —adults are life-centered (or task-centered or problem-centered) toward learning. Adults are motivated to learn in order to perform tasks or deal with problems or situations in their life.
6. Motivation —while adults do respond to some external (extrinsic) motivators such as higher pay, job promotion, a better job, the most powerful motivators for adults are intrinsic or internal pressures such as better quality of life, increased job satisfaction, and higher self-esteem.

For learning objectives to be effective, adult learners need to determine their own learning objectives, such that the learning objectives will then be relevant to their self-determined needs. Adult learners prefer to be self-directed in learning. Knowles, et al., (2005) believe children progressively move toward self-directedness in their learning as they age and mature. The authors provide direction for engaging, motivating, implementing, and evaluating when teaching adults. Knowles (1989) foresaw technology as being beneficial in supporting self-directed learning, where it could provide just-in-time learning, with the learner being in complete control. The book points out that evidence is growing which supports that when adults are self-directed in learning, the learning is deeper and more permanent than when adults learn by being directed by another person.

The student-centred approach is consistent with Knowles' adult learning theory. Hannafin, Hannafin, and Gabbitas (2009) studied student-centered web-based

learning. The authors noted that in student-centered learning, learners take on the responsibility of setting their learning goals and tracking their progress, as well as for making changes and adapting those goals as needed. The learners make the determination for when their goals are met. Using the internet can be a challenge for self-directed learning, as learners must be able to identify which resources to use and then how to assemble and manage them to support their specific learning goals. The authors found that the cognitive demands of student-centered learning change from primarily selecting, processing, and encoding in directed learning, to anticipating, seeking, and assessing significance, as it relates to their individual and evolving goals. Often students are unable to formulate theories or adequate explanations to enact meta-cognitive processes to produce a coherent evidence-based explanation for their problem. Thus, in self-directed, web-based learning, it is important that the student have effective support. The authors did not advocate either student-centered or direct instruction approaches; more so, they identified where differences existed. For instance, they referred to a study by Eveland and Dunwoody (2004) where when performance of two groups was studied— student performance using websites with different hyper-linking, and students using a paper-based format—the paper-based group out-performed the two web-based groups. This suggested hyper-linking may increase the cognitive load. Being able to manage the cognitive load is essential for effective learning. In the conclusion of the article, Hannafin et al. (2009) state web-based and student-centered learning have gained considerable momentum. A key learning from this research is the instructional design needs to ensure distance learners have effective support. For this study, social networking software was provided for

the participants, this gave them quick and easy access to their peers, nutritional expertise and the researcher for any support they required.

Mickelson, Kaplan, and MacNeily (2009) created a student-centered curriculum that resulted in an active learning outcome. As a result of a mandate from the Royal Canadian College of Physicians and Surgeons, the University of British Columbia (UBC), urologic curriculum needed to be changed. A curriculum committee was formed and compromised of three final year resident students and the program director. The committee shifted from the traditional active-teacher passive-student approach, to a more student-centered learning approach for the new curriculum. Weekly topics for learning were chosen with a resident expert appointed to lead the week's article reviews and discussions. Third to fifth year residents were responsible for delivering different topics on the curriculum to their fellow residents and had the responsibility for testing the others on the topic. For certain CanMED competencies that were required to be addressed, for example, the financial planning competency which is part of the physician manager component, guest speakers were brought in for these topics. Observations the authors had on the new approach were that the resident students supported the curriculum and that they took ownership. The residents presented material that they wanted to learn more about and became experts in it. It was observed that there was a shift in the learning to the students adopting an active learning approach to the new curriculum. Active learning was defined as a meta-cognitive process, the ability of the learner to monitor his or her current levels of understanding, and develop an idea of how they learn. During active learning, students take responsibility for their learning. In conclusion, the shift in pedagogy from an

approach of having an active teacher and passive students to a constructivist approach of having the curriculum student-centered led to the unforeseen creation of an active learning environment, which proved to be positive, with student satisfaction and buy-in. The active learning produced a successful outcome, resulting in deep learning, motivated learners, and a student (resident) directed curriculum. This m-learning for this study was designed as student-centered learning and the meta-cognitive learning strategies used by the learners is examined.

Shih et al. (2007) introduced m-learning into an established literature class. The researchers were interested to find out how mobile technologies influence teaching and learning in a traditional education setting. They created a model for instruction that brought m-learning into a traditional literature class. They evaluated the students' learning and considered the benefits and challenges of using m-learning in this situation. Their research showed mobile learning with its 24/7 access and its capacity to allow the learner to learn "anywhere anytime" can support independent and collaborative learning. Mobile learning helps students to recognize areas where they need help and it helps to reduce the formality from the class atmosphere. The increased awareness of the students coupled with the reduced formality helps to engage the reluctant learner. Most significantly, Shih et al. found that mobile learning helps learners stay engaged in the learning for longer periods of time, and mobile learning helps to raise students' self-esteem and self-confidence (2007).

Keller (1987) developed and applied the Attention, Relevance, Confidence and Satisfaction (ARCS) model of motivation for instructional design. The ARCS model provides a method for improving the motivation of students through instruction

and the way instructional materials are developed. The model is grounded in expectancy value theory, which works on the principle that people are motivated to engage in an activity if they perceive that it will satisfy a need they have, and that the expectation is that the activity will be successful in being able to fulfill the need. The model is made up of four conceptual areas, paraphrased from Keller (1987).

1. Attention – Is part of what makes up motivation, and is a prerequisite for learning. Gaining a student's attention is the first part, the more difficult aspect is having it sustained, and focused on the appropriate stimuli.
2. Relevance – One way of having instruction relevant is having it relate to a problem or potential problem in a learners life. If the material is perceived as having little or no relevant use for the student, then the instructional design must provide relevance. For example, students with a high need for affiliation will enjoy working in groups with other students; this makes the learning relevant to their social needs.
3. Confidence – Confidence has an effect on a student's persistence to accomplish a challenging task. Confident people see ability and effort leading to success, whereas people with low confidence see luck or difficulty as being the determining factors in success. People with low confidence have an ego influence where they need to impress others, therefore, that makes them fear failing, rather than simply being focused on working towards success. The students need to feel that if they work reasonably hard at learning a topic that they will be successful in learning it.

4. Satisfaction – This is the positive, good feeling people have when they accomplish something. According to reinforcement theory people will be motivated if a task and reward are known. It's important that the reward is not controlled by the teacher, but is within the control of the student.

In this paper Keller describes a process for applying the model. The model was applied in two separate situations with middle school students. The two field studies showed positive results. This dissertation on m-learning focuses on understanding more about the relevance and confidence (self-efficacy) aspects of successful m-learning.

In constructing their model, Shih et al. (2007) followed Keller's ARCS model of motivational design. The first phase of the ARCS model is to create interest within the learners. The second phase is to demonstrate how the learning will be of relevance to the learners. The third phase creates a situation where the learners can gain confidence with the learning, and the fourth and final phase provides a situation where the learners can apply their new learning in a real or simulated situation. Keller (1987) found learning following the ACRS model produces true satisfaction within the learner. The experiment by Shih et al. (2007) was conducted at California State University with 46 students. The students were allowed to access the course contents at their Moodle website using smart phones. Further to this, learning notifications were sent by text messages. The students were able to join other students in online discussions, and learning activities were completed electronically. The aim of this experiment was to give students the added convenience and flexibility in completing the course requirements.

Subsequently, Shih and Mills (2007) adapted the ARCS learning model to mobile technology in order to create Shih's Mobile Learning Model. For the attention aspect of Keller's model, Shih and Mills (2007) sent a multimedia message to the students' mobile phones to act as a reminder and motivate the students. For the relevance aspect, the researchers then sent a message containing embedded hyperlinks with related information. They added a combination step where both the relevance and the confidence aspects were addressed, incorporating peer-to-peer discussion using text, voice, images, and video. The learners then produced a digital story, telling in either audio or a video format. (This step reflects Keller's Confidence aspect.) Lastly, for the satisfaction component of Keller's Model, Shih and Mills had the students apply their learning in an online simulated environment; for example, an educational game. A summary of the findings by Shih and Mills (2007) include the following:

- the students appreciated the added flexibility that m-learning provided;
- students had higher levels of motivation;
- there was an improvement in the interaction between students and with the instructor;
- students found this type of instruction attractive;
- the students were more willing to collaborate; and,
- the quality of learning was determined to be as good as or better than the traditional face-to-face classroom delivery of the course.

Shih and Mills (2007) also felt that Vygotsky's (1978) cognitive development theory fit well with m-learning. Vygotsky (1978) describes what he calls the "zone of proximal development". This represents the area between the current level of

development a child is at and the level of development a child is capable of being at if his or her developing cognitive functions are brought out with the aid of an adult or more advanced peer. This jump in development can only be made possible through interaction with others more developed. M-learning allows this connection for a learner to be connected to a person more developed in the specific area, which, according to Vygotsky (1978), would enable them to learn more than they otherwise could on their own. While this connection to other more capable people can be the case for other types of learning, with m-learning the connection can be made anywhere anytime, thereby enhancing the learner's ability. Specific to this dissertation's quasi-experimental study, some learners will be more advanced in the knowledge of nutrition than others. While this is a limitation of the study, it also allows for the others to learn quickly and catch up the knowledge of others as a result of the "zone of proximal development." The learning will occur between and among athlete peers, through personal interaction and through the social networking software used for learner support.

Lin and Gregor (2006) looked at websites designed for learning and enjoyment. The researchers chose to examine museum websites. The websites chosen were created to support the museum's mission of providing the public with educational material for study and enjoyment. These websites are designed not as part of any formal education undertaking, but rather to provide enjoyment to the user while learning. This exploratory study conducted a number of semi-structured interviews with both museum and educational experts. The interviews lasted on average 1.5 hours. The major questions asked are summarized as follows:

1. What have been your experiences with e-learning websites in your organization?
2. Do you think that an e-learning website can encourage learning by the general public? If yes, how? If no, why not?
3. What are the conditions for creating an enjoyable learning experience with an e-learning website?
4. How can a website for the enjoyment of e-learning be developed?

The article provides a short overview of e-learning and provides the two characteristics that define e-learning by the Australian National Training Authority. Firstly, it is assisted by information and communication technologies, and secondly, a diverse media is required for e-learning to be effective. Experts they interviewed added that the use of interactivity and multimedia helped to capture the learner's attention and improved his or her learning experience. The article provides a discussion on what enjoyment is, and then comes to the conclusion that enjoyment simply means the meeting and fulfillment of one's needs, or simply, to fulfill what a person is motivated to learn. The paper then explores what the needs are, examining the human motivation work of Maslow (1987) and Ford (1992), which leads to the goals humans have. They include affective, cognitive, subjective organization, self-assertive social relationship, integrative social relationship, and task goals. We are predisposed to achieving these goals. Learning can satisfy a number of our needs or goals; therefore, it can be enjoyable as long as there is a positive effect to it. This enjoyment would stem from intrinsically motivated learning. The paper's conclusion

is that effective learning websites need to be enjoyable, supportive, positive, active, engaging, contextual, and collaborative. To achieve this, six features were determined:

1. The website needs to be aesthetically pleasing.
2. It needs to have interaction with the learners.
3. It needs to be easy to use. The learner should find it easy to navigate, and should find it trouble free.
4. The learner should have the flexibility to learn with the method that they want, and when they want, reflecting that it should be asynchronous.
5. The learning tasks should be short, without any testing, as it should be relaxing for the learner.
6. Useful hyperlinks should be part of the website.

The paper also proposed five development guidelines: multimedia and interactive technology; solid characteristics of adult learning; the provision of adequate funding and qualified personnel for the website; and, that it needs to take into consideration who the target audience will be. A final guideline is to build the website to Sharable Course Object Reference Model (SCORM) standards to enable the information to be more sharable.

These concepts are applied in this study. The m-learning consisted of audio-video clips, some text, and links. The learners were in control of their learning and the social networking platform allowed for asynchronous interaction and support.

Relevance and Self-Efficacy

Emotional and social dimensions related to online learning do have an influence on a student's learning, according to Wosnitza and Volet, who, in their

study of 2005, examined the impact of emotions in social online learning. Their study determined that the online topic to be learned could be perceived to be anywhere in the range from familiar and easy, to unfamiliar and difficult. Regardless of where on the spectrum the online course was perceived to be, if the topic was also perceived to be relevant to the learner's personal goals, the generated emotion would result in an emotional arousal that resulted in the person's motivation to pursue the learning. This fits with Keller's ARCS model (1987), where relevance relates to providing the learner with a positive benefit in terms of fulfilling a need for them that was also found to be a motivating force.

Bandura (1982, 1997) developed social cognitive theory, which predicts that a person is more likely to behave or do a certain thing if he or she fully expects that it will deliver positive benefits. Relevance is a central component an individual needs to recognize a different behavior as being beneficial for them rather than un-rewarding before making a change. For example, it may predict that an athlete will follow a particular diet if he or she expects it to help him or her win and/or play better.

Students' positive self-efficacy correlate strongly to higher academic results in online learning (Artino, 2010; Lynch, 2003; Wang & Newlin, 2002). Self-efficacy is the confidence level a person feels about this or her ability to accomplish a specified task. High self-efficacy enables people to stick to their goals in the face of obstacles. The higher a student's self efficacy, the greater the chances are of his or her success in mastering a change in behavior (Brehm, 2004). A person's self-efficacy can be increased through helping him or her see early results from the behavior change. Providing education enables the person to know he or she is on the correct path, and

subsequently, also provides positive reinforcement (McAuley & Blissmer, 2000; Schilcht, Godin & Camaione, 1999). In another study, Callaghan (2005) found higher self-efficacy of older adults correlated strongly to their ability to make behavioral health changes. In this study, self-efficacy is examined to determine what role it played in the m-learning and resulting behavioural changes.

Determining the Depth of Learning

Learning can be defined as gaining actionable knowledge (Siemens, 2005). Learning can have varying degrees of depth. A person working on the third floor of an office building may think the nearest washroom is on the fifth floor. Upon gaining the knowledge that there is a washroom on the third floor, his or her behavior could change as he or she may start using the third floor washroom to save time. This behavior change as a result of learning (gaining actionable knowledge) requires simple recall, whereas gaining knowledge that requires making judgments based on various criteria in order to turn the knowledge into something actionable would require the person to learn at a deeper level. This study expected the athletes involved in the study to be able to make nutritional value judgments based on criteria learned in the m-learning. The content and delivery was assessed to ensure the learning objectives were at a deep enough level. For this reason, learning taxonomies were considered.

Bloom came up with the idea to create a classification of statements around what students were intended to learn from instruction. The idea was for various universities to be able to share and create banks of test items for educational objectives. Bloom gathered a group of measurement specialists, who met twice a year

starting in 1949. In 1956, the group published the *Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook 1: Cognitive Domain* (Bloom, et al., 1956). This taxonomy (Appendix A) has six levels: knowledge, comprehension, application, analysis, synthesis, and evaluation. These are broken down into sub-sections, except for the application level. The levels progress from simple to more and more complex. The taxonomy is a cumulative hierarchy where mastery of the first level is required in order to move up to the next level and so on. Krathwohl (2002) revised the Bloom et al. (1956) taxonomy (Appendix B). Where the original taxonomy focused mostly on developing the six main categories which make up the foundation, the revised version resulted in some changes to this foundation. Most of the focus and hence, changes, were to the sub-categories which then more clearly describe the main categories. The revised version is not as strict as the original as it allows some overlapping, but it is still very much a hierarchy. The revised version added a section for meta-cognitive levels. The Quellmalz Framework (Appendix C) is a modified version of the Bloom et al. (1956) original taxonomy, a framework comprised of an educational objective taxonomy with only five levels: recall, analysis, comparison, inference, and evaluation. Gronlund (1998) observed many teachers find the Quellmalz Framework taxonomy easier to use. These category descriptions are stated in a more verb-and-noun style than the original taxonomy (Quellmalz, 1987).

All of these taxonomies allow for determining the degree to which a particular learning objective is learned. A learning objective can be evaluated in terms of its depth or complexity to master. Conversely, a learned topic can be assessed against the

criteria to determine to what degree or complexity level the topic was learned. In the case of learning nutritional information an athlete would need to evaluate and make judgments based on criteria recalled from the nutritional information, or would have to access information using his or her mobile device and then make a judgment. He or she may also need to plan ahead in order to be able to make the choices he or she wishes during travel. This would require the athlete learner to learn at the deepest levels described by any of the three taxonomies. The deepest levels involve making judgments based on material that has been learned. In this study, athletes were given nutritional learning, then, made judgments about their nutritional intake based on the nutritional information gained from the mobile learning. Further to this, they had the ability to access related information with their mobile device to make decisions on their nutritional intake. This leads to the question: What type of cognitive processes do athletes employ to learn the nutritional information for recall later, and how do they apply that learning to nutritional decisions?

Cognitive Processes Used in Learning

Cognitive processes are different strategies a learner will employ to aid them in learning a new task or material. Task value for a student can be described as the degree to which he or she finds a task important and/or useful (Artino & Stephens, 2006). Task value then can be seen as similar to relevance for a learner. Artino and Stephens (2006) found students who felt a learning topic had high task value for them, and who also had high self-efficacy for online learning, was a strong predictor that those students would report using the cognitive processes of elaboration, critical thinking, and meta cognitive strategies in learning the topic. This supports the idea

that relevance and self-efficacy which are elements of motivation are linked with academic performance. If students indicate they have high self efficacy for a topic and see the topic having a high degree of relevance, it can be determined whether the students used cognitive processes of elaboration, critical thinking, and meta cognitive strategies in learning the topic. This study attempts to make to do this, in an effort to determine what degree cognitive processes are used by the students relative to their success in learning as measured by Kirkpatrick's evaluation model.

Elaboration, critical thinking, and meta cognitive strategies can fit under a larger category of self-regulated learning. Self-regulation by learners is a process learners employ to "set their own goals and manage their own learning performance" (Driscoll, 2000, p. 304). This self-regulatory process is a cycle with three stages. Stage one, forethought, occurs when the learner makes plans and establishes goals for the learning. Stage two, performance control, occurs when the student exercises self-regulation for effort and concentration during the learning. Stage three, self-reflection, occurs when the learner reflects on what was learned and evaluates its usefulness, which in turn impacts future forethought, thereby completing the cycle (Zimmerman, 1990).

Self-regulated learning strategies are the processes learners use to aid themselves in learning. These can be broken down into these various types of strategies as described by Haihong and Gramling, (2009, p.127-128):

- Meta Cognitive
    - Goal Setting – determining target results of learning, and setting of sub-goals

- Strategic Planning – deciding on learning methods to achieve goals
- Self-Monitoring – keeping track of behavior, cognition and motivation
- Self-Evaluation – making judgments and causal attribution of performance
- Cognitive Rehearsal – selecting and encoding information in a verbatim manner
- Organization – making internal connections from the information in the learning
- Elaboration – connecting learning material with material found from other sources along with past knowledge

- Resource Management
  - Time Management – scheduling, planning, coordinating one's time
  - Environment – organizing study environment to be efficient and free of distractions
  - Effort Regulation – controlling effort and attention in the face of distractions and uninteresting tasks
  - Help Seeking – obtaining help from others to overcome academic difficulties

The use of self-regulatory learning strategies has been found to result in more positive learner motivation (Schunk & Ertmer, 1999; Zimmerman & Kitsantas, 1999), greater persistence (Lan, 1996), and in higher academic achievement (Schunk & Swartz, 1993; Zimmerman & Martinez-Pons, 1986). Cognitive and behavioral strategies also need to be considered. Before a person changes his or her behavior, the

person must want to change, and where the idea to change comes from forms a new found intellectual understanding (Brehm 2004), which then leads him or her into a process of change. As a person progresses through the stages of the behavior change process he or she will employ various cognitive and behavioral strategies. Cognitive strategies would include increasing knowledge, being aware of risks, caring about the consequences to others, comprehending benefits, and increasing healthy opportunities. Behavioral strategies would include substituting acceptable alternatives, enlisting social support, rewarding oneself, and committing and reminding oneself (DiClemente, Prochaska, Fairhurst, Velicer, Rossi, & Velasquez, 1991; Prochaska & DiClemente, 1983). The process starts with the person having some motivational reason to embark upon these strategies. This study only takes a cursory examination of motivation, self-efficacy, and relevance. An in-depth look into self-regulated strategies is not taken, rather the focus is on awareness of their link to learner motivation and to what degree self-regulated learning strategies are employed by the participants in the study.

Behavior Change

Understanding what motivates or creates desire in a person to change his or her behavior is vital in creating an environment where a person can change the behavior. Unless a person believes that he or she has a good reason to change, he or she will not change as it goes against his or her nature (Vohs & Heatherton, 2000). A person's normal behavior comes from striving to maintain stability in their lives. Stability is a force of habit in everyday life; it allows us to do many routine things in our lives with little cognitive effort, which frees us to be creative and think about

more important matters than the routine daily tasks of life. The notion of changing behavior typically begins with a person recognizing a need for change. The person then examines the pluses and the minuses involved that would result from the change. When the pluses are greater than the minuses the person then starts to come up with strategies for making the change. The change is successful when the plans have been followed through to the point of the change having occurred. After time the changes become routine, and the new behavior is instinctive versus requiring thought and sources of motivation. Once this point has been achieved a new version of stability exists (Brehm, 2004).

There is a great deal of research supporting the notion that an intention is formed before the initiation of any behaviour. A number of research studies show behavioral intention is the most important predictor of behaviour (Milne, Rodgers, Hall & Wilson, 2008; Bargh & Chartrand, 1999; Gollwitzer, 1993; Sheeran, 2002). If a person is going to change his or her nutritional intake, or once the change has been made, if he or she is going to continue with the changed diet, he or she needs to form the intention to do so. Understanding how change occurs over time and what happens is helpful for the support person and the person going through the change. For sedentary people changing their behaviour to an active lifestyle the first several months of change are the most difficult (Prochaska, Johnson, & Lee, 1998). Behaviour change should be viewed as a process, starting at the person having no thought of change, through a series of steps leading to action and eventually lasting change (Weinstein, Rothman, & Sutton, 1998). A popular model used for changing health behaviours is the Transtheoretical Model of Behavior Change commonly called

stages of change (Prochaska et al., 1983). Since the model's introduction it has continued to be used and studied (Marcus, King, & Bock, 1998; McKee, Bannon, Kerins, & FitzGerald, 2007; Reed, Pritschet, & Cutton, 2012). McKee et al., (2007) studied the use of the stages of change model to monitor diet, exercise and stress behaviour changes in cardiac rehabilitation patients. The stages of change model in that study was characterized as "a useful simple method" for use in monitoring patient behaviour change (McKee et al., 2007, p. 233). More recently, researchers have begun to look deeper into specific aspects for the model, for example Reed, et al., (2012) examined grit and conscientiousness with respect to the stages of change model.

The stages of change was first used to help people quit smoking. It has since been used to help people make other health related behaviour changes (Marcus & Forsyth, 2003; Reed, 1999). The following summary from several researchers represents a brief outline of the stages of change, and includes a short description of each stage and how it works (Prochaska et al., 1998; Marcus et al., 1998; Marcus & Simkin, 1994; Prochaska & Marcus, 1994; Riebe & Nigg, 1998), as follows:

1. Pre-contemplation Stage: In this stage a person has no intention of changing. He or she may not be aware of his or her bad habits or poor choices, or, may be aware but feel he or she can’t change, or do not know what to change. They may not understand the seriousness or degree to which they suffer from the poor behavior. They may well employ defensive strategies when other people point out that a particular behavior of theirs might be a problem. This group is further divided into believers and non-believers (Reed, 1999). Believers see the value in change, whereas non-

believers do not (Brehm, 2004). Brehm (2000) states education is the best strategy to help both believers and non-believers form an intention to change.

2. Contemplation Stage: In this stage a person has not taken action but is thinking about making the change. He or she is aware of many of the advantages and disadvantages of making the change. In many cases people have made the change or a similar change in the past that was positive or negative, resulting in varying degrees of self-efficacy for the contemplated change.
3. Preparation Stage: In this stage the person has decided to make the change, although he or she may not yet have taken action. He or she may have bought the food and drinks products needed, and may have bought a knapsack to carry the food and drinks, or may have bought a portable drinking bottle. He or she is convinced and ready, but has not yet followed through with healthier eating and drinking.
4. Action Stage: In this stage a person has made the behavior change, where he or she has changed his or her diet, started exercising, or stopped smoking. Whatever the change was, he or she is now living in the changed way.
5. Maintenance Stage: In this stage a person has maintained the change for six months or more. The new behavior has become routine, but the person experiences temptation to go back to old habits. The first six months of change are the most difficult.

In progressing through the stages of the stages of change people will employ various cognitive and behavioral strategies. Cognitive strategies comprise increasing knowledge, being aware of risks, caring about the consequences to others, comprehending benefits, and increasing healthy opportunities. Behavioral strategies include substituting acceptable alternatives, enlisting social support, rewarding oneself, and committing and reminding oneself (DiClemente et al., 1991; Prochaska & DiClemente, 1983). An important consideration for this study is DiClemente et al., (1991) and Prochaska and DiClemente, (1983) finding for the need of social support. This further supports the concept of providing the participants of this study with social support through the process of learning and potential behaviour change. In addition, it is beneficial in achieving the behavior change for the person to record the changes; it does not matter what method is used. It can be as simple as writing short notes on a calendar (Baker & Kirschenbaum, 1998), or adding to a text list set up on a mobile device.

Setting goals is another cognitive process that can increase motivation (Cox, 2007). Locke, Shaw, Saari, and Latham (1981) describe a goal as "attaining a specific standard of proficiency on a task, usually within a specified time limit" (p. 145). Goals can be categorized into many different specific types (Cox, 2007). Three common types of goals are outcome, performance, and process goals. For example, an outcome goal might be to defeat opposing hockey teams that play a rough physical style in more than 60 per cent of the games next season. A performance goal could be where an athlete sets a goal of gaining three kilograms of muscle by the start of the next season. One of the process goals to achieve the three kilograms of added muscle

would be specific nutritional behaviors that the athlete would do each day to achieve the performance goal (Kingston & Hardy, 1997). The best goal setting results are achieved by using a combination of all three goal types (Filby, Maynard, & Graydon, 1999). Setting goals intrinsically motivates people by energizing them to achieve something beneficial, the more specific and reasonably difficult, the greater the motivational effect (Locke & Latcham, 1990).

Before setting goals, a person must arrive at the point of forming intent to change. This happens in the early stages of the behavioral change process. Motivational interviewing refers to a way of talking to people who are in the early stages of behavior change. It was originally used by counselors working with alcohol addiction treatment, but the approach has been successfully used in other types of behavior change programs (Miller & Rolnick, 1991). This technique is used to help the person form the intent to change. Before a person changes his or her behavior, the person must want to change; the idea to change comes from a new found intellectual understanding (Brehm 2004). Some of the cognitive processes that that lead a person to change have been categorized by psychologists (Courneya & Bobick, 2000). Three of these processes which are pertinent to this study are summarized as follows (Brehm, 2004);

- Consciousness-raising is the raising of a person's awareness of something that would be beneficial for the person. For example, how a change in nutritional intake will help him or her to be healthier, stronger, and have more energy.

- Concern, i.e., a person can be concerned that without the change he or she is not being as helpful and supportive as he or she could be to friends, family, or team mates.
- Emotional relief, i.e., in this case the athlete feels discomfort in knowing he or she is not doing his or her part to help the team. The term *crystallization of discontent* is used to describe the discomfort that motivates people to form that intention to change (Heatherton & Nichols, 1994).

Changing nutritional habits requires people to change their routines, and the change results in added stress from coping with the change. Energy in the form of coping is required to change a behavior. The willpower or coping energy that is required is referred to by psychologists as self-regulation or self control (Muraven, Tice, & Baumeister, 1998). Each person has a limited amount of cognitive energy he or she can use for self control (Baimeister, Bratslavsky, Muraven, & Tice, 1998; Giner-Sorolla, 2001; Muraven & Baumeister, 2000; Vohs & Heatherton, 2000). Some people have more self control than others (Brehm, 2004). Practicing self control increases a person's ability to exercise self control (Muraven & Baumeister, 2000). Conversely when a person falls under stress from another source, his or her coping energy is reduced. This explains why a person may revert back to old habits (diet) upon having another stress being placed upon him or her, for example, the stress of exams for a university student (Baimeister et al., 1998).

A person who believes that he or she has the self control to conquer urges working against the behavior change he or she wishes to make will be more successful in making the change. Callaghan (2005) found higher self-efficacy of older adults

correlated strongly to their ability to make behavioral health changes. Self-efficacy is the confidence level a person feels about his or her ability to accomplish a specified task. High self-efficacy enables people to stick to their goals in the face of obstacles. The higher a person's self-efficacy is, the greater the chances of his or her success in mastering a change in behavior (Brehm, 2004). A person's self- efficacy can be increased through helping him or her see early results from the behavior change by providing education enabling the person to know he or she is on the correct path, and by providing positive reinforcement (McAuley & Blissmer, 2000; Schilcht, Godin, & Camaione, 1999). This is supported by Bandura's social cognitive theory (1982, 1997); as mentioned earlier Bandura's theory predicts that a person is more likely to behave or do a certain thing if he or she fully expects that it will deliver positive benefits.

Social support has a strong influence on helping a person through behavior change (Sarason & Sarason, 1985). This study enabled the participants to stay connected with the social support of their teammates that were also involved in the study through the use of the social networking software. Adherence to a health-based program is enhanced when it is introduced to an existing group by means of pre-existing feelings of affiliation amongst the group's members (Izquierdo-Porrera, Powell, Reiner, & Fountaine, 2002). High quality instruction and support of the behavior change in a group environment develops a stronger sense of cohesion in the group (Estabrooks, 2000). The interaction by a group's members support adherence to the behavior change, even limited interaction is beneficial (Annesi, 1999). This study allowed for the interaction of group members and the support from one another

through the use of social networking software. Behavior change is not a simple feat. In many cases it is challenging just to overcome personal barriers. As a result is important that a person trying to make a behavior change has support (Janis & Mann, 1977).

Learning theories and behaviour modification (Skinner, 1953) have been applied extensively in the area of health improvement behavioural change (Marcus & Forsyth, 2003). A person is more likely to adopt a new behavior if pleasurable consequences are experienced as a result of the new behavior (Skinner, 1953). People make decisions to adopt new behavior by comparing the benefits to the perceived negative consequences of the behavior (Janis & Mann, 1977). The further a person has progressed in changing a behavior the more he or she perceives benefits of the new behavior. Conversely, in the early stages of change the person sees more disadvantages to the behavior change (Marcus, Rakowski, & Rossi, 1992; Marcus & Owens, 1992). Having the person commit the perceived disadvantages to text enables the person's social support to address these issues (Marcus, Rakowski, & Rossi, 1992; Wankel, 1984).

In order to better understand people's difficulty in changing addictive behavior such as smoking and drinking, the relapse prevention model was developed. The central idea of the model is to have a planned response to predictable or previous barriers (Marlett & Gordon, 1985). This coping strategy is a pre-thought-out action to overcome a known barrier. By effectively coping when the barrier arises, the person's self-efficacy will be maintained or increased (Marcus & Forsyth, 2003). A mobile device could hold plans and information to overcome barriers, for example, when the

athlete is traveling to an event and the food choices he or she has at home are not available. A mobile device with previously installed links to calorie and other nutritional information for food choices, along with acceptable substitutes, could be accessed. This would allow the athlete to make good nutritional decisions and have the confidence ahead of time that he or she can make sound choices in the face of known barriers. The sport nutritional learning provided in this study allowed the participants the ability to access various nutritional information and link to nutritional resources with the use of their mobile devices.

M-Learning Content

The following section provides a brief overview of the sports nutritional content that was delivered through the m-learning component in this study. The content was provided by a registered dietician holding a bachelor of science degree in nutrition and her staff of qualified dieticians who provide sports nutrition support to a professional hockey team and their junior and minor pro prospective players. The researcher provided the instructional design and delivery expertise of the learning. Good nutrition is important for everyone, however high level athletes and highly active people have higher nutritional needs than the general population. Making the proper nutritional choices and getting adequate nutritional intake can be difficult for these people. Their ability to perform up to their potential is dependent on them getting proper and adequate nutritional intake (Benardot, 2012; Burke, 2007; Juekendrup & Gleeson, 2004; Bompa, Di Pasquale, & Cornacchia, 2003; Martens, 1997). This is the basis for this study choosing sports nutrition content to study mobile learning.

Hydration. While playing hockey the body is under stress from the exercise, and equipment and clothing make it more difficult for the body to cool. As a result of these conditions, thirst may not be a reliable indicator for the body's need for fluid replacement (Greenleaf, 1992). An athlete needs to recover from a strenuous bout of exercise (e.g., on ice or off-ice practice, resistance training, games). This recovery involves restoring spent muscle and liver glycogen, replacing electrolytes and fluids lost through sweat, and synthesis of new protein required as a result of the tissue damage from the exercise (Burke, 2007). After exercise many athletes experience involuntary dehydration; they are dehydrated, but they do not feel thirsty as a result. Even though fluid replacement is available they do not drink it (Nadel, Mack, & Nose, 1990).

Food make up. Adequate nutritional intake is vital for athletes. It is necessary for the athlete to consume enough carbohydrates, protein, vitamins, minerals, and other nutrients required for the athlete to remain healthy and have the energy to train and compete (Burke, 2001). For an athlete to train and perform at a high level, he or she needs to pay adequate attention to his or her diet to ensure he or she is consuming enough of the right foods. Athletes should consume foods predominately high in carbohydrates as their main source of energy. Fat and proteins need to be consumed as well to maintain a balanced diet. It can be difficult for athletes to consume enough carbohydrates which contain about four calories per gram (as does protein), whereas fat contains nine calories per gram. Fat intake is needed for high level athletes to have enough energy to complete their daily workouts (Benardot, 2012).

Supplements. Common supplements hockey players are known to use are covered. Those supplements are carbohydrates, protein, vitamins, creatine, bicarbonate, citrate, caffeine, Colostrum, glutamine, ribose, medium chain triglycerides (MCT), Chromium Picolinate, Pyruvate, Inosine, L-carnitine, nitric oxides, Coenzyme Q10, B-hydroxy B-methylbutyrate, and omega 3 fatty acids.

Alcohol. Burke (2007) states there is very little reliable data on the alcohol intake and drinking practices of elite athletes. This is mostly due to the fact there is no reason to research food or drink that has no benefit to athletic performance. We do know athletes involved in team sports drink more alcohol than athletes in non team sports, and we know the non team sport athletes drink more than what is average for the rest of the adult population. Therefore, we know on average, athletes on team sports most likely drink more than what would be considered healthy or normal. It is therefore important to address alcohol consumption in the nutritional m-learning component for the athletes in this study.

Vegetarian diets. Athletes put higher demands on their body and if they are on a vegetarian diet, they are at risk of having an inadequate intake of energy, protein, calcium, iron, zinc and vitamin B12 (Venderley & Campbell, 2006; Borrione, Grasso, Quaranta, & Parisi, 2009). Vegan diets are also related to dysmenorrhea from insufficient energy, which is related to lower bone density, which in turn puts the athlete at greater risk of bone fractures (Nichols, Sanborn, & Essery, 2007). Vegetarianism, due to its low energy intake, is considered a risk factor in adolescents for developing eating disorders (Renda & Fischer, 2009). It is difficult but an athlete on a vegetarian diet can compensate and obtain an adequate supply of energy and all

required nutrients (Benardot, 2012). As a result vegetarian diets are included in the nutritional content.

Female athlete triad. A specific area of sports nutrition is the female athlete triad. A female triad is a female athlete with three separate, but related health issues/problems (Johnson, Loucks, & Wilmore, 1997).

1. Poor nutritional intake as a result of severely restricted caloric intake (anorexia nervosa) and/or binge/purge eating habits (bulimia nervosa).
2. The loss of menstrual cycles (amenorrhea). This is caused by over training and/or by poor nutrition, as described in #1 above.
3. The loss of bone mineral resulting in less dense and weaker bones (osteoporosis). This occurs as a result of poor nutrition.

Estrogen helps the body absorb calcium from the intestine. It acts directly on the cells that remodel the bones. Women who exercise and have normal levels of estrogen will gain more bone density than they otherwise would. Postmenopausal women lose 1-5% of bone density each year; therefore it is important to build a solid base (Johnson et al., 1997). The female athlete triad situation starts with poor nutrition. The poor nutrition results in:

- lack of calcium, which is vital to bone building;
- loss of menstrual cycles and low estrogen levels; proper estrogen levels are vital to bone building;
- low vitamin D levels; vitamin D is essential for bone building; and,
- overall, a hazardous situation for maintaining a healthy body.

Learning Design

In this section various instructional approaches will be reviewed and discussed in terms of how they will be applied in this study. A cross-sectional, non-experimental research designed study was conducted by McCombs (2010) on a group of 1,345 university students taking an undergraduate course in Information and Communication Technologies (ICT). McCombs found the students who learned using podcasts via m-learning performed equally well to the students who learned in the traditional classroom manner. The term podcast came from combining the name iPod and the word broadcast (Buffington, 2008). Podcasts were originally audio recordings accessed through iPods (Brookes, 2010). The term has now grown to be more generally accepted as non-streamed digital audio recordings that can be accessed through the internet. Podcast has grown to be video podcasting as well (McCombs, 2010). Video podcasting is essentially what Ally (2009) described as being used in order to achieve greater effectiveness than just audio in his study using m-learning to teach English pronunciation. This study employed the approach of using video podcasts for instructional delivery.

Four areas of concern to be mindful of in developing and using a podcast approach were developed by Brookes (2010). These four areas will be considered in the development of this study's video podcasts. Brookes studied 100 undergraduate students taking a hospitality module which was part of a three credit university course (2010). The students were given access to weekly podcasts that ranged between five and seven minutes in length. The study found that most students enjoyed learning through the regular lectures and appreciated having access to podcasts which could be

taken as m-learning, especially when they missed a lecture. The study clearly showed that the podcasts had a positive impact on the students' understanding and knowledge. This research also indicated four areas of concern as quoted below (Brookes, 2010, p. 62):

1. Assumptions —academics should not assume that all students desire and are willing to use podcasts for learning and teaching purposes and should not make assumptions in relation to:
2. Attitude—of students of the perceived value of podcasts to help them in learning and teaching and the attitude of students to technology,
3. Ability—of students to download and listen to podcasts in different ways and in academic settings, even if they consider themselves good with technology, or
4. Accessibility—the willingness of students to use their personal technological devices for learning purposes.

The following study demonstrates that knowledge can be applied from research with learning objects to podcasts for m-learning. Ally, Cleveland-Innes, Boskie, & Larwill (2006) studied the use and the value of learner developed learning objects. The study surveyed two groups of adult learners in the workplace. The participants all worked in a call centers or help desk and all were taking a Customer Needs course. One hundred subjects took their survey; 43 were enrolled in a fall offering of the course, and the remaining 57 took the winter offering. A learning object repository was created by the researchers at Athabasca University. The objects were developed with the learner in mind by tagging the objects for ease of finding and

retrieving by the learners. The workplace learners evaluated the ability to retrieve and use the learning objects from the repository. The researchers indicated that the effectiveness of learning objects is enhanced when they are linked to learning outcomes, and when learners use learning objects for their own purposes, their independent learning skills are improved.

Integrating previous research with the survey yielded the following conclusions:

- For adults, the learning objects need to be relevant to the adult learners work or personal goals.
- Learning objects in the repository must be tagged properly to allow easy access and to provide the learner with enough information to select the most appropriate objects.
- In developing the learning objects, the learner's motivation level should be a consideration, with the possibility of developing several levels of objects based on varying motivation levels.

Based on these studies a podcast approach was used for delivering parts of the nutritional content. In line with what Ally et al. (2006) found, the podcasts used in this study, along with supporting learning resources, were clearly labeled to indicate that each is related to a learning objective. This approach lends itself to expanding the content of an m-learning program in an organized and methodical manner.

Identified Technology Obstacles to M-learning

Vyas et al. (2010) studied the application of m-learning to enhance medical training at remote sites in India. The operating system Opera Mini was used for the

cell phones in this study. Opera Mini is an open source browser that works on most mobile phones. They redesigned the existing online computer based learning material so that it could be more easily viewed on a small cell phone screen. All the redesigned material was tested to ensure it worked and fit the small screen as intended. The authors noted that a great deal of thought went into modifying the existing e-learning into m-learning. Further, it is worth noting that their multimedia e-learning along with its discussion tool were all successfully adapted to m-learning from online computer based learning. Based on the results from this research the podcasts were designed to be viewed on a mobile computing device, not for a computer monitor, and the discussion tool was designed for use on a mobile computing device.

Rekkedal and Dye (2007) examined mobile learning integrated with online distance education at the Norwegian Knowledge Institute (NKI). NKI has an enrollment of up to 10,000 students yearly, making it the largest distance education institution in Norway. NKI is a non-government institution aimed at delivering full and part-time learning for secondary and post-secondary level education. The methodology was designed to examine two projects. The first project studied two courses wherein the students used PDAs and mobile phones. The first course was an introductory course for tutors and had nine students. The second course was a master's level course on teaching and learning online; this course had three students. The researchers found "downloading and synchronizing learning materials to the student's PDAs caused few (if any) problems" (Rekkeddal et al., 2007, p. 8). The students struggled with taking notes due to the small keypads the handhelds had, but this was overcome by using portable keyboards. Using the mobile phones to interact

in student forums and to submit assignments was found to be easy for the students. The second project used wireless PDAs that were always online. This enhanced the learning by allowing the use of interactive materials, and the researchers found it increased the students' use of other resources on the internet. Further to this, it was more convenient as students did not have to always log in. They did find that the web pages needed to be designed for mobile devices due to their small screen size. These findings were incorporated into the instructional design to enhance the content delivery to the highest standard possible. For this study, video content was created and designed to be viewed on small screens.

Summary

Ally (2009), Vyas et al. (2010), Redd (2011), and Shih et al. (2007) were all able to produce successful m-learning interventions for learners. McCombs (2010) determined m-learning in his study was "as good as or better" than the traditional classroom offering of the material. The studies do, however, point to motivation as a potential problem with the m-learners. Low motivation prevents the learning from happening to the degree it could. By chance, learners can find the motivation to make learning successful. Previous studies show considerable effort and attention needs to be given to the aspect of motivation in the instructional design. This study examines student motivation, along with the role relevance and self-efficacy play in enabling successful m-learning.

The m-learning program was evaluated using Kirkpatrick's four level evaluation model. The participants were surveyed for their reactions to the m-learning and the use of mobile devices. The amount of nutritional knowledge learned by the

learners was assessed. A pre- and a post-evaluation were completed to determine if behavior change occurred, and if so, to what degree. Level four of Kirkpatrick's model, the evaluating for results, was not done due to the difficult nature and weakness of such measurements.

The m-learning was developed using web-based learning strategies such as those described by Lin et al. (2006). In order to provide the student with support found necessary by Hannafin et al. (2009), the designed learning content had the ability for open communication between students, teacher and the researcher. As another means of support, the main delivery method for instruction was video podcasts similar to that which Ally (2009) used effectively. The podcasts were constructed and applied using the knowledge gained from Brookes' (2010) study on podcasting. In looking at studies on m-learning, another concern arises around the small screens and keyboards; from this experience, it was important that the learning materials were designed and tested on the small screens that were used in this m-learning study.

The m-learning instruction was based on research findings that have proven successful. The study takes a cursory examination of student motivation, self-efficacy, relevance and use of self-regulated learning strategies. The m-learning was developed at the level judged to be at the highest level of Bloom's taxonomy (1956) (evaluation), or at the highest level of the Quellmalz Framework, (evaluation), (1987), and at the highest level of Krathwohl's (2002) revised taxonomy (create), all of which are defined as the learner being able to make judgments based on criteria of the subject, which is essential for the participants of this study.

Chapter 3: Methodology

Introduction

This chapter will outline the methodology used for this quantitative research study. The methodology will define how the m-learning was presented and how it was accessed and used by the participants. This methodology provides data about who the participants were, and a description of how the data was collected, evaluated and compared. The Athabasca University Ethical Review Board has approved the use of human subjects for this study (Appendix H).

Research Design

This quantitative research study used a quasi-experimental research design with a pre-test, an intervention and a post-test. Quantitative research is designed to show a relationship between independent and dependent variables using the scientific method. In this quasi experiment an intervening variable is added; engagement with mobile learning. The dependent variables are the reactions to using a mobile device for learning, learning of the content and behavior outcomes resulting for the learned content. Quantitative research use two approaches, a descriptive approach that establishes associations between the variables, or an experimental method that attempts to establishes causality (Thomas et al., 2005). This study is partially a descriptive case with a measure of association.

A qualitative research study is different in that as it progresses the data is revealed and premises and connections emerge, as opposed to starting with an hypothesis (Christensen, Johnson, & Turner, 2011). In this study qualitative data is

gathered solely to create a profile of the participants ownership, usage, and competence with mobile devices .

With qualitative research the tasks of data collection and analysis of the data are usually (but not always) performed by the researcher (Goetz & LeCompte, 1984). The pre- and post-tests of this study were developed in part by the researcher, Koole's (2006) FRAME research questionnaire, and from Ally and Cleveland-Innes (2011) m-learning questionnaire. The methods of data collection are typically instruments designed by the researcher, such as observation, surveys, and interviews (Goetz et al., 1984). By contrast, quasi-experimental research studies are deductive studies searching for cause and effect, and can be categorized as one of three types: Quasi experimental designs that do not use control groups; designs that use control groups with pre-tests; and those using control groups that do not use pre-tests (Shadish, Cook, & Campbell, 2002; Cook & Campbell, 1979). In educational research it is often not possible not conduct true experiments with "randomized assignation of participants to control or experimental groups"(Cohen, Manion, & Morrison, 2007, p. 282) As a result quasi-experiments in the field are often conducted. A one group pre-test, post-test is an accepted quasi-experiment design for educational research (Cohen et al., 2007). The one group pre-test, post-test is the quasi-experimental design used in this study.

Quasi experimental research designs attempt to evaluate an intervention or interventions without the use of randomization and analyze an intervention and an outcome in an effort to demonstrate causality relationship (Harris, Bradham, Baumgarten, Zuckerman, Fink, & Perencevich, 2004). Cohen et al., (2007) note the

validity of quasi-experiments are threatened by the fact any number of outside influences could impact the post-test results. In an effort to strengthen this study's quasi-experiment the principles of the scientific method of problem solving have been applied to its design. The basic principles of scientific design suggest that a result must be testable, and evidence of a research claim must exist in a way that it can be analyzed and evaluated (Jenkins, van Kessel, Tompkins, Dzwiniel, Falk, Lantz, & Klimiuk, 1993). The scientific method is an approach that requires the use of procedures and standards to qualify its empirical findings in order to demonstrate a fit between the real world and its findings (Cuff & Payne, 1979). Thus, it is important in designing any quasi-experiment to understand the limitations it can have, and ensure the quasi design is sufficiently strong enough that any reviewer of the study will be convinced by credible evidence that the outcome was a result of the intervening variable. This study applies the Mann Whitney U-test and Chi Square statistical analysis methods to demonstrate the data supports the quasi-experiment's outcomes.

Research Questions

The main questions for this research study are:

1. What are learner's reactions to learning with mobile devices, as measured by Kirkpatrick's evaluation model (level one)?
2. Does m-learning result in knowledge gain as measured by Kirkpatrick's evaluation model (level two)?
3. Does m-learning result in behavior change as measured by Kirkpatrick's evaluation model (level three)?

4. Are there connections between learning with a mobile device and motivation**,** self efficacy, relevance, and the use of self-regulated learning strategies?

A questionnaire was developed and pilot tested to meet the study objectives. All the questionnaires that have been used are influenced by direction from Kirkpatrick (1998). Details on the testing of the pre and post-questionnaires are presented later in the chapter under the Pilot study sub section. The post-questionnaire section on mobile technology is a slightly modified version from Athabasca University professors and researchers Dr. M. Ally and Dr. M. Cleveland-Innes. The post-questionnaire included a section of questions derived from Koole's (2006) Framework for the Rational Analysis of Mobile Education (FRAME) model. The FRAME model is used to examine the relationship between mobile devices, learning environments and their users. The FRAME model questions, along with the mobile technology questions help create a profile of the users in this study.

Procedures

Before the participants began the m-learning, they responded to a pre-test questionnaire determining their nutritional knowledge and behaviors. The results from the pre-test questionnaire formed a baseline estimate of their nutritional knowledge and behaviors. The participants were then given four weeks to complete the m-learning intervention on sports nutrition. After the four week period for completing the m-learning intervention, the participants responded to another questionnaire (post) that asked the same questions regarding their nutritional knowledge and behavior. The two questionnaires are compared for changes in nutritional knowledge and behavior.

The post-questionnaire further surveyed the participants' reaction to the learning and the mobile devices used to learn with. The post-questionnaire went on to seek answers surrounding the role, if any, that motivation, relevance, and self-efficacy played in their mastering the m-learning material.

Learning Program Details. The participants, by team, began the m-learning by viewing an introduction video via their mobile device. The introduction video addressed different aspects of sport nutrition in a manner to prompt the athletes to think of what they would like to learn more about. By gaining the athletes interest in different areas of sport nutrition the athletes would informally determine their own learning objectives relative to sports nutrition. Sports nutrition specific to the demands of elite level hockey players that address their learning objectives were provided via m-learning. The m-learning consisted of several modules made up of videos, text, and web links. The participants had access to the modules and social networking software to discuss the learning. The female athletes had access to one additional module that was specific to female athletes. The participants were able to access the modules anytime and anywhere, including while travelling by bus or plane to a competition. Upon completing a module, using the social networking software, the participants were able to ask questions, discuss amongst themselves and briefly state what changes, if any, they will make to their nutritional habits based on the m-learning. The interaction on the social networking software is for the learning benefit of the participants and was not collected as data for the study. Only the participants, the instructor, and the researcher were able to view the comments. The participants had the ability to ask the instructor questions in private if they desired.

The social networking software also served the function of allowing the researcher to have easy practical access to the participants throughout the data collection phase of the study. A researcher needs to have easy practical access to the subjects, and this should be determined early on (Cohen, Manion, & Morrison, 2007). The social networking software provided support for the participants as they were connected to other participants, the instructor, and the researcher.

Participants

Canadian university varsity level athletes do not have sufficient time to handle all the university academic work and fulfill all the demands required to train and compete at the elite level (Hamilton, Smith, McGregor, Ekert, Ali, Hahto, Shields, McAdam, Read, Paradis, & Scholte, 2012). This study intended to enable university athletes to learn about a topic that is necessary to their elite athletic development (Hamliton et al. 2012) at a time that would otherwise be unproductive. Participants of this study were male and female ice hockey players. The participants who started this study came from professional, university varsity, college varsity, and junior category hockey teams. The age range of this population was 18 to 26 years of age. The student athletes have large time demands with full-time school studies, and practices three to four times per week and two to three games per week. On top of this, the majority would do some type of off-ice strength and fitness training at least twice per week (Hamliton et al. 2012). The nutritional demands and caloric intake of these individuals is high in relative to recreationally active people of their age (Benardot, 2012). These players travel by bus or plane to competitions at least once every other week during the pre-season, regular season and playoffs, which run from early September through

to the middle of March. This study revolved around their schedule, with the data collection completed by mid- March of 2013.

At the start of the data collection there was a possibility of 112 participants. This number dropped to 92 when one of the male participating team's head coach was replaced in mid season, and his replacement while in favour of the study, did not want anything additional happening in the beginning of his tenure as head coach. Shortly after the National Hockey League (NHL) lock out was ended, the participating NHL organization became focused on player movement and addressing the compressed NHL schedule, as a result their pre-questionnaires were not fully completed and no post-questionnaires were dispensed. Their participation and access to their players playing in the American and East Coast Hockey Leagues was on the basis if the NHL lock-out was resolved they would no longer be able to participate. This left a possibility of 72 participants coming from two female teams (one college and one university team) and one male university team. Fifty-five consented to participate in the study. Thirty-one participants from the female teams responded to the post-questionnaire. Eight of the 31 female participants reported they did not use a mobile device for the learning and had to be excluded from the results. Of the 24 male participants who completed a pre-questionnaire only four of these participants completed a post-survey questionnaire. This was due to their team being eliminated from post season play much earlier than expected. The twenty male players who did not complete the post-questionnaire, reported they no longer felt the learning would be of value to them at this point in time as their season had ended. This left a total of 27 participants, 23 female and four male who wholly completed the study.

Sample Size

A purposive sample is non-probability sampling in which certain criteria determine who can make up the sample (Oliver, 2006). The participants in this study were made up from a purposive sample that met the criteria of being adult elite level hockey players. The quality of a research study relies on solid methodology, accurate data collection, and a suitable sample selection and sizing (Morrison, 1993). The larger the sample size, the greater the reliability (Cohen et al., 2007). While there is no definitive answer on what the sample size should be in a research study, it is suggested that the minimum number of subjects should be 30 per variable, and if statistical analysis is to be used, the same 30 subjects could be used for other variables (Cohen et al., 2007). While this research study will not employ in depth statistical analyses, this study attempted to use a sample size greater than 30. In this research design random sampling was not possible. Strictly speaking, for a study's outcomes to be generalized to another group it must not differ in any way from the sample population (Kruskal & Mesteller, 1979). "A 'good-enough' principle of sampling, however, can allow generalizations to any population for which the sample is representative enough", according to Serlin, (1987, p. 366). The sample results must be capable of being generalized to a greater population to have external validity (Cohen et. al., 2007).By using a sample size of close to 30 participants and including both male and female elite level university athletes ranging in ages from 18 to 26 years, the results will be capable of being generalized to a population beyond just the players in the study.

Reliability and Validity

Validity is the degree to which the results measure the outcome they purport to, whereas reliability is the measuring device or method that is used, and if it is reused again in the same situation, to what degree will it provide the same result (Thomas et al., 2005). "Reliability is a necessary precondition of validity, and validity may be sufficient but not a necessary condition for reliability," (Cohen et al., 2007, p. 133). A study must measure what it claims to measure and the measurement must be repeatable in similar situations. If the study does not measure what it purports to measure, but the measurement in similar situations will yield the same result, the study is of no value (Cohen et al., 2007).

Validity should not be seen as an absolute yes or no; it should be viewed more as to what degree of validity the research possesses (Gronlund, 1991). Internal validity attempts to provide an explanation based on data of the phenomena being studied (Cohen et al., 2007). For qualitative research data to have internal validity it must be credible and plausible, and there must be sufficient data to support the claim it is making (Hammersley, 1992).

External validity attempts to demonstrate how the results of the research can be generalized to a wider group or population (Cohen et al., 2007). A good case can be made against qualitative research having any real degree of external validity based on the lack of control over the variables and non-randomization of samples. Conversely, Lincoln and Guba (1985) and Eisenhart and Howe (1992) assert that a situation can be assessed for typicality. They suggest qualitative research findings can be viewed as comparable and transferable and as such, have external validity. Face

validity or logical validity is the "degree to which a measure obviously involves the performance being measured" (Thomas et al., 2005, p.193). This study's pre- and post-test questions (Appendices D and E) that participants were given to respond to, match up to exactly answer the posed research questions in detail. The questionnaires were verified in a pilot study using participants from a similar level of hockey and similar in ages as those on the teams who participated in the study.

A strong argument can be made that reliability cannot be found in qualitative research. Winter (2000), Stenbacka (2001), and Golafshani (2003) are a few examples of those who have opposed using the term reliability in qualitative research. It has been suggested that terms involving the concept of *dependability, like credibility*, *applicability*, and/or *consistency* be used in place of the term *reliability* for qualitative research (Lincoln & Guba, 1985). Bogdan and Biklen (1992) suggest reliability in qualitative research can be considered to what degree of a match is there between what actually occurred and the data, or simply having comprehensive coverage with a high degree of accuracy. Brock-Utne (1996) projects the notion that reliability in qualitative research is the quality that makes up dependability. By the use of exactly worded pilot verified questions, given in the same environments to the same participants for the pre- and post questionnaires (Appendix D and E), this study strives to have results with a high level of credibility and consistency. Credibility and consistency are elements that make up dependability. A qualitative study that demonstrates credibility in its results, according to Lincoln and Guba (1985) and Bogdan & Biklen (1992), demonstrates reliability for a qualitative study.

Data Collection

Each participant was given a paper and pencil pre-intervention questionnaire, and then a post-intervention questionnaire developed by the researcher for this study. These questionnaires were designed to measure the participant's nutrition knowledge and habits. The post-questionnaire had additional questions to determine the learner's reaction to the learning, the use of mobile devices, and the role that motivation, relevance, and self-efficacy played in the participant's use of, and success, or lack of success, in taking the m-learning.

In designing the questionnaires, care was taken to keep the questionnaires as brief as possible, since many respondents have negative feelings toward questionnaires, finding them intrusive and an impingement on their time (Thomas et al., 2005). To ensure each question is truly required by this research study, each question was designed to answer a specific objective of the research (Thomas et al., 2005). Shorter questionnaires have better response rates (Borg & Gall, 1989). It has been shown that each page added to a questionnaire reduces the response rate (Borg et al., 1989). It was clearly stated that all their individual responses would be kept confidential and only the group results will be made public. The respondents should have trust in the fact their responses to the questionnaire will be confidential (Fowler, 2002). The researcher ensured privacy and committed to the participants that their participation and information will be held strictly confidential.

Closed-ended questions make up the majority of the questions on the questionnaires, whereas, open-ended questions have been kept to an absolute minimum. Closed questions only allow a specific response, are typically multiple-

choice, but also allow for scaled response, true/false, and/or categorical responses. Open-ended questions allow for the respondents to construct their own answer, which further allows them to express their feelings and expand on ideas. Most respondents do not like open-ended questions as they require more time (Thomas et al., 2005). As well, closed questions allow for more precise comparisons between questionnaires (Oppenheim, 1992). As stated earlier by Thomas et al. (2005), this will result in better response rates and higher validity.

The cover letter's message was clear to the participants. This was verified by the pilot participants who responded they unambiguously understood from reading the cover letter that they were fully free not to participate in the study. For the study to be successful, the full participation and cooperation of all the participants is of the utmost importance. To gain their full cooperation it was important that the participants bought into the idea of helping with the research study. Respondents will likely be interested in participating if they find from the cover letter that the study is worthwhile (Thomas et al., 2005). The cover letter (Appendix F) was short and concise, worded for a reading level of the participants, written in a professional manner, and explained the topic of the research and what their total commitment would be if they chose to participate. The cover letter provided to the university participants was scored at the grade 11.2 level using the Flesch-Kincaid readability test. The cover letter explained the pre-questionnaire would take approximately 15 minutes to complete and the post-questionnaire would take approximately 45 minutes to complete. Another important factor is gaining the trust of the participants. For instance, it is vital that they trust the fact that their individual responses will be kept confidential. As explained in the ethics

section of this chapter, it is important that the participants fully understand and trust this to be true. As such, the cover letter was quite clear in this regard.

Participants were given a unique identification number for their questionnaires. The researcher had a master list of the participants' names and unique study identification numbers, and only the researcher saw and had access to this cross-referenced list. All the completed questionnaires and the cross-referenced list remain in the researcher's custody and control, being locked in a filing cabinet in the house of the researcher. The questionnaires will be destroyed five years after the study is completed.

Data Analysis

The responses from the pre- and post-tests were examined to identify changes in nutritional knowledge and behavior, as well the participants' reactions to the learning and technology used to learn with. The post-test had additional questions to determine connections, if any, that motivation, relevance, self-efficacy and self-regulated learning strategies had in regards to the participants learning with a mobile device.

Research question one, will learners' have a positive reaction to learning with mobile devices, as measured by Kirkpatrick's evaluation model? Data gathered from the post-questionnaire that is based on Kirkpatrick's level one 'reactions' evaluation was used. These survey questions are influenced by the Ally and Cleveland-Innes mobile device use questionnaire (Ally & Cleveland-Innes, 2011). The participant's responses to these questions were compiled and analyzed to determine the types of mobile devices used, for how long the participants have used mobile devices and what

their current frequency of use is, and what the participants use their mobile devices for. A five-point Likert scale was used in asking to what degree did they like or dislike using their mobile device for learning.

Research question two, can m-learning result in knowledge gain as measured by Kirkpatrick's evaluation model? Results were gathered from ten questions on the pre-questionnaire and ten questions on the post questionnaire. The questions on the both the pre and post questionnaires are identical. The questions are based on the nutritional content provided by a baccalaureate prepared registered dietician who holds a degree in nutrition and her staff of qualified dieticians. These dieticians have reviewed the questions and answers for accuracy and the questions were verified through a pilot study prior to being used in the study. The data gathered from the pre and post questionnaires were compared on an individual and group basis for differences in correct responses, SPSS (Version, 15) was used for the statistical analysis.

A parametric test such as a t-test requires a number of assumption to be true. These include, having a large enough random sampling, that results in normal distributions. Normal distributions being defined as having *z* scores of less than one (Moore & McCabe, 2006). The *z* scores for this study's results indicated the data might be non-parametric. While there is no standard agreed upon definition for non-parametric statistics, it is agreed non-parametric statistical procedures are used where the populations being compared do not have normal distributions (Wackerly, Mendenhall, & Scheaffer, 2008). Questions of validity can arise if there are uncertainties as to whether a valid statistical procedure was applied. In cases where

there can be questions about the data not meeting the assumptions for a parametric test, a non-parametric statistical procedure should be used (Wackerly et al., 2008Wac). "Research has shown that non-parametric statistical tests are almost as capable of detecting differences among populations as applicable parametric methods" (Wackerly et al., 2008, p. 742). A Mann-Whitney U test was the non-parametric statistical procedure chosen for statistical analysis of the second research question, as it is designed for use with two independent variables.

Research question three, can m-learning result in behavior change as measured by Kirkpatrick's evaluation model? Data gathered from a pre and post-survey for the mobile learning intervention were compiled to determine if any behavior change has occurred. The survey questions were designed to assess the participants general weekly diet, what their pre- and post-practice and game eating and drinking habits are, what if any supplements they are using, and what their alcohol consumption and timing of consumption are. The data gathered was analyzed on an individual and group basis for behavior changes that have occurred pre- to post-test relative to the mobile learning content.

The data obtained from the pre- and post-test, relating to research three are qualitative type data. In order to quantify this data, its pre- and post -test response were categorized by the number of positive changes that could be attributed to the m-learning. The data was categorized with respect to the type, timing and amount of; fluid intake, carbohydrate intake, protein intake, fat intake, and supplement use . The two sets of data were statistically analyzed using a chi-square test. A chi square test creates a statistically expected result and compares it to the actual result. Based on the

difference between the statistically expected result and the actual result a degree of significance is determined (Cohen et al., 2007). A Chi-square was used to statistically analyze the data for research question three.

Research question four, are there connections between learning with a mobile device and the motivation, self efficacy, relevance, and the use of self-regulated learning strategies?

Data gathered from post survey questions designed to assess;

a) how confident the participants were about being able to successfully use mobile devices to learn with,
b) if they felt the content was relevant to any goals they have,
c) to what degree they felt they were motivated to learn the nutritional content.
d) which, if any, self-regulated learning strategies did they use

This data was compared to each individual's results for knowledge gained and behavior change. The effects of self efficacy, relevance and self-regulated learning were then analyzed to determine their connections to learning and behavior change.

Pilot Study

It is important to know that research does not always work out the way it was planned to (Cohen et al., 2007). A pilot study should be conducted to determine if any issues with the questionnaires arise such that changes can be made prior to the study (Thomas et al., 2005). Pre-testing a questionnaire by means of a pilot study can be vital to its success. Applying the learning's from the pilot study will improve the reliability and validity of the questionnaire (Oppenheim, 1992; Wilson & McLean, 1994). A pilot study with seven players from ages 18 to 23 from hockey teams in a

similar league as those planned for study completion was carried out. The pilot study was intended to bring forth any issues with the questionnaires, or accessing the online learning material and discussion board so that any issues could be remedied prior to the main study being conducted.

Ethical Considerations

A major ethical dilemma faced by researchers is that they are driven to pursue the truth, while at the same time they must ensure that the values and the rights of their research subjects are not jeopardized (Cohen et al. 2007). The primary method of analyzing an ethical dilemma for a researcher is to consider the cost versus benefits ratio, and whether the possible benefits resulting from the research outweigh the costs to the subjects (Frankfort-Nachmias & Nachmias, 1992). Where an ethical dilemma exists, or could exist, the subjects need to be informed and understand the risks, and in order to participate, must then consent to cooperate in the research based on being fully informed (Cohen et al. 2007). Informed consent is when a person makes the decision to participate in a research investigation after being made fully aware of all the facts and information that could likely have an impact on his or her decision (Diener & Crandall, 1978). In chapter two the stages of change model (Prochaska et al., 1998; Marcus et al., 1998; Marcus & Simkin, 1994; Prochaska & Marcus, 1994; Riebe & Nigg, 1998), and the cognitive processes that that lead a person to change (Muraven, Tice, & Baumeister, 1998) noted that when a person goes through a behavior change, he or she experiences added stress. In this study, the participants will experience added stress as they attempt to change their nutritional behavior. If a participant in a study is going to experience added stress, then obtaining informed

consent from the participant is particularly important (Frankfort-Nachmias & Nachmias, 1992). Before any participant became involved in this study informed consent from him or her was obtained (Appendix G). Informed consent was obtained right at the very start of the study as is suggested by Cohen et al. (2007). If informed consent needs to be obtained before any subjects can be involved in a study, it is best to get the informed consent from the subjects early on. The application for ethics approval was submitted before the informed consent was required.

Approval from the Athabasca University Ethical Review Board was required for this study (Appendix H). All participants were required to sign an Informed Consent form. All the participants in this study were 18 years of age or older. A sample of the Informed Consent form is provided in Appendix G, as approved by the Athabasca University Ethical Review Board. All reasonable steps have been taken to protect the participants and their privacy.

Limitations

Limitations are weaknesses of a study that cannot be controlled (Thomas, Nelson, & Silverman, 2005). Limitations in this study are identified as the following: (a) The participants may have had varying knowledge levels and experience with the use of mobile technology; (b) There was varying degrees of interest in the m-learning topic of nutrition amongst the participants and this could have an effect on their motivation to learn and apply what they do learn; and (c) Participants were unable to complete the study for various reasons. This could be due to a number of reasons, some of which could be due to being released from the team's season, injuries,

suspension, or personal reasons; (d) bias introduced by the study's design. These limitations have the potential to negatively impact the credibility of the results.

Delimitations

Delimitations are weaknesses in the study as a result of the researcher's scope and design of the study. These delimitations exist as a result of the decisions the researcher makes to design a study to gain insight into a workable problem (Kroll, 1971). Delimitations of this study include the fact that only a limited number of teams make up the participants, whereas a larger sample size would make the results more valid. Only the sport of hockey is being considered, and further to this, all the participants were in essentially the same environments. Behavior change is only being assessed at a maximum of three weeks following the m-learning. A greater length of time would allow for greater validity. The participants involve a narrow range of ages—all are young adults between ages 18 and 26.

Assumptions

Assumptions of the study address considerations such as: (a) The participants performed to the best of their ability, and responded to the evaluations as accurately and honestly as possible; (b) All participants started off with similar reasons for their interest and motivation for being involved in the study and the young adult participants all have had similar experience, knowledge and skills background relative to the topic to be learned; (c) The test instruments has accurately measured what they are designed to: and, lastly, the delimitations and limitations will not have a large enough effect to skew the results to the point that they are not of value.

Summary

This quantitative research study used a quasi experimental design. The study delivered nutritional education using m-learning to elite level male and female hockey players to fulfill their self- determined sports nutrition learning objectives. Pre- and post-tests were used to gather information related to the participants reactions to the m-learning, the nutritional knowledge learned, and behavior habits of the participants, and to identify any connections between m-leaning and motivation, relevance, self-efficacy and the use of self regulated learning strategies. The participants were free to participate, or not participate in the study. Further, the participants had the right to drop out of the study at anytime without having to provide any explanation. Each participant signed an informed consent form in order to participate. This study was approved by the Athabasca Ethics Review Board.

Chapter 4: Results

Introduction

This chapter reports the research findings addressing the pilot study and the main study's research questions relating to Kirkpatrick's evaluation model and the connection, if any, between m-learning and motivation, self efficacy, relevance, and the use of self regulated learning strategies. The pilot study involved seven participants who tested the research questionnaires and online material. The pilot results found the questionnaires to be clearly understood and easily comprehended. The pilot yielded no issues with accessing, and using the online material. The main study's findings were derived from 27 participant's responses to pre- and post-questionnaires that the pilot group had verified as being unambiguous. The quantitative and qualitative data from these 27 participants will be presented in this chapter.

Sample Dynamics Relative to Mobile Devices

The post-questionnaire gathered qualitative data from the participants to determine specifics about their mobile device choices, usage, and interactions. Some of these questions come from a slightly modified version from Athabasca University professors and researchers Dr. M. Ally and Dr. M. Cleveland-Innes mobile device questionnaire (Ally & Cleveland-Innes, 2011), while others were derived from Koole's (2006) Framework for the Rational Analysis of Mobile Education (FRAME) model. The FRAME model is used to examine the relationship between mobile devices, learning environments and their users. This information, presented with descriptive statistics creates a profile of the participants and their uses, experiences

and choices with respect to mobile devices. This data is relevant in chapter five's discussion of the results in answering the research questions.

The participants were asked, "How many mobile devices do you currently use?" Twenty-two percent responded that they use one, 48% currently use two and 30% use three, none of the participants stated they currently use four or more mobile devices. The mean(with standard deviations in parentheses) number of devices used by participants was reported to be 2.1(0.52).

To the request "Select the mobile device that you used MOST OFTEN in learning the nutritional content", 7% of the participants replied with an Apple iPad tablet, 59% used an Apple iPhone smart-phone, 4% used an Android powered smart-phone, and 30% used a laptop with mobile internet connectivity (see Figure 1).

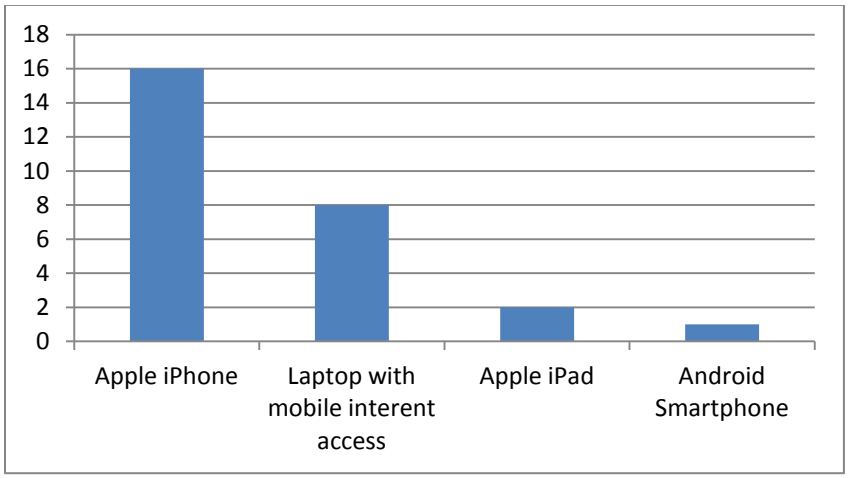

Figure 1. What type of mobile device did you use most often in learning the content?"

The participants were asked "How long have you been using your current mobile device?" Nineteen percent replied zero to six months, another 19% said 6 to 12 months, and 19% replied one to two years, 22% stated two to three years, 11% said

for three to five years, 7% replied five to ten years, and 4% said for ten or more years. The mean length of time a participant has been using their current mobile device is somewhere in the time frame between one to two years.

To the question "How often do you use this mobile device?" The participants responded with 11% stating they use the mobile device one to two times per day, while the other 89% participants reported using their mobile device three or more times per day.

The participants were asked, "What do you generally use this mobile device for?" They were given several options and asked to mark all the ones that apply. One of the options given was "Other" and left a space for the participant to specify anything that was not given as an option. None of the participants chose "Other" as one of their responses. Fourteen replied they used their mobile device for formal learning, 13 for learning informally, eight for work related uses, 18 said for socialization and 24 reported pleasure use among their uses (see Figure 2).

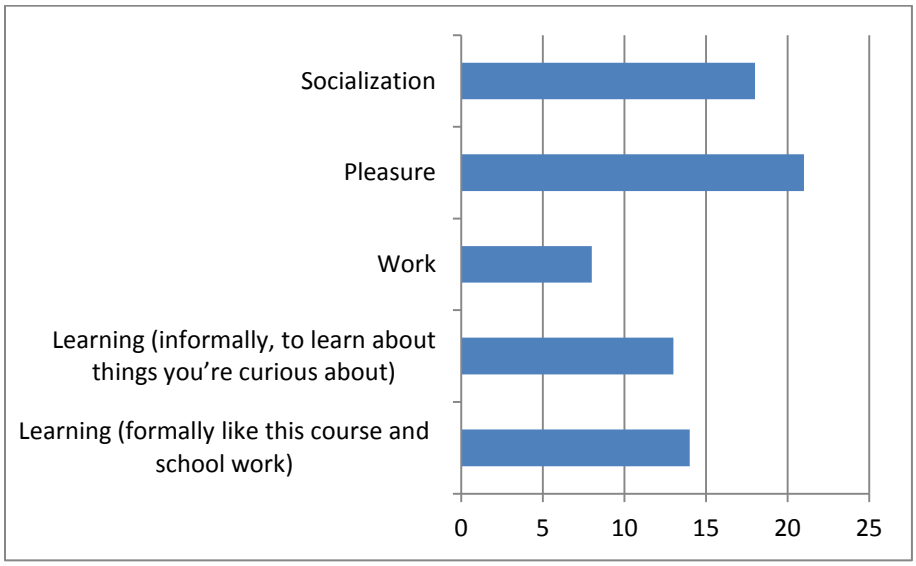

Figure 2. What do you generally use this mobile device for?

The participants were asked "Did anything significant interfere with your learning in this study?" and they were asked "Did you experience problems or difficulties in using the mobile device to learn with?" Fifty-nine percent reported that something significant did interfere with their learning, only 4% reported experiencing difficulties or problems using their mobile device to learn with (see Figure 3). Indicating the use of mobile devices did not present a learning problem for the participants.

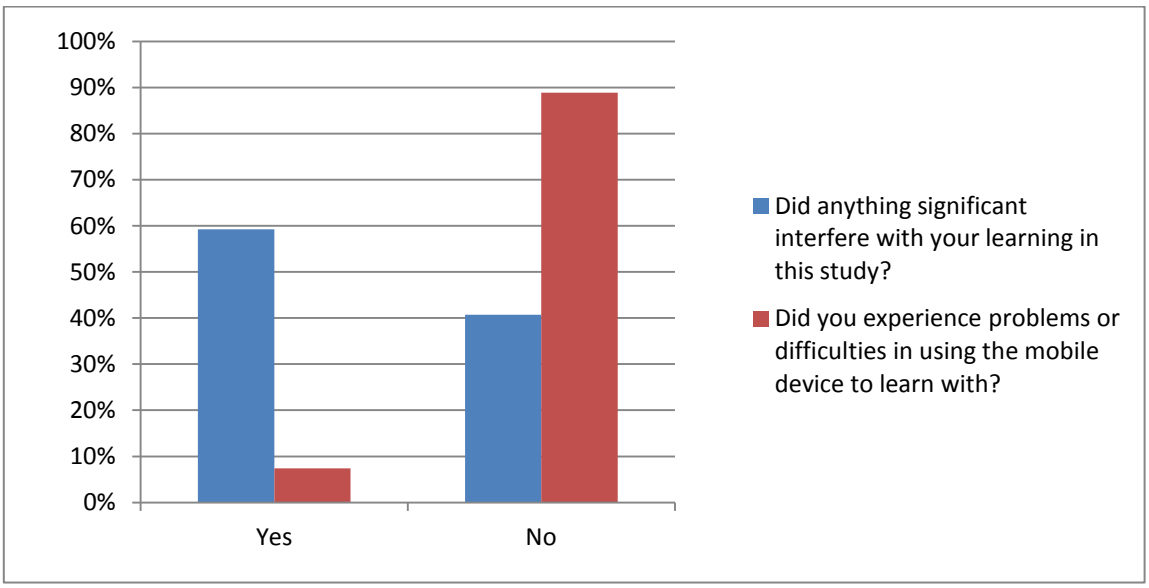

Figure 3. Interference or difficulties with mobile device?

The participants were asked "Have you taken a course using a mobile device in the past?" Eleven percent of the participants had taken a course using a mobile device in the past. Eighty-nine percent reported they had not taken a course using a mobile device before.

The participants were then asked, "If you answered YES to having used a mobile device to take a course in the past, how did you feel about learning that way?"

The responses were one participant responded with a score of two (did not like it), one participant scored their feeling a three (neutral), and one participant rated it a four (liked it) on a Likert Scale of one to five with one being I really liked it" to five being "I did not like it".

The participants responded to a series of questions in three areas derived from the FRAME model (Koole, 2006). The FRAME Model examines the relationship between mobile devices, users and learning environments. Appendix I contains the questions and answers from mobile laptop users. Appendix J contains the questions and responses from smartphone users and Appendix K contains the questions and responses from tablet users.

Research Question 1

The first research question of this study is;

> What will the learner's reaction be to learning with mobile devices, as measured by Kirkpatrick's evaluation model (level one)?

In order to gain insight into this question, the participants were surveyed for both their reactions to the content (what they were learning) and for their reactions to using a mobile device (how they were using technology to learn). This was done to separate reactions, for example if a participant really liked the content, but not the delivery via a mobile device they might respond positively to a more general question about their reaction to learning with a mobile device because of their "like" for the content. At the same time negative reactions to the content could be a reflection on the delivery mode. For example if the videos are poorly shot for viewing on a small screen, the video quality could be given a negative reaction, and by extension the

participants might then give learning with a mobile device a lower rating than it deserves.

The participants were asked, "How would you rate the content of the nutritional learning?" Twenty-two percent of the participants reported they found the content very interesting, 30% said it was somewhat interesting, 41% reported it was interesting, 7% replied it was a little interesting and none of the participants found the content to be not very interesting (see Figure 4).

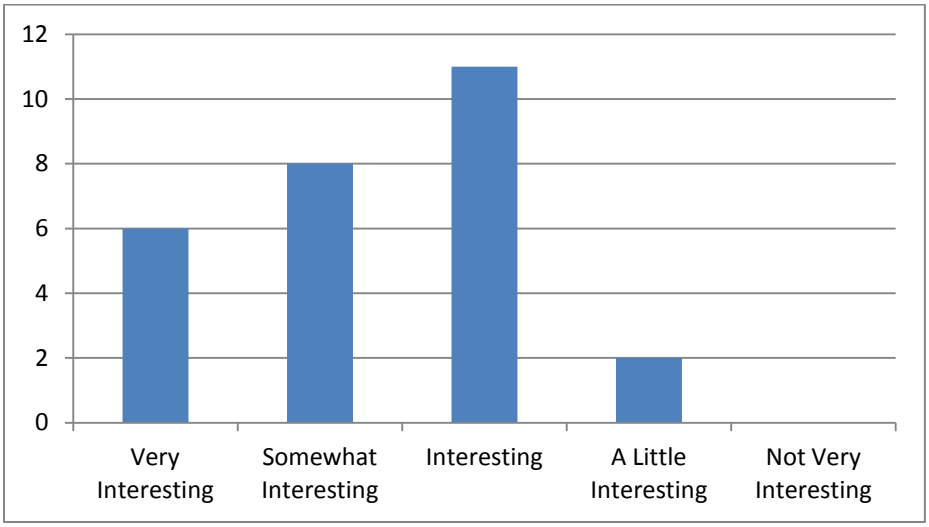

Figure 4. How would you rate the content of the nutritional learning?"

The participants were asked to respond to the question "How would you rate the videos?" Seven percent of the participants reported the videos as being "excellent," 44% reported that they found the videos to be "very good," 41% found the videos to be "good," 7% of the participants stated the videos were "fair," and none of the participants reported the videos to be "poor" (see Figure 5).

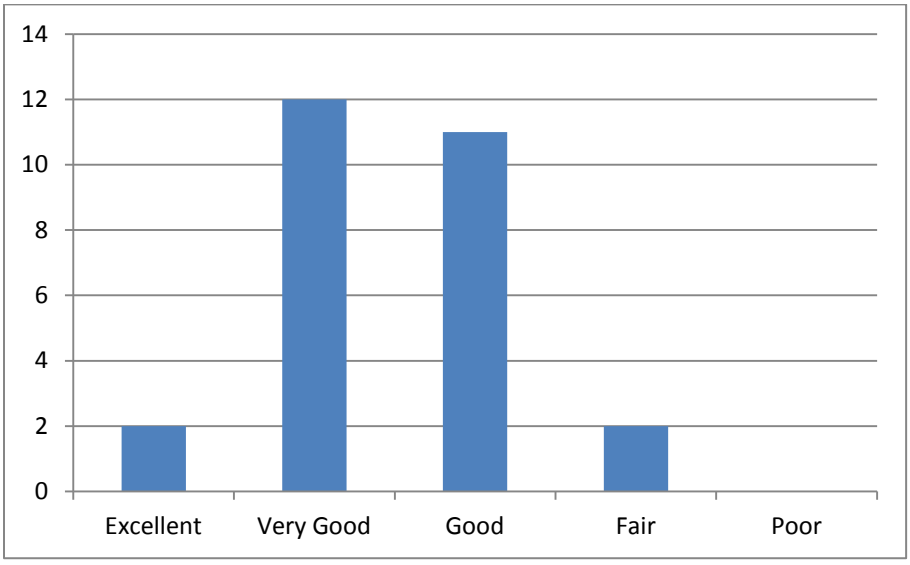

Figure 5. How would you rate the videos?

The participants were asked, "How would you rate the non video content?" Eleven percent responded they found it "excellent," 26% replied it was "very good," 56% found it to be "good," 4% reported it was "fair," and 4% found it to be "poor" (see Figure 6).

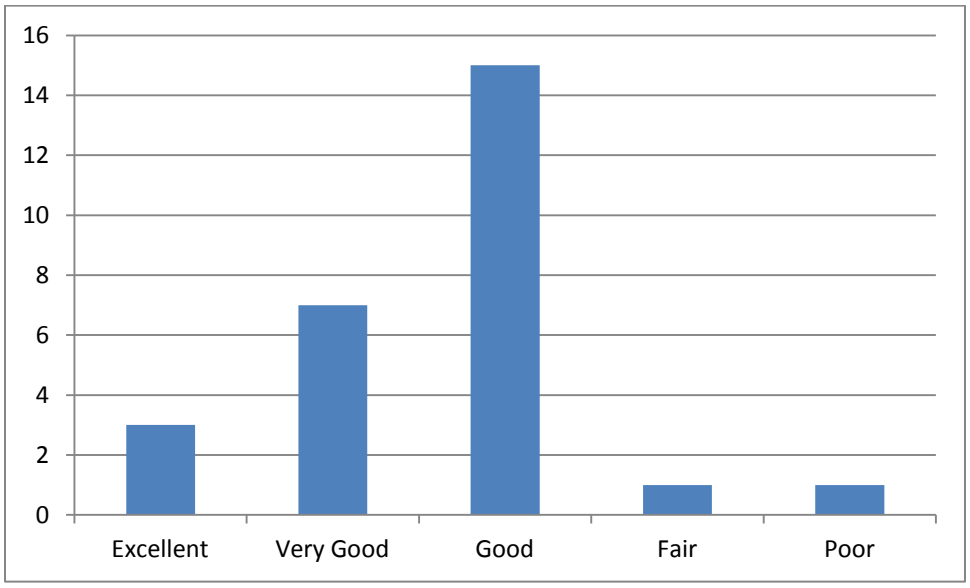

Figure 6. How would rate the non video content?

The participants reported on "How would you rate the support (being able to ask questions and how they were answered or not answered, did you like this approach)?" Three percent of the participants replied the support was "excellent," 37% of them felt it was "very good," 41% responded it was "good," and 4% responded it was "fair," and none of the participants replied it was "poor" (see Figure 7).

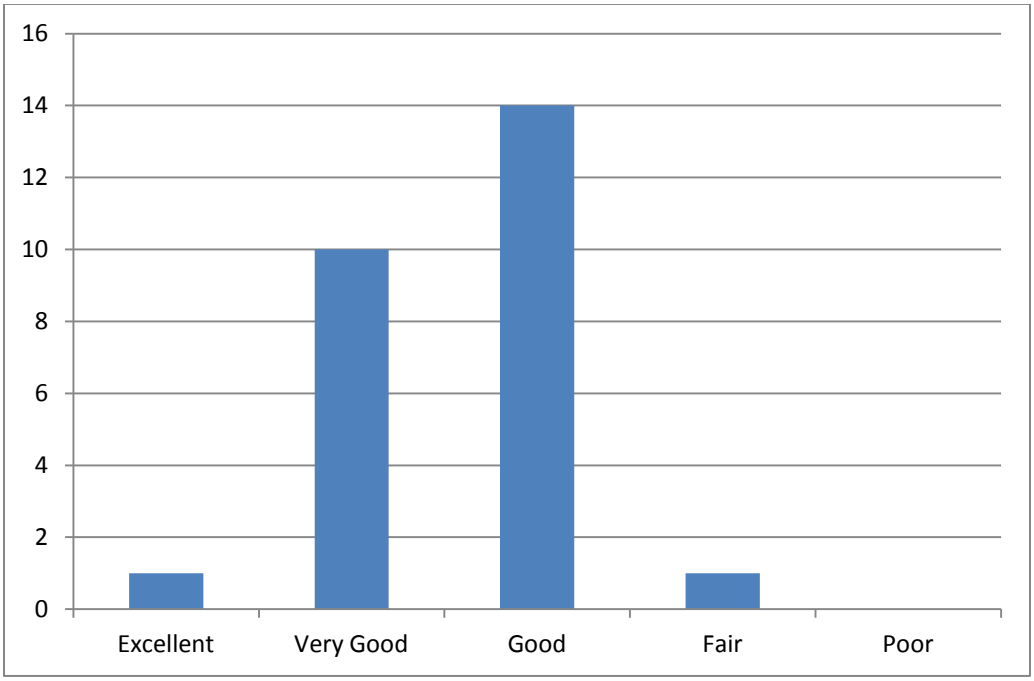

Figure 7. How would you rate the support (being able to ask questions and how they were answered or not answered, did you like this approach)?"

The participants were given a five point Likert scale to respond to, "The content (videos, text docs, and methods used to ask and answer questions) was well prepared and easy to use?" Five on the reporting scale represented "Yes very much" while one on the scale represented "No not at all." Twenty-two percent of the participants responded with a five rating, 37% with a four rating, 30% with a rating of three, and 7% with a rating of two, and none of the participants reported a one (see

Figure 8). The mean (with standard deviations in parentheses) for the reactions to the content were 3.7(1.0).

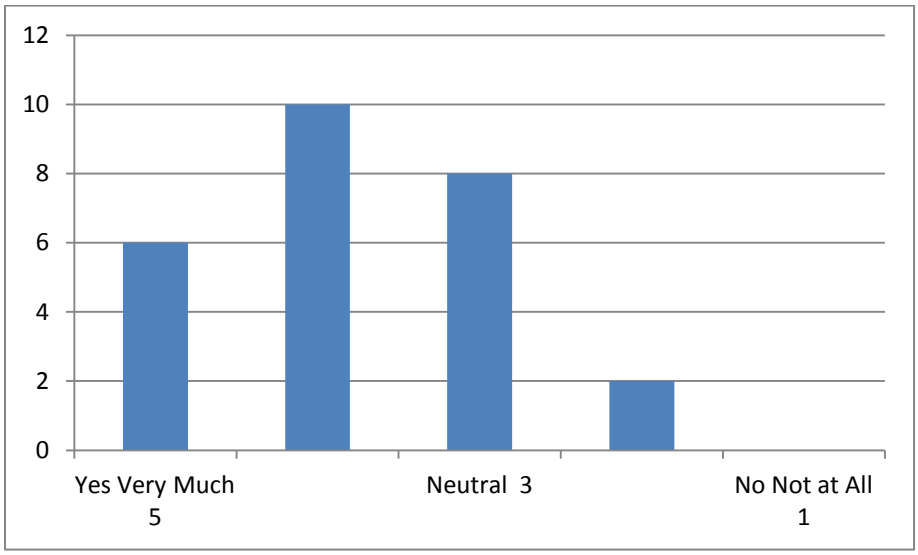

Figure 8. The content (videos, text docs, and methods used to ask and answer questions) was well prepared and easy to use?

The participants were asked, "How would you rate learning using a mobile device (convenience, comfort)?" Eight percent replied with a rating of "excellent," 31% responded with a rating of "very good," 42% gave it a rating of "good," 19% rated it "fair," and no participants reported it as being "poor" (see Figure 9).

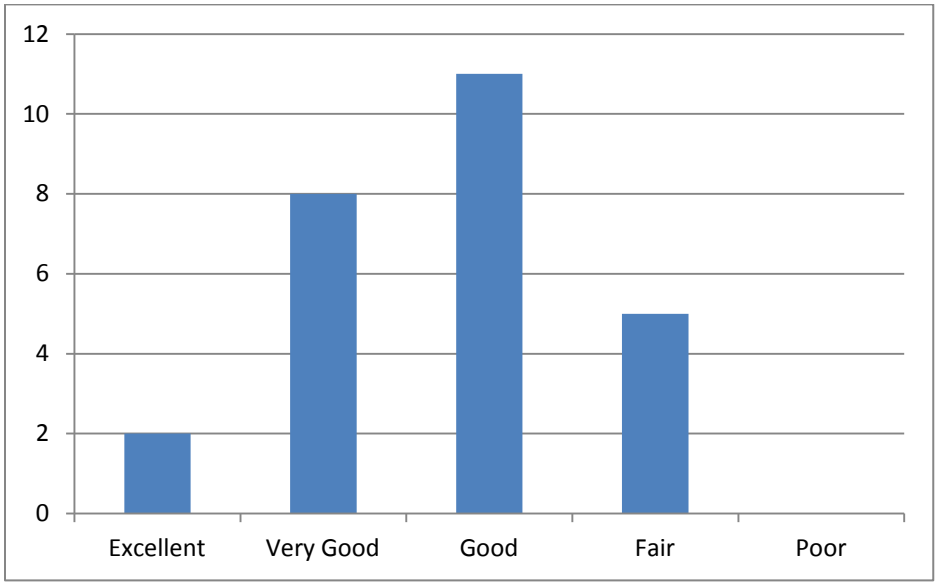

Figure 9. How would you rate learning using a mobile device (convenience, comfort)?

The participants were posed with, "The method of delivery (via mobile devices) used to teach the nutritional learning was an interesting and enjoyable method for me?" The participants were given a five-point Likert scale to respond with. A score of five represented they "very much" liked the mobile device as a delivery method at the other end of the scale one represented they did "not all" like the mobile device as a delivery method for the learning. Four percent of the participants responded with a score of five, 23% with a score of four, 58% with a score of three, 4% with a score of two and 11% with a score of one (see Figure 10). The mean (with standard deviations in parentheses) for the method of delivery (via mobile devices) used to teach the nutritional learning was 3.0(0.9).

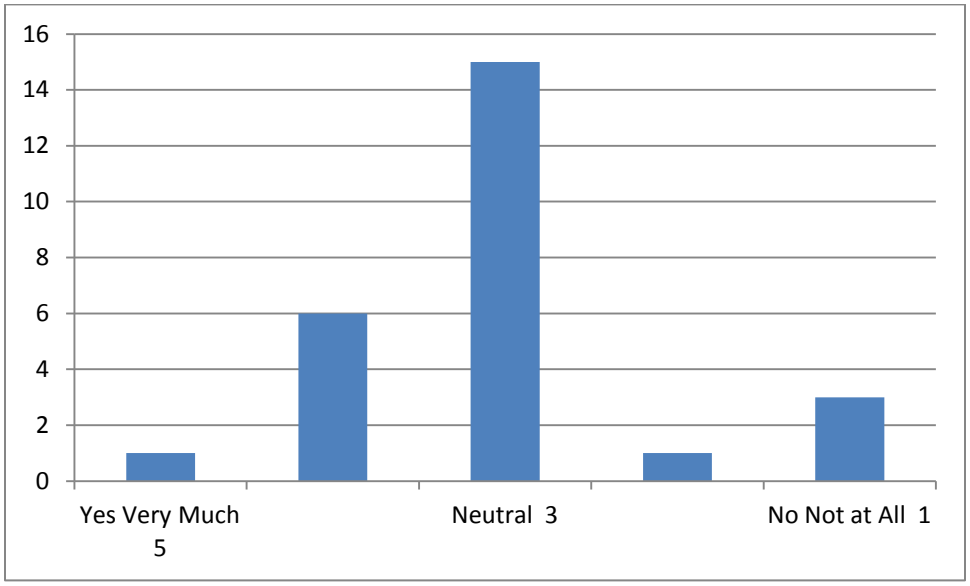

Figure 10. The method of delivery (via mobile devices) used to teach the nutritional learning was an interesting and enjoyable method for me?

To determine the participant's reaction to if they felt the content was useful and could be applied in a beneficial way they were posed with the statement, "I will be able to apply the nutritional learning in a beneficial way." The participant's option to reply was via a Likert scale that ranged from five representing they "very much" felt the content would be useful and beneficial for them, to one at the opposite end of the scale that represented they did "not at all" feel the content would be useful and beneficial. Twenty-six percent scored this with five, 44% gave it a score of four, 11% scored it three, 15% scored it as a two and 4% scored it as a one (see Figure 11). The mean (with standard deviations in parentheses) for the participant's reaction to if they felt the content was useful and could be applied in a beneficial way, was 3.7(1.1).

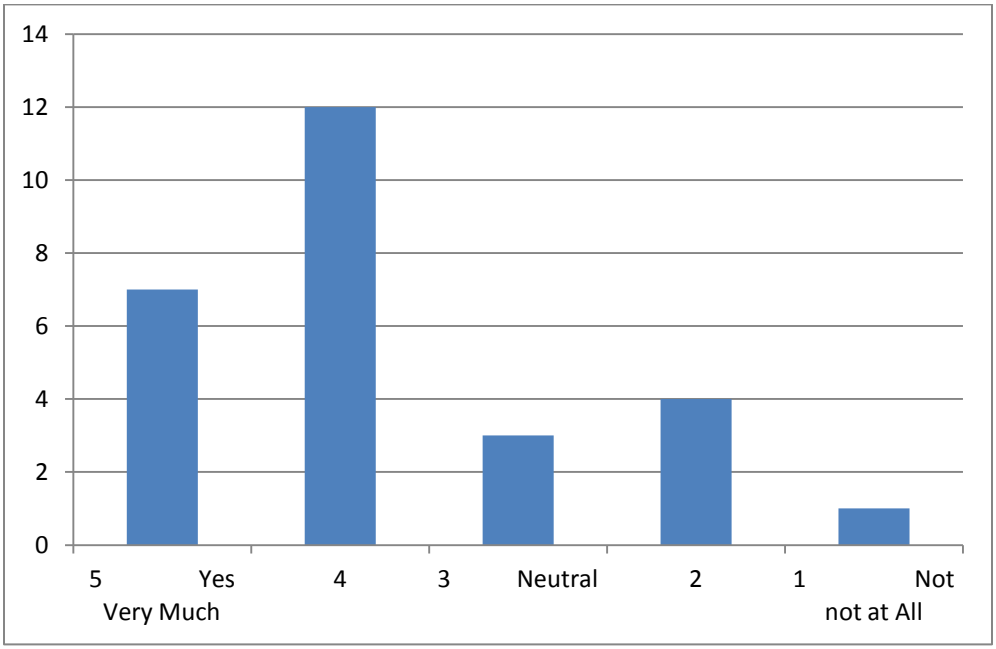

Figure 11. I will be able to apply the nutritional learning in a beneficial way.

A summary of all the reactions indicate the overall reaction to the learning was positive. The totals include reactions to both the content and the participant's reactions to learning with a mobile device. All the reactions to each individual question were totaled to achieve an overall reaction score. Eighty-one percent reported better than neutral reactions, seven percent had a neutral overall reaction and 11% had a more negative than a neutral reaction to learning the content via a mobile device.

A summary of just the mobile device reactions indicate an overall positive reaction to learning with a mobile device. Seventy percent of the participants overall reaction to using a mobile device for learning was more positive than a neutral or negative response, 7% had an overall neutral response and 22% of the participants overall reactions were more negative than neutral or positive.

The participants were asked if they went outside of the content provided to learn more about nutrition. Fifteen percent of the participants reported that they did go beyond the content provided. Eighty-five percent of the participants responded that they did not go outside of the provided mobile learning.

The participants were asked which self-regulated learning strategies they employed. The participants were given a number of self-regulated learning strategies to choose from. Twenty of the 27 participants responded to this question. Therefore the highest number responses any one particular strategy could score would be 20. Sixty-five percent of the participants who responded reported using goal setting. Sixty percent reported using self-monitoring. Fifty-five percent responded they employed self-evaluation. Forty-five percent reported using time management. Forty percent reported making adjustments to, or selecting specific environment in which to do the learning. Thirty-five percent reported employing strategic planning (making deliberate plans on what topics to learn and when). Thirty percent reported using organization (connecting what they were learning to what they already knew about nutrition). Twenty percent reported using elaboration (seeking information from outside the course content). Twenty percent reported using effort regulation. Ten percent reported using cognitive rehearsal and two reported obtaining help form others (see Figure 12).

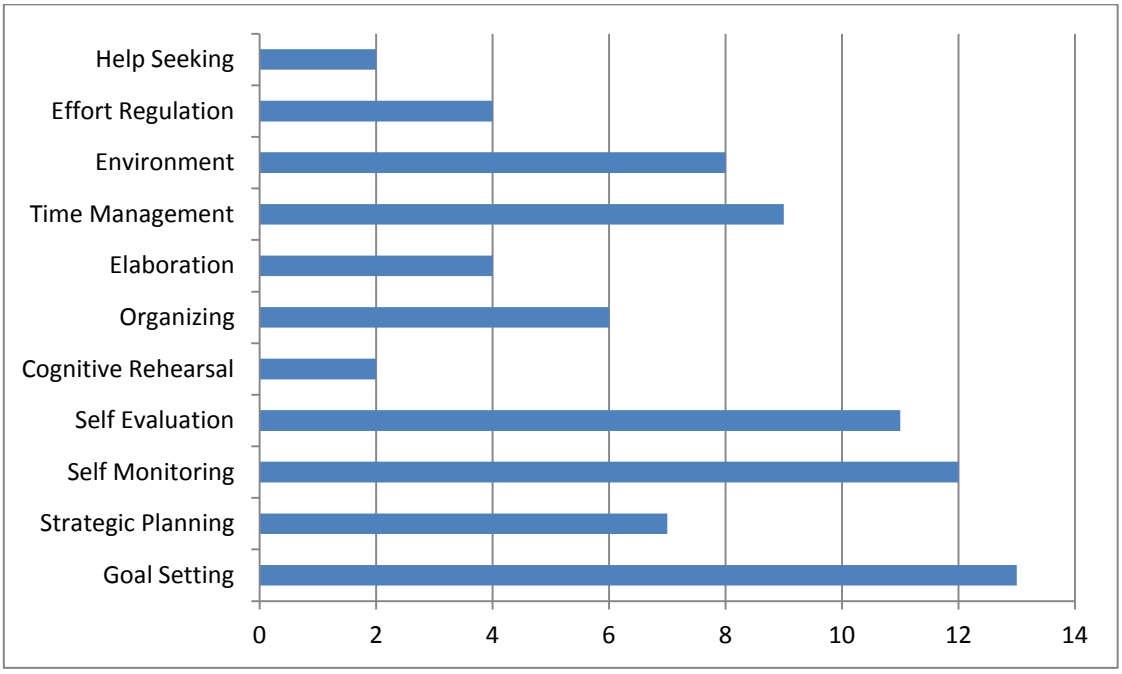

Figure 12. Self regulated learning strategies employed by participants.

Research Question 2

The second research question of this study is;

Can m-learning result in knowledge gain as measured by Kirpatrick's evaluation model (level two)?

To answer this question, a 10 item test and scoring system was developed in conjunction with a registered dietician holding a bachelor of science degree in nutrition and her staff of qualified dieticians who provided the content for the mobile learning. The test questions and answers related directly back to material taught in the instructional videos, reinforced in the supporting text documents and were part of discussion topics on the discussion board. Each of the ten questions had a maximum score of 10 points, giving the test a maximum score of 100.

The first test question yielded 52% of the participants whose mark improved from pre-test to post-test, while 7% of the participant's marks decreased. Forty-one percent who scored the same, 11% of who had full marks on both the pre- and post-test (see Figure 13). The means (with standard deviations in parentheses) for the pre test score was 3.4(3.6) out of 10 and it improved to a mean value of 5.3(3.9) out of 10 on the post test (see Figure 14).

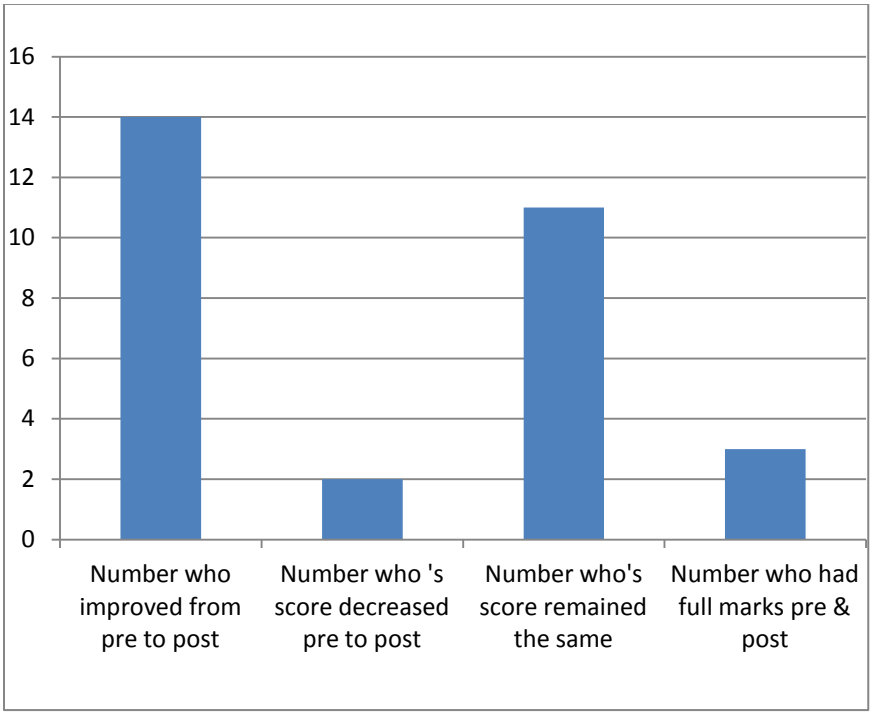

Figure 13. Pre to post test score changes for Question 1

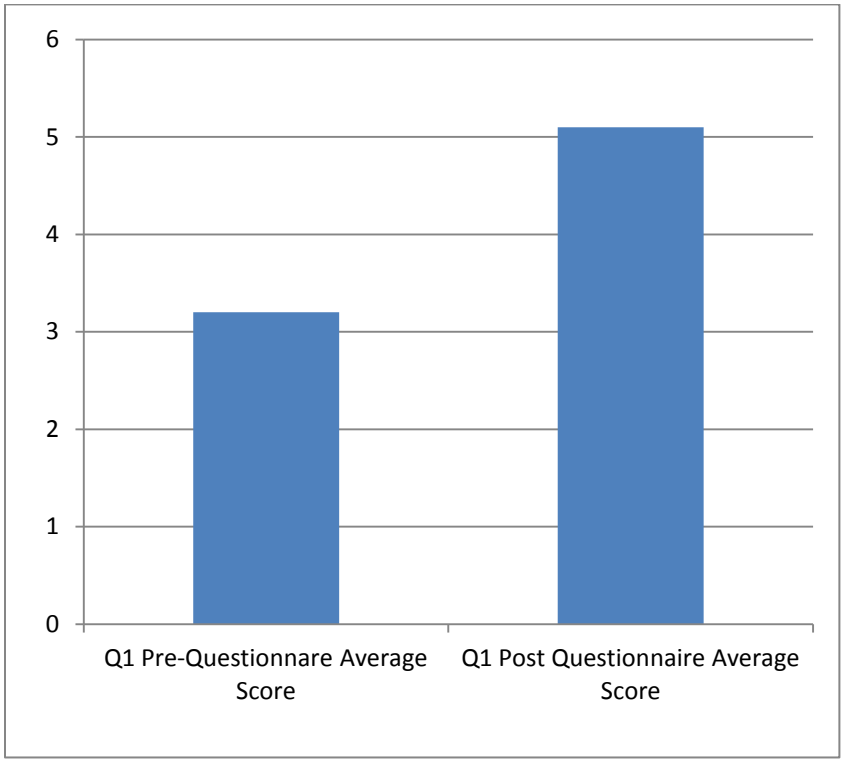

Figure 14. Mean values for pre and post test Question 1

The second question resulted in 33% of the participants improving their score from pre test to post test, while 15% participants score decreased. Fifty-two percent achieved the same mark, and 44% had full marks on both the pre and post tests (see Figure 15). The mean (with standard deviations in parentheses) for the mark achieved on the pre test was 6.6(4.2) out of 10, and the mean value for the post test mark was 7.1(4.1) out of 10 (see Figure 16).

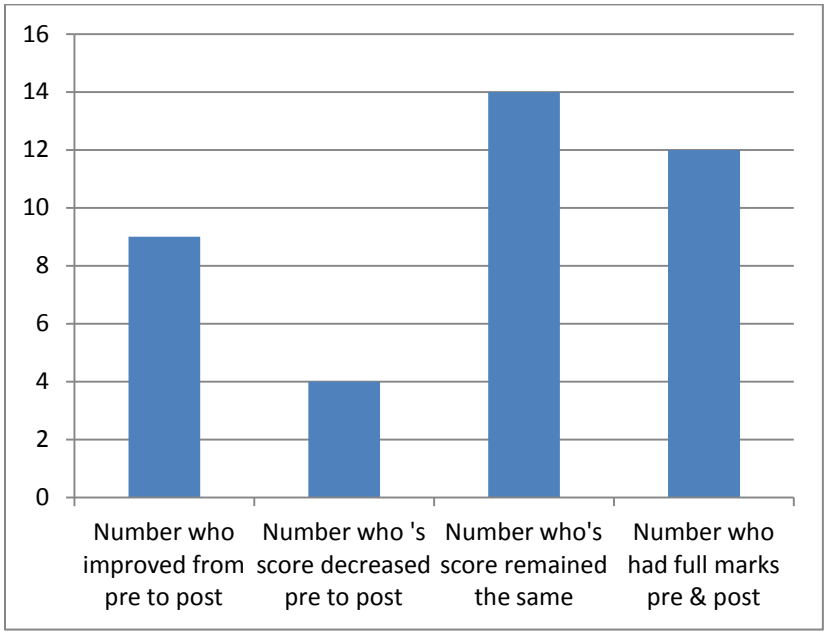

Figure 15. Pre to post score changes for Question 2.

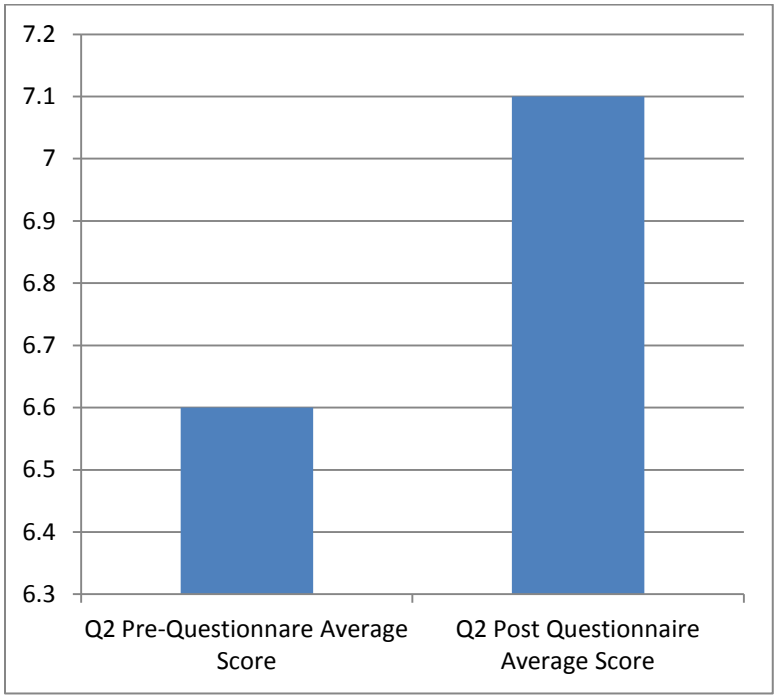

Figure 16. Mean values for pre and post test Question 2.

Question three responses resulted in 30% of the participants improving their mark, and 7% participants whose mark decreased. Sixty-three percent of the participants mark remained the same, 15% of whom had full marks on both the pre and the past test (see Figure 17). The mean (with standard deviations in parentheses) for pretest question three was 3.2(2.9) out of 10, while the mean for the post test was 5.4(4.2) out of 10 (see Figure 18).

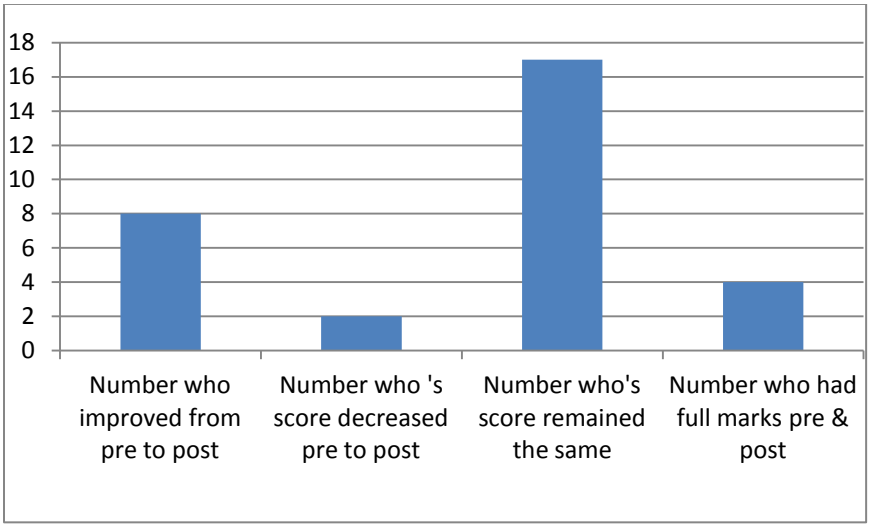

Figure 17. Pre to post score changes for Question 3.

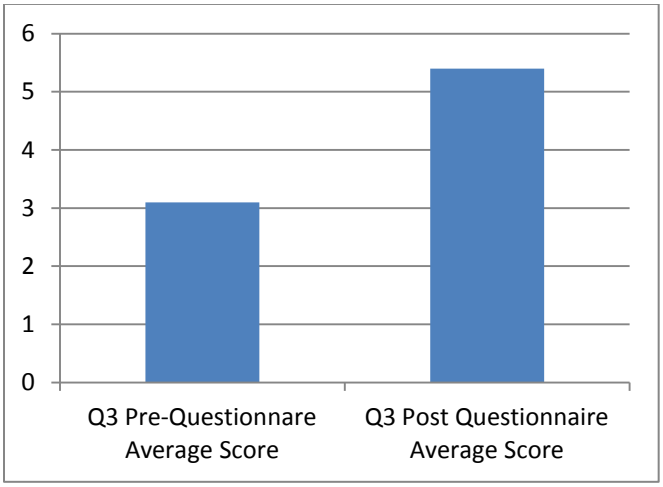

Figure 18. Mean values for pre and post test Question 3.

The fourth question revealed 89% of the participants achieved a perfect mark on both the pre and the post test. Eleven percent of the participants improved their mark from pre to post test and 4% of the participants mark decreased from pre test to post test (see Figure 19). The mean (with standard deviations in parentheses) for the pre test was 9.3(2.2) out of 10 and the mean post test mark was 9.5(1.9) out of ten (see Figure 20).

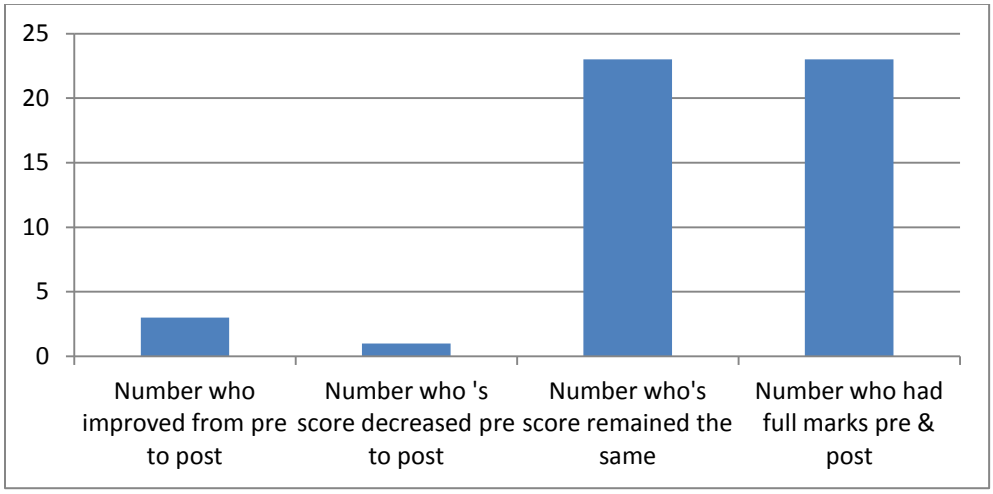

Figure 19. Pre to post score changes for Question 4.

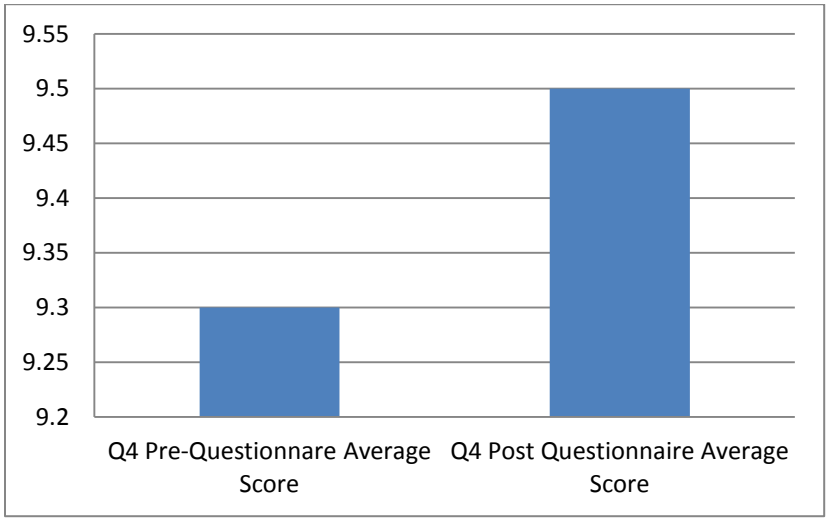

Figure 20. Mean values for pre and post test Question 4.

Question five yielded 67% of the participants who had their mark increase from the pre test to the post test, and saw no participants have their mark decreased from pre test to post test. Thirty-three percent of the participants mark remained unchanged from pre to post test, 7% of whom achieved a full mark on both pre and post tests (see Figure 21). The mean (with standard deviations in parentheses) for pretest question five was 1.1(2.9) out of 10 and the mean score for the post test was 7.5(4.3) out of 10 (see Figure 22).

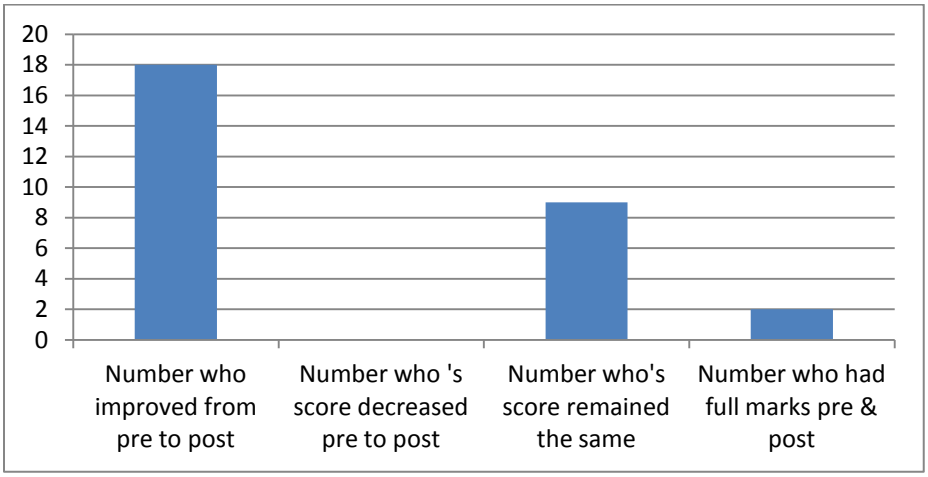

Figure 21. Pre to post score changes for Question 5.

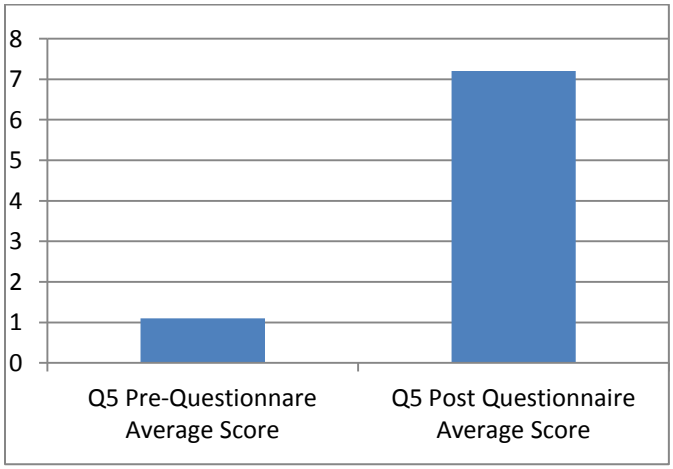

Figure 22. Mean values for pre and post test Question 5.

Question six resulted in 19% of the participant's marks increasing from the pre test to the post test, with no participant's score decreasing from pre to post test. Eighty-one percent had their score remain the same, while none of these participants achieved full marks on either the pre or post test (see Figure 23). The mean (with standard deviations in parentheses) for the mark achieved on the pre test was 1.9(0.5) out of 10, and the mean for the post test mark was 2.9(2.6) out of 10 (see Figure 24).

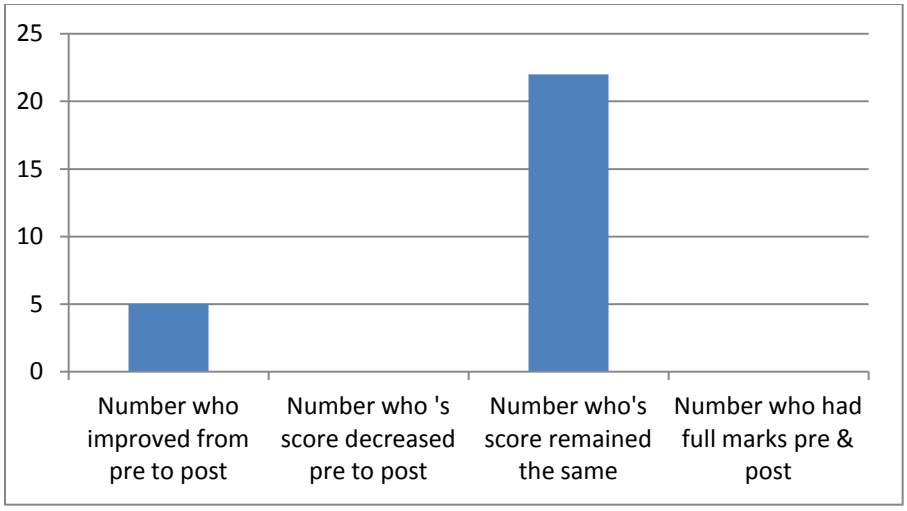

Figure 23. Pre to post score changes for Question 6.

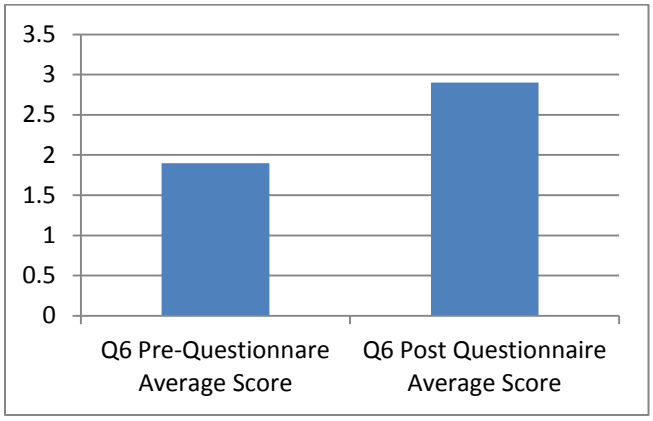

Figure 24. Mean values for pre and post test Question 6.

Question seven resulted in 19% of the participant's mark increasing from the pre test to the post test. Seventy-four percent of the participant's score remained the same, 4% of whom had full marks on both the pre and the post test (see Figure 25). The mean (with standard deviations in parentheses) for the score achieved for the pre test was 1.2(2.7) out of 10, and the post test mean score was 2.5(4.1) out of 10 (see Figure 26).

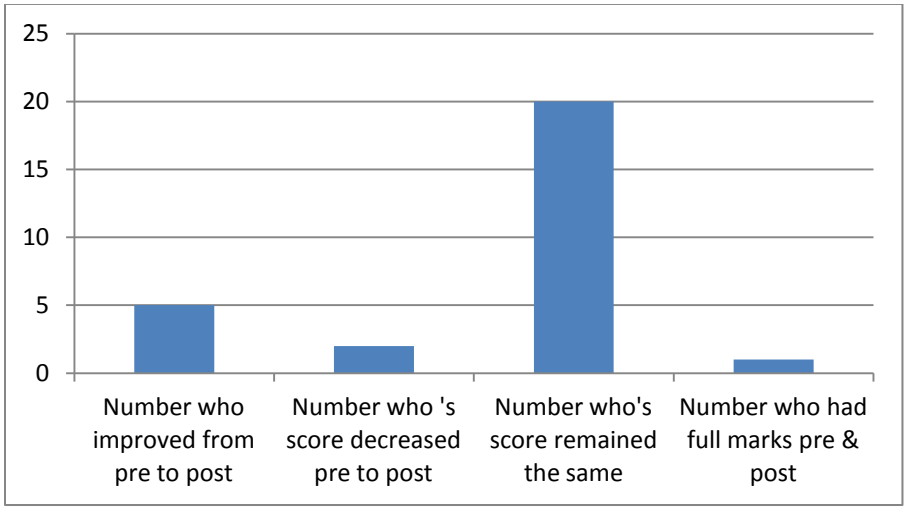

Figure 25. Pre to post score changes for Question 7.

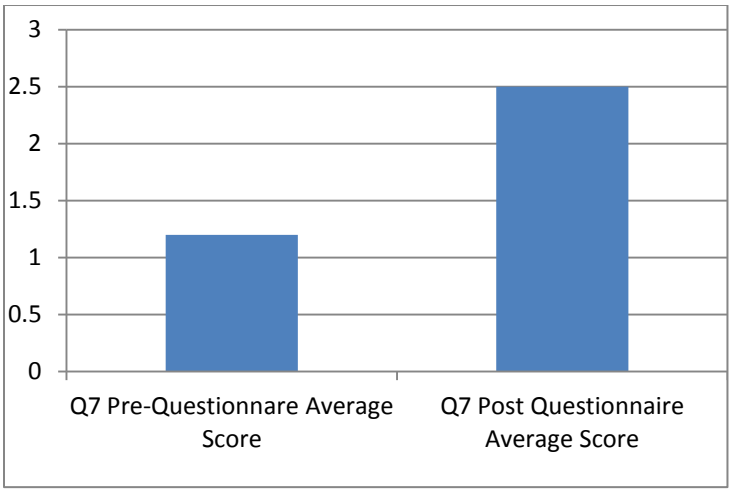

Figure 26. Mean values for pre and post test Question 7.

Question eight tallied 41% of the participants whose mark increased from pre test to post test, and 7% whose mark decreased pre to post test. Fifty-two percent of the participants score remained unchanged pre to post test, 4% of who had full marks on both the pre and the post test (Figure 27). The mean (with standard deviations in parentheses) for the pre test was 4.6(3.0) out of 10, and the mean score for the post test was 5.7(3.1) out of 10 (Figure 28).

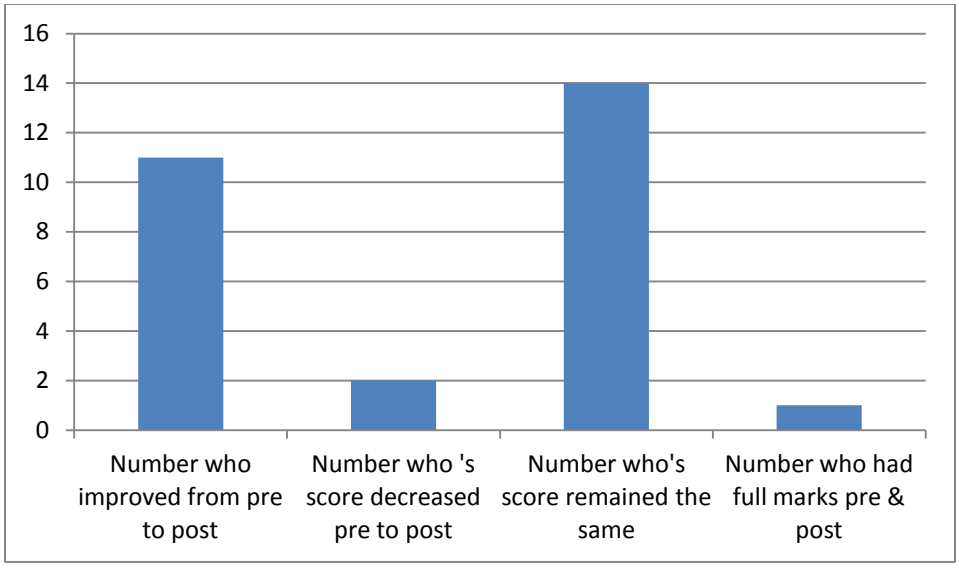

Figure 27. Pre to post score changes for Question 8.

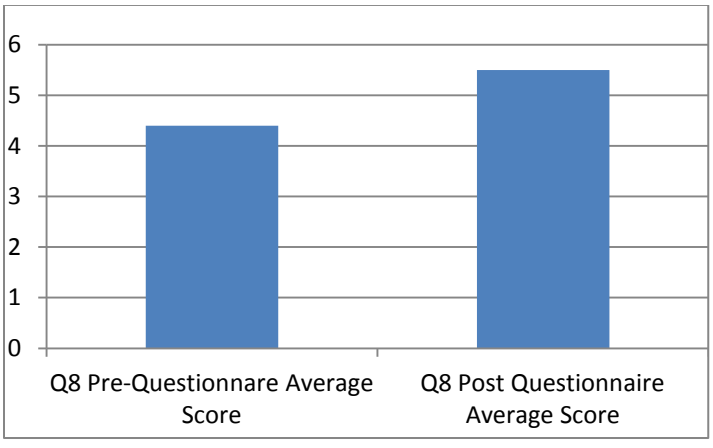

Figure 28. Mean values for pre and post test Question 8.

Question nine resulted in 22% of the participants whose mark increased from the pre test to the post test, and 4% whose mark decreased for pre to post test. Seventy-four percent of the participants score remained the same and none of the participants whose score remained unchanged scored full marks on either test (see Figure 29). The mean (with standard deviations in parentheses) for the pre test was 7.6(3.7) out of 10, and the mean mark for the post test was 8.4(3.3) out of 10 (see Figure 30).

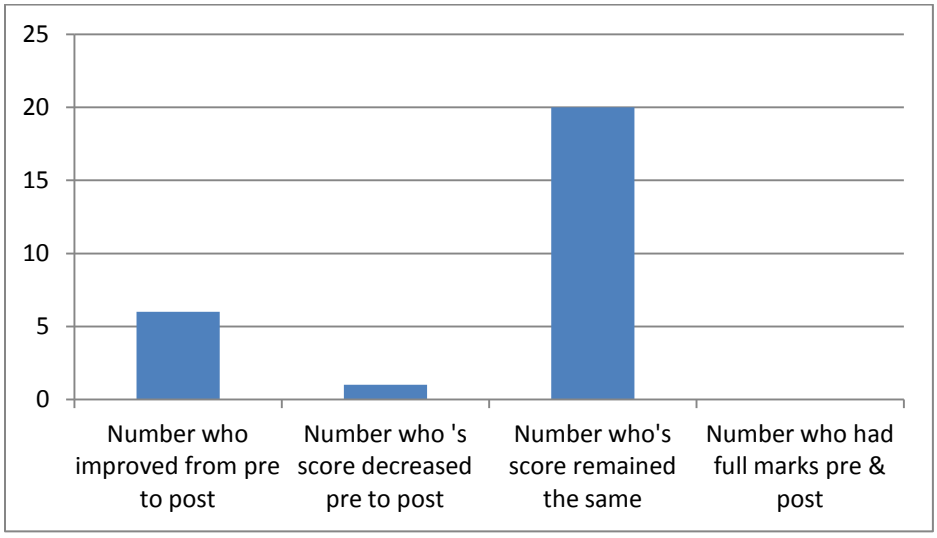

Figure 29. Pre to post score changes for Question 9

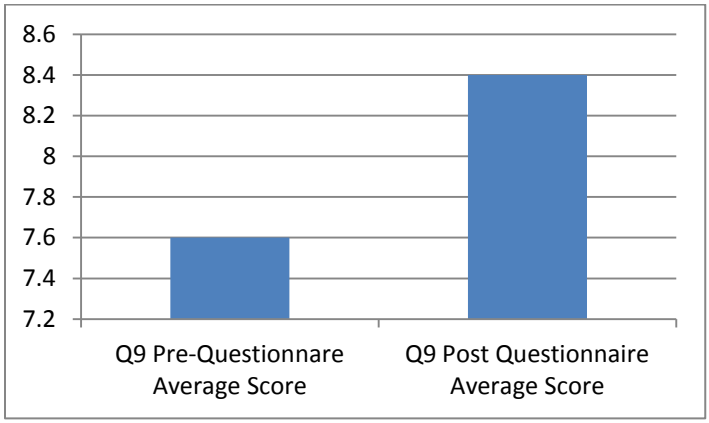

Figure 30. Mean values for pre and post test Question 9.

Question ten resulted in twenty-six percent of the participants mark increasing from the pre test to the post test, and 11% of the participants mark decreased from pre to post test. Sixty-three percent had their score remain the same, 4% of these participants scored a full mark on both pre and post tests (see Figure 31). The mean (with standard deviations in parentheses) for the pre test was 1.9(2.4) out of 10, and on the post test the score was 2.3(2.9) out of 10 (see Figure 32).

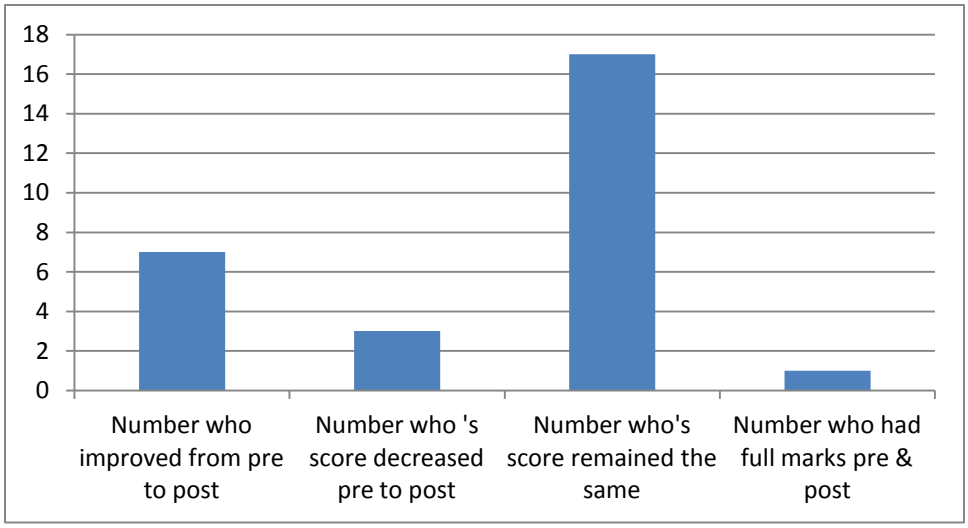

Figure 31. Pre to post score changes for Question 10.

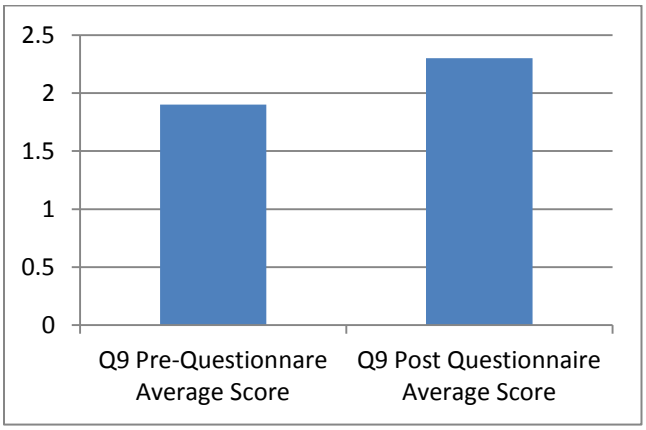

Figure 32. Mean values for pre and post test Question 10.

A summary of all ten pre test, and post test questions with resulting score differences are shown in Figure 33. An overall mean score of 40.2 for the combined ten questions of the pre test and the overall mean score of 56.4 for the post test are displayed. The resulting net change overall from the pre test to the post test scores was an increase of 16.2%.

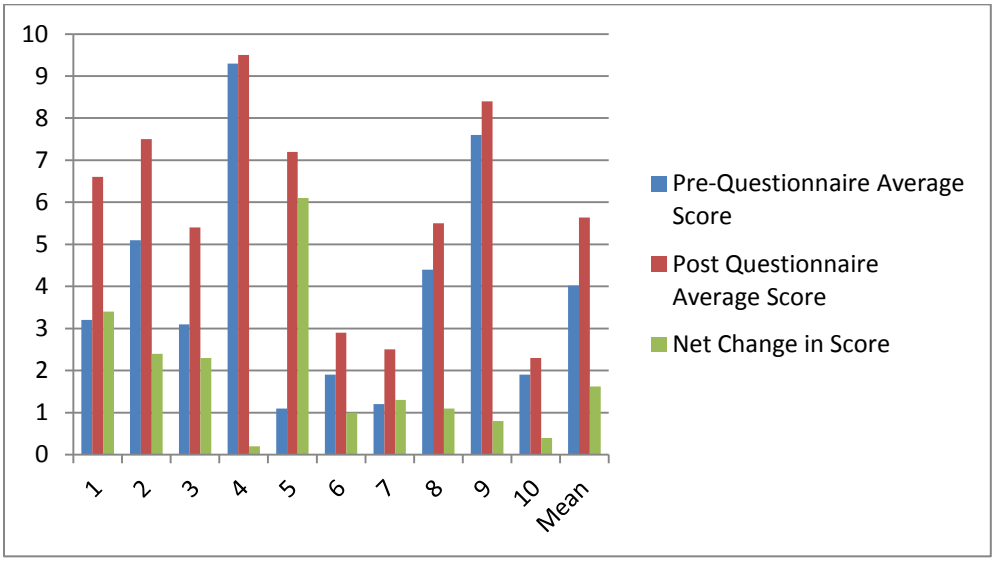

Figure 33. Summary of all ten pre and post test question results.

The highest mark achieved on the pre test was 60.5, the highest mark achieved on a post test was 97.5. The lowest score achieved on a pre test was 20.0 and the lowest mark scored on a post test was 28.5. The largest increase from pre to post test was 63.5 and the lowest increase from pre to post test was minus 10 (see Figure 34).

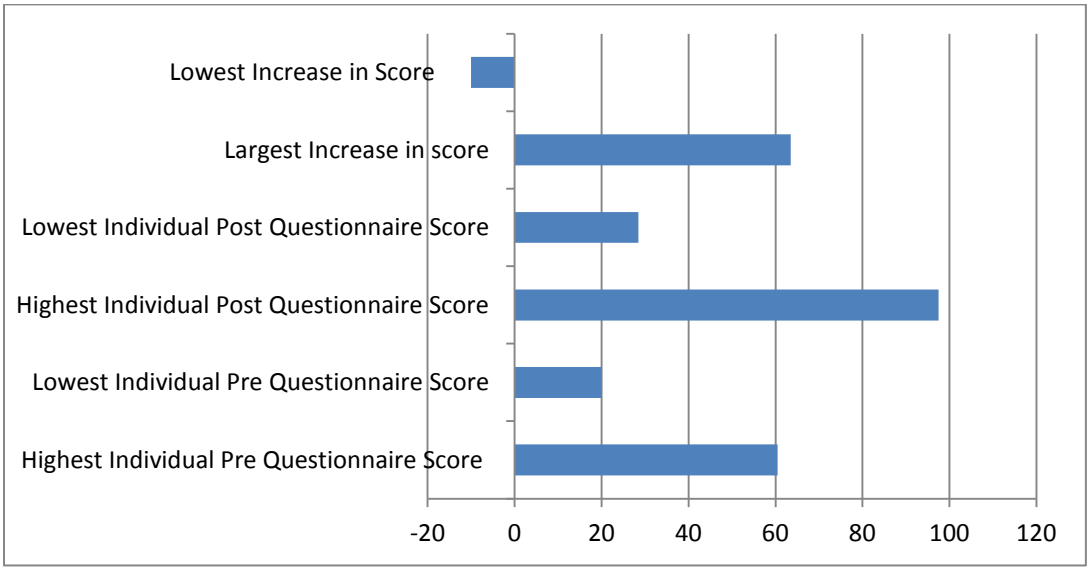

Figure 34. Summary of individual mark comparisons.

The pre- and post-test scores were rank and ordered for all the participants (n = 27). A Mann-Whitney U-test was used to compare the pre and post test results. SPSS (2006) statistical software was used for this Mann-Whitney U-test. The results indicated the increase in scores from pre-test to post-test is statistically significant U = 146, $p < .001$.

Research Question 3

The third research question of this study is;

> Can m-learning result in behavior change as measured by Kirpatrick's evaluation model (level three)?

To answer this question the participants self-reported on their timing and intake of fluids, carbohydrates, proteins, fats, and supplements. The participants were asked identical questions in both the pre-test and the post-test with respect to their

timing and intake of fluids, carbohydrates, proteins, fats, and supplements. Their responses were judged as to whether the reported changes were improvements consistent with the nutritional learning provided. The participants were then asked if they had made conscious decisions to change their timing and or intake of fluids, carbohydrates, proteins, fats, and supplements as a result of the nutritional learning provided. A Chi -square test was performed to determine if the changes that occurred were sufficient in magnitude to rule out chance variation or if it was likely the changes resulted from the learning that occurred prior to the changes.

The first self-reported question asked what they drank and how much prior to practices. Thirty-seven percent of the participants showed improved fluid intake based on the nutritional learning provided. Eleven percent of the participants showed poorer fluid intake and 52% remained the same (see Figure 35).

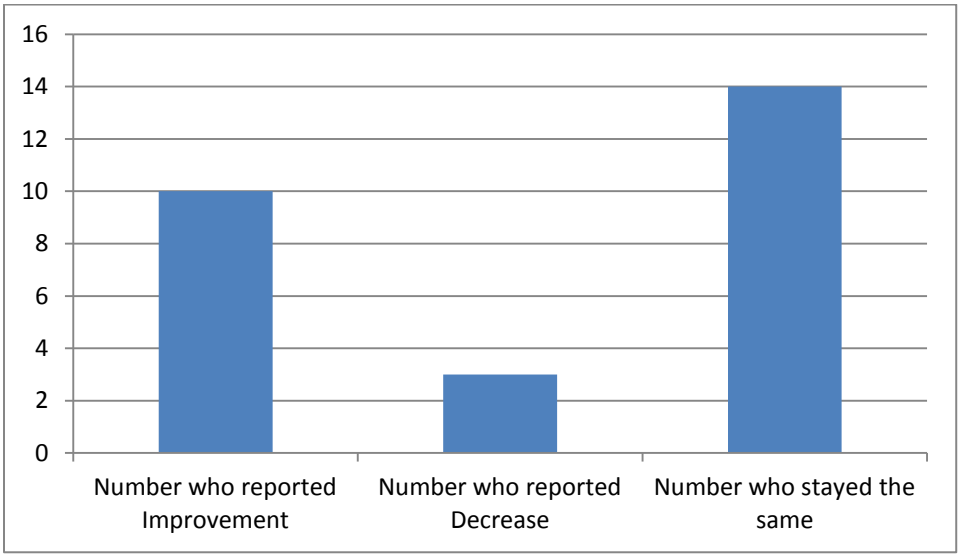

Figure 35. Self-reported type and amount of fluid intake prior to practices, as compared to what be optimum choices per the learning intervention.

The participants self-reported on their pre game fluid intake. Thirty-seven percent of the participants showed an improvement from the pre test to post test in the type and or quantity of fluid consumed prior to games based on the nutritional learning. None of the participants showed a decrease in the quality of their fluid intake from pre to post test, and 63% remained unchanged from pre test to post test in their fluid intake prior to games.

Thirty-three percent of the participants self reported an improvement from pre test to post test based on the learning, on the type and amount of fluid they consumed in the four hours following practice. Twenty-two percent reported a decrease from pre test to post test in the quality of their post practice fluid intake, and 44% reported no change pre test to post test in their post practice fluid intake (see Figure 36).

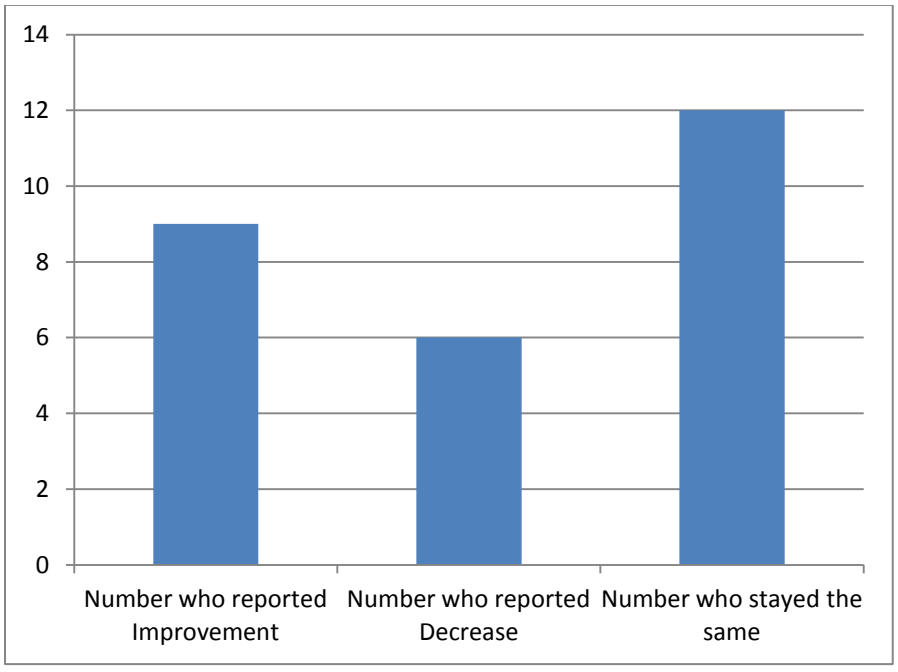

Figure 36. Self reported type and amount of fluid intake after practices.

In responding to the type and amount fluid intake in the four hours following a game, 37% of the participants showed an improvement from pre test to post test, based on the learning. Eleven percent reported a decrease in the quality of their post game fluid intake, pre to post test. Forty-four percent participants showed no change in their fluid intake pre test to post rest (see Figure 37).

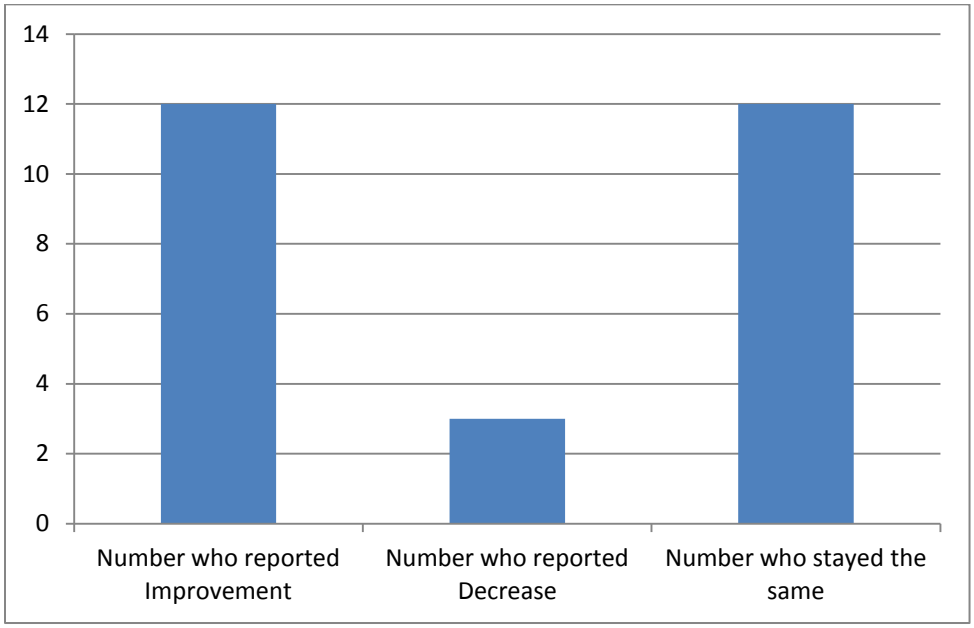

Figure 37. Self reported type and amount of fluid intake after games.

The participants self reported on the amount of protein, fat, and carbohydrate that are in their diet. They were asked if their diet is high in protein, fat or carbohydrates, or is it roughly equal in all components. Based on the learning content, 19% of the participants reported an improvement in this area, pre test to post test. Seven percent showed a worsening of overall intake pre test to post test. Seventy-four percent of the participants reported no change pre test to post in their overall protein, carbohydrate and fat intake (see Figure 38).

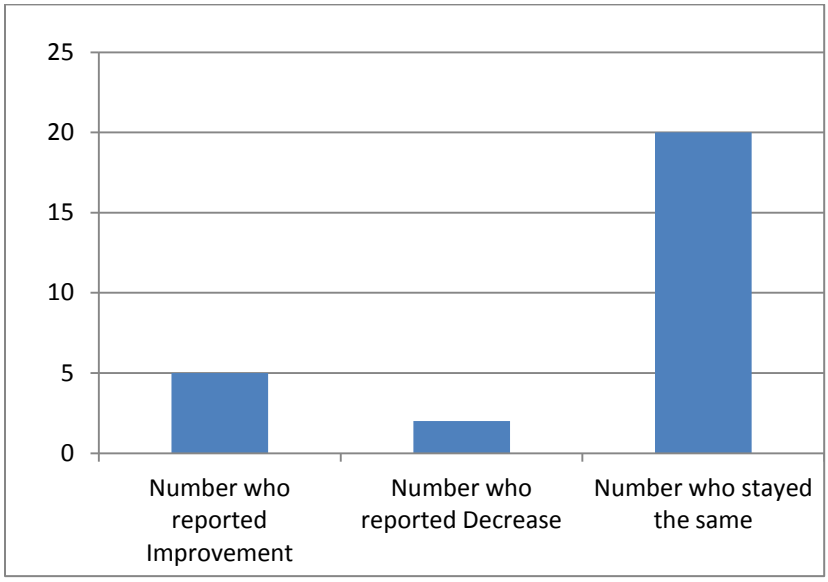

Figure 38. Self reported carbohydrate, fat, and protein overall intake.

The participants self reported on the timing of their protein, fat, and carbohydrate intake. Forty-eight percent of the participants, based on the nutritional learning content showed an improvement pre test to post test. None of the participants showed a decrease pre test to post test. Fifty-two percent of the participants reported no change in the timing of their carbohydrate, protein and fat intake pre test to post test (see Figure 39).

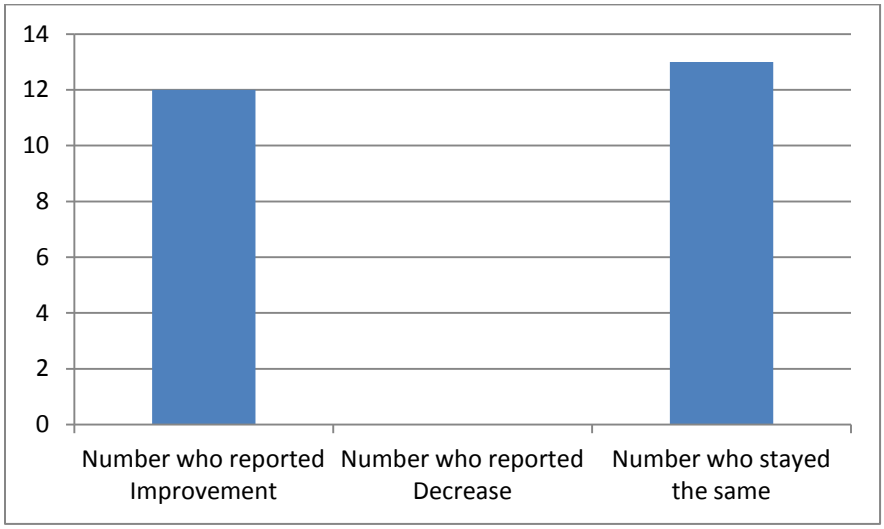

Figure 39. Timing of protein, carbohydrate, and fat intake.

The participants self reported on their intake of supplements. The emphasis of the nutritional learning was on the athletes not taking too much of any supplement. Based on the learning content, 11% of the participants showed an improvement pre-test to post-test, in their intake of supplements. Four percent of the participants showed poorer supplement intake pre-test to post-test (Note: the reported decrease is not considered unhealthy, but rather sub optimal as assessed by the registered dieticians involved with the content development for this study). Eighty-five percent displayed no change in their supplement intake behaviour (see Figure 40).

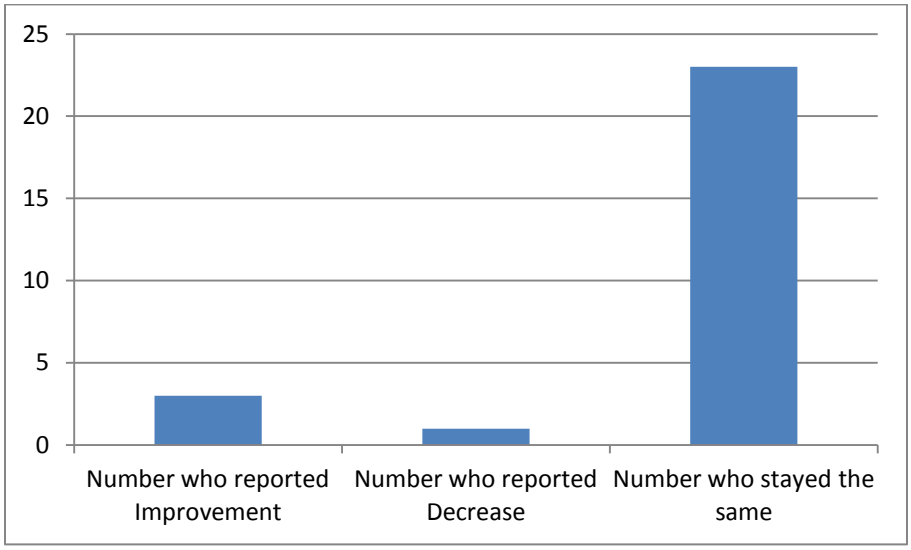

Figure 40. Supplement intake.

The participants self-reported on their alcohol consumption. None of the self-reported consumption was seen to be a health problem of concern by the registered dieticians involved with the content development for this study. Four percent of the participants showed a small increase in their alcohol intake pre test to post test. Another 4% of the participants showed a small decrease in their alcohol intake pre-test to post-test. Ninety-three percent of the participants remained unchanged from pre-test to post-test in the alcohol intake (see Figure 41).

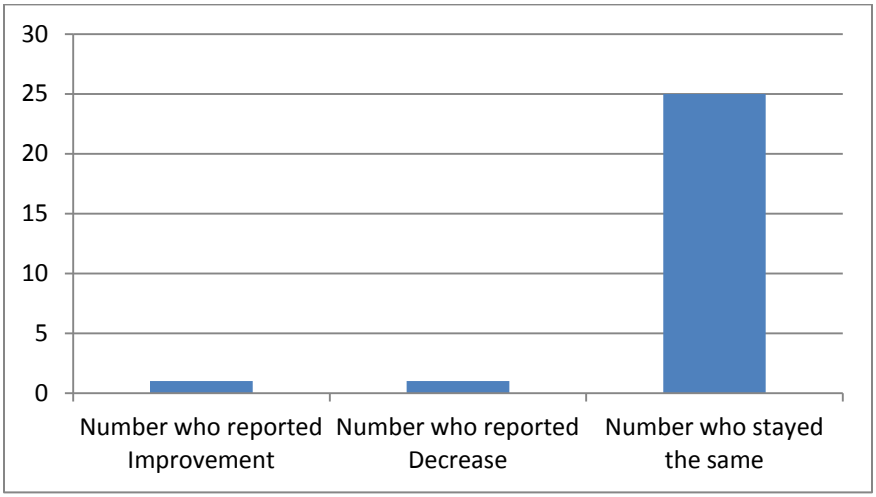

Figure 41. Self reported alcohol consumption.

No data is being shown for the pre- and post-test questions regarding the use of tobacco products or if the participants were vegetarians. As none of the participants reported being vegetarians and none of the participants reported using tobacco products.

The participants were asked on the post test, if after taking the nutritional learning if they had intentionally made changes in their fluid intake. Fifty-two percent self reported yes they had made intentional changes, and 48% reported they had not made any intentional changes to their fluid intake.

The participants were asked to self-report on the post-test, if after taking the nutritional learning if they had intentionally made changes in their intake of protein, carbohydrates or fats. Forty-eight percent reported that they had, and 52% responded that they had not made any intentional changes to their intake of protein, carbohydrates or fats.

The participants were asked to self-report on the post-test, if after taking the nutritional learning if they had intentionally made changes in the timing of their intake of protein, carbohydrates and fats. Thirty-seven percent reported they had, and 63% responded they had not made any intentional changes to the timing of their intake of carbohydrates fat, and protein.

The participants were asked to self-report on the post-test, if after taking the nutritional learning if they had intentionally made changes to their intake of supplements. It is important to note that the registered dieticians involved with the content development for this study reviewed the pre and post-test responses, and they felt no participant in either the pre or post test reported unhealthy supplement intake. Eleven percent of the participants reported they intentionally changed their supplement intake based on the nutritional learning content. Eighty-nine percent reported no change.

The participants were asked to self report on the post test, if after taking the nutritional learning if they had intentionally made changes in their intake of alcohol. Four percent reported they had made intentional changes (reduction) to their alcohol intake and 96.3% reported they made no changes to their alcohol intake.

The female participants were asked to self report on the post test, if after taking the nutritional learning if they had made intentional changes to their diet and training as a result of the female triad content. Twenty-six percent reported they had, and 74% reported they had not made any intentional changes as a result of the female triad content.

A summary of all the reported intentional changes as a result of the nutritional learning yields 63% participants who reported making intentional changes, and 37% who have not made any intentional nutritional changes as a result of the nutritional mobile learning (see Figure 42).

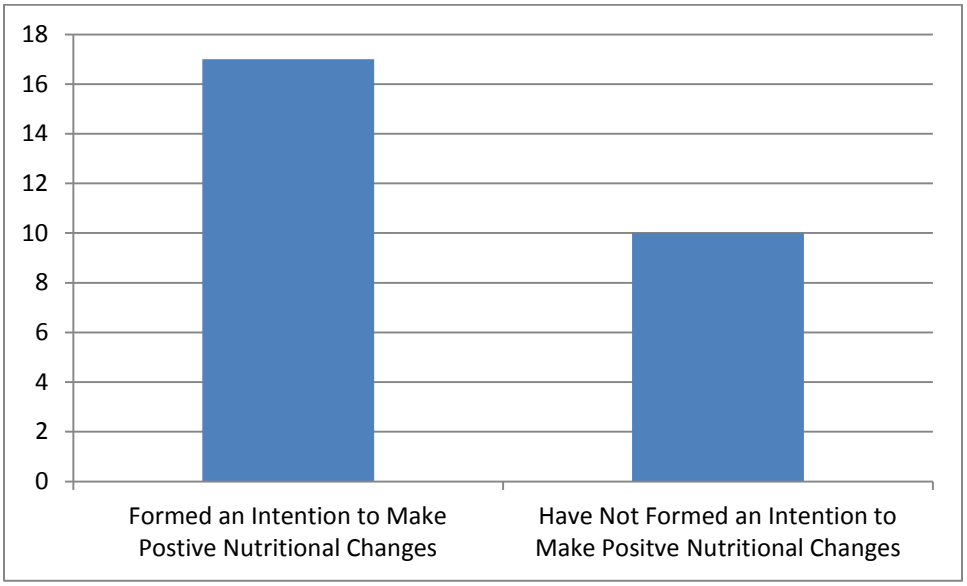

Figure 42. Number who self reported making intentional nutritional changes to their diet (n = 27, 85% female).

A combined summary of the reported intentional changes along with the self reported nutrition intake provides the following data. Seventy-eight percent reported more positive than negative nutritional changes pre test to post test. Eleven percent made more negative than positive nutritional changes pre test to post test. Eleven percent reported no net nutritional change pre test to post test. Four percent reported no intentions to change nutrition intake and no net self reported nutritional intake change. Ninety-six percent of the participants reported either intentional change as a result of the mobile learning or had self reported positive change after the mobile learning or both (see Figure 43).

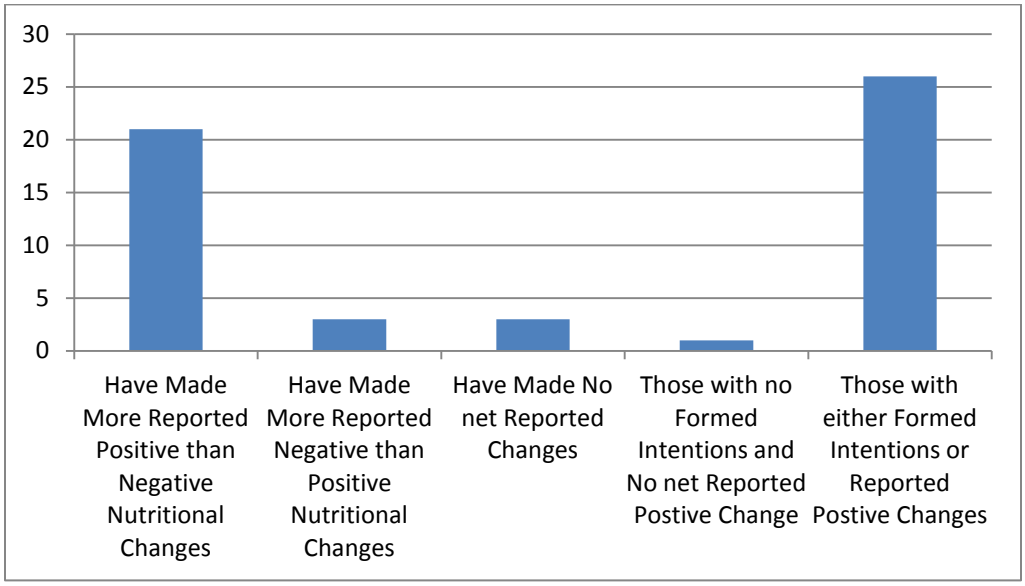

Figure 43. Summary of changes after mobile learning.

A Chi Square test was performed on the self-reported nutritional behavior changes. The data was categorized in three areas, pre-exercise fluid intake, post-exercise fluid intake, and carbohydrate, protein and fat intake. The Chi-square test determined the amount of self reported behavior change to be statistically significant ($p < .05$), indicating the change was likely due to the mobile learning and not simply due to chance.

Research Question 4

The fourth research question of this study is;

Are there connections between learning with a mobile device and motivation**,** self efficacy, relevance, and the use of self-regulated learning strategies?"

The participants were asked on the post test how motivated they were to learn using a mobile device. Using a Likert scale, a score of five represented they were

"strongly" motivated and a score of one represented they were "not at all" motivated. Four percent of the participants reported they were strongly motivated. Eleven percent reported a score of four. Forty-one percent reported a score of three which represented a score being directly in between being strongly motivated and not at all motivated. Nineteen percent reported a score of two. Twenty-six percent responded with a score of one, which represented not at all motivated to learn with a mobile device (see Figure 44). The mean response (standard deviation on parentheses) was 2.5 (1.1).

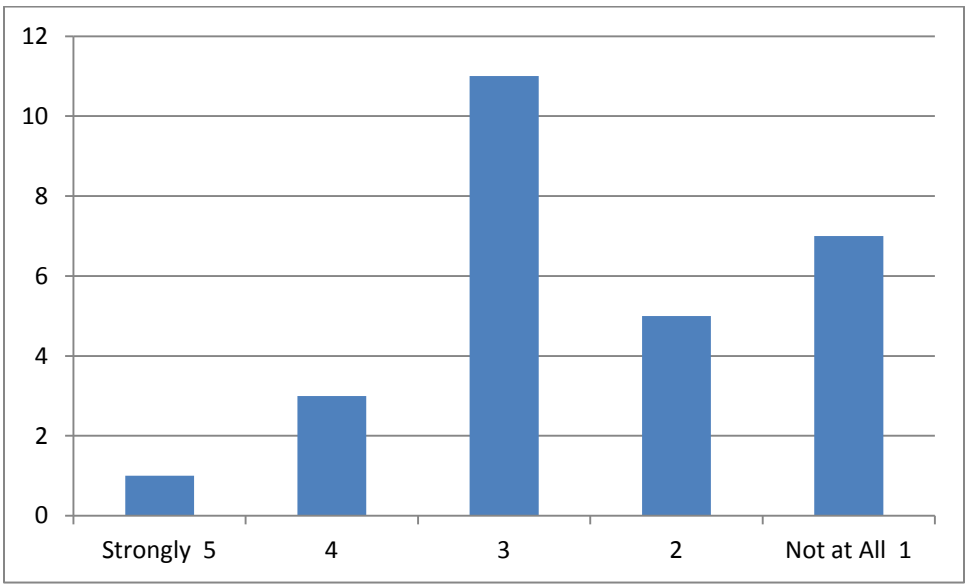

Figure 44. How motivated the participants felt to learn with mobile devices.

The participants were asked how motivated they were to learn the contents of the nutritional course using a Likert scale, a score of five represented they were "strongly" motivated and a score of one represented they were "not at all" motivated. Eleven percent of the participants reported they were strongly motivated. Twenty-six percent reported a score of four. Forty-four percent reported a score of three which represented a score being directly in between being strongly motivated and not at all

motivated. Eleven percent reported a score of two. Four percent responded with a score of one, which represented not at all motivated to learn the contents of the nutritional course (see Figure 45). The mean response (standard deviation on parentheses) was 3.3 (1.0).

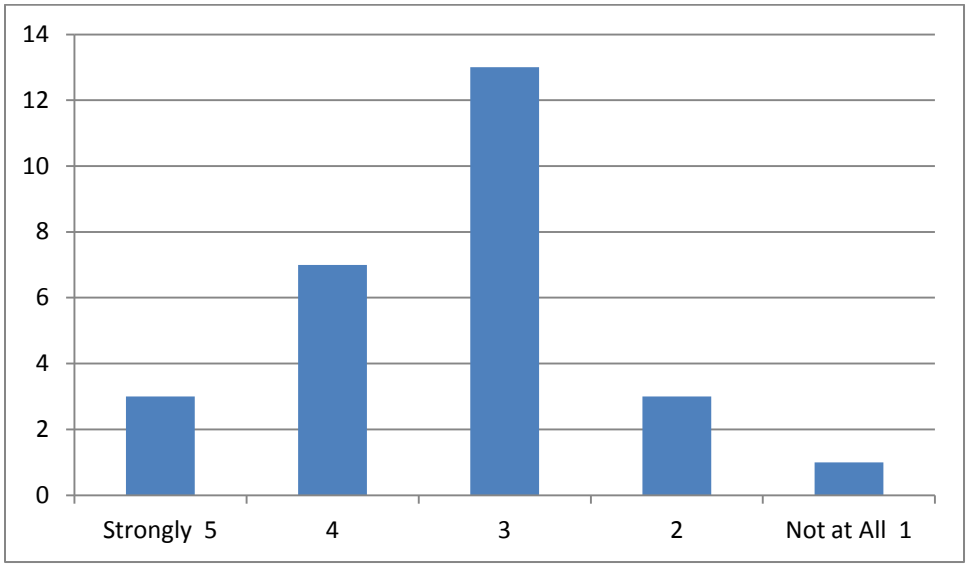

Figure 45. How motivated the participants felt to learn the nutritional contents.

The participants were asked if their motivation level changed while they were taking the mobile learning course. Twenty-two percent reported that their motivation went up while they were taking the mobile learning. Four percent reported their motivation went down. Seventy-four percent reported that their motivation stayed the same (see Figure 46).

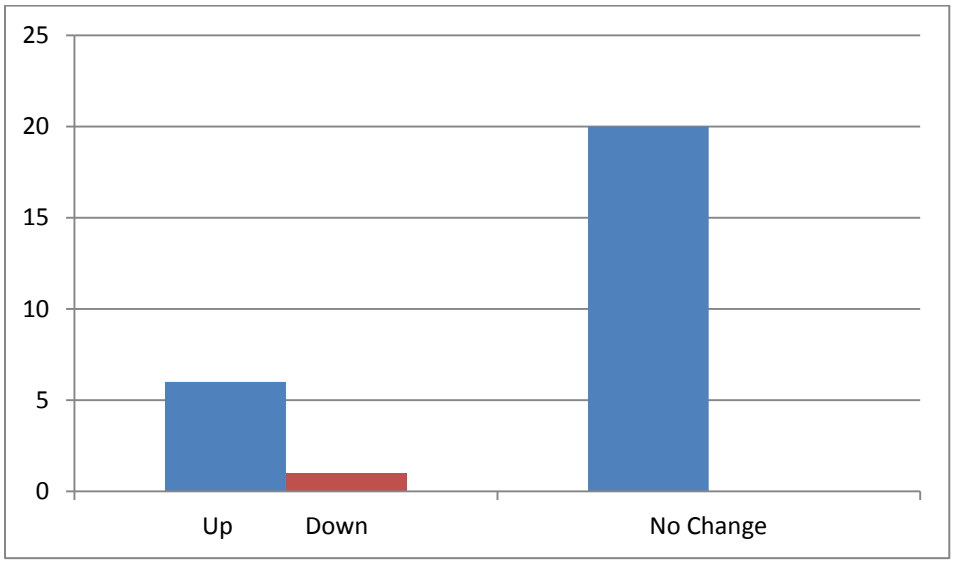

Figure 46. Did the participants motivation level change up or down?

The 26% of participants, who responded that their motivation did change, were asked what caused this change. Four percent of the participants who responded that their motivation dropped did not explain why. The 22% of participants, who reported that their motivation went up, explained this was due to them finding the learning relevant and useful.

The participants were asked if the motivation to learn the nutritional course was coming from them or was someone else persuading them. Fifty-nine percent responded the motivation was coming from within them (intrinsically motivated). Forty-one percent reported the motivation was coming from someone else (extrinsically motivated).

The participants were asked if they learned what they wanted when they wanted, or was someone else providing direction for a topic to be learned and by when. Seventy-four percent reported that they learned what they wanted when they wanted (intrinsically motivated). Twenty-six percent reported someone else was providing direction for a topic to be learned and by when (extrinsically motivated).

On the post-test the participants were asked, after you learned something that you found useful, did that give you more energy and desire to learn more? Forty-one percent of the participants reported that after learning something useful it gave them more energy and desire (motivation). None of the participants reported that it lowered their motivation. Fifty-nine percent reported it made no change to their level of motivation. None of the participants reported they did not learn anything useful.

The participants were asked, before they started the mobile learning, did they feel learning more about nutrition would be helpful to them. Ninety-six percent reported yes they felt the nutritional content would be helpful to them. Four percent of the participants reported they did not feel the nutritional content would be helpful for them.

Using a Likert scale of one of to five, the participants self-reported on the post test, as to how relevant the nutritional mobile learning was to them. A score of five represented “very” relevant, and a score of one represented “not at all” relevant. Nineteen percent of the participants responded with scores of five, finding the learning very relevant. Thirty-seven percent responded with scores of four. Twenty-six percent responded with scores of three. Fifteen percent responded with scores of two. Four percent responded with a score of one (see Figure 47). These results indicate the

overall feeling of the participants was that the content was relevant for them. The mean response (standard deviation on parentheses) was 3.5 (1.1).

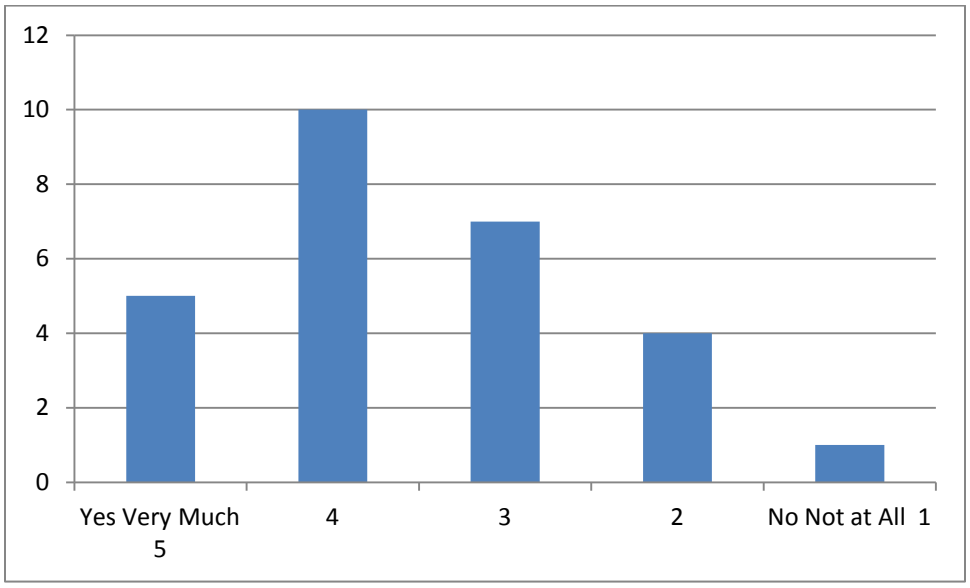

Figure 47. How relevant was the nutritional mobile learning.

The participants were asked how confident they were about learning with a mobile device prior to starting the mobile nutrition learning. A Likert scale with a range for one to five was used. A score of five represented the participant was "very" confident in being able to learn with a mobile device, a score of one represented they were "not very confident at all" about being able to learn the nutrition content with a mobile device. Twenty-two percent of the participants scored with fives reporting they felt very confident. Four percent score scored it a four. Thirty-seven percent scored their feelings as a three. Twenty-six percent scored it with a two. Eleven percent reported they felt not at all confident and score it a one (see Figure 48). The mean response (standard deviation on parentheses) was 3.0 (1.3). The group as a whole

reported they felt slightly less than neutral in terms of their self efficacy relative to their perceived level of competence to learn with a mobile device.

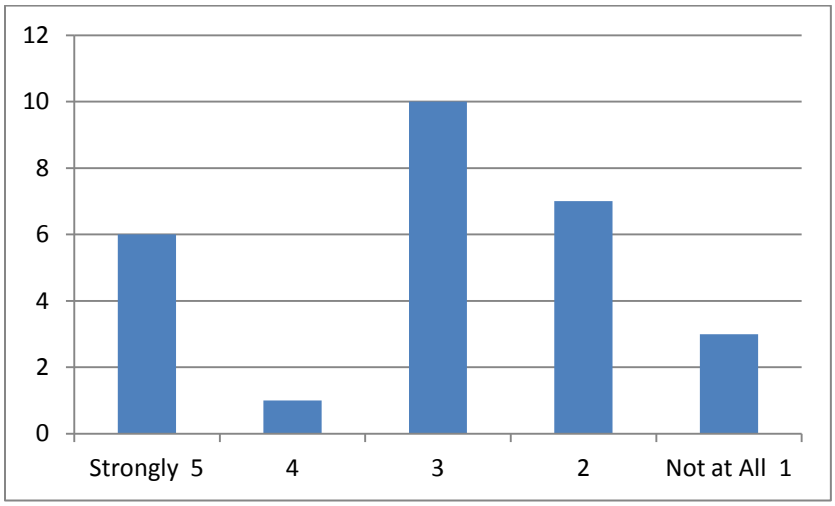

Figure 48. How confident participants felt about being able to learn with a mobile device.

The participants were asked, if they gained confidence in being able to learn using a mobile device as they moved through the nutritional learning. Fifteen percent reported their confidence did go up. Thirty percent reported their confidence using a mobile device to learn went down as they progressed through the nutritional learning. Fifty-eight percent reported their confidence learning with a mobile device remained the same (see Figure 49).

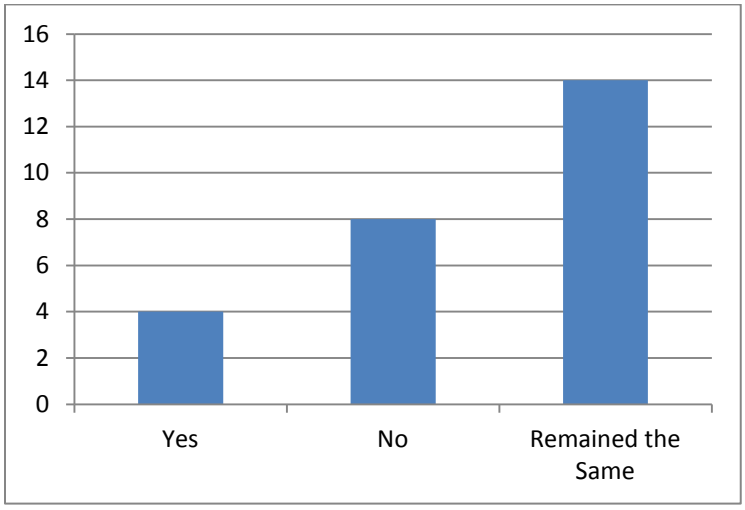

Figure 49. Did the confidence level of being able to learn with a mobile device go up as the participants progressed through the nutrition learning.

The participants were asked how confident they felt about being able to learn about the topic of nutrition before beginning the mobile learning. A Likert scale with a range for one to five was used. A score of five represented the participant was "very" confident in being able to learn the nutritional content, a score of one represented they were "not very confident at all" about being able to learn the nutrition content. Twenty-six percent of the participants reported feeling very confident with scores of five. Fifteen percent responded with scores of four. Thirty-three percent responded with scores of three. Nineteen percent responded with scores of two. Seven percent reported feeling not at all confident in being able to learn the nutritional content (see Figure 50). The mean response (standard deviation on parentheses) was 3.3 (1.2).

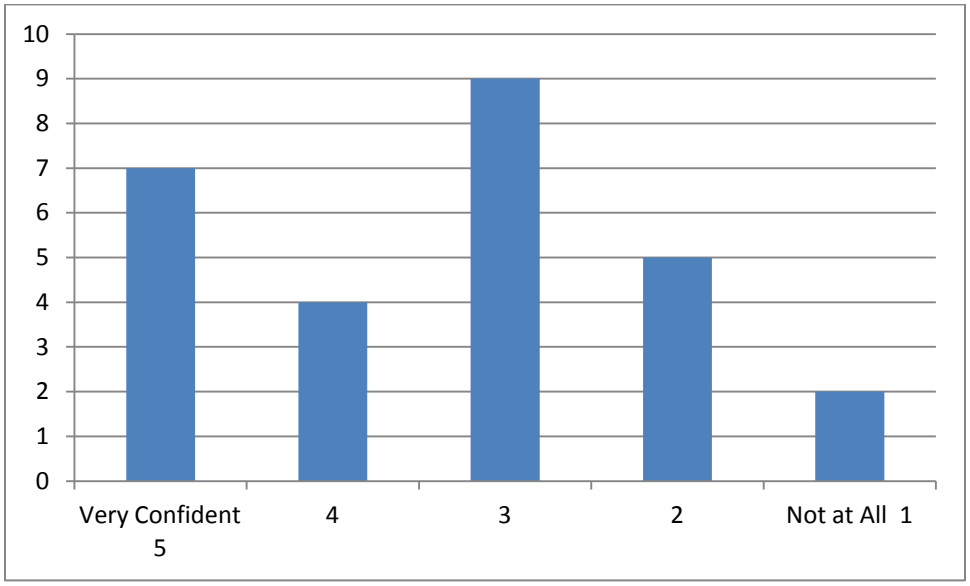

Figure 50. How confident participants felt about learning the nutritional content.

The participants were asked how they found learning using a mobile device. A Likert scale with a range for one to five was used. A score of five represented the participant found learning with a mobile device to be "easy," a score of one represented they found learning with a mobile device "difficult." Seven percent of the participants found learning with a mobile device to be easy and scored the question with a five. Fifteen percent scored the question with a four. Twenty-six percent scored the question with a three. Thirty percent score it with a two. Eleven percent found learning with a mobile device to be difficult and scored the question with a one (see Figure 51). The mean response (standard deviation on parentheses) was 2.7 (1.2).

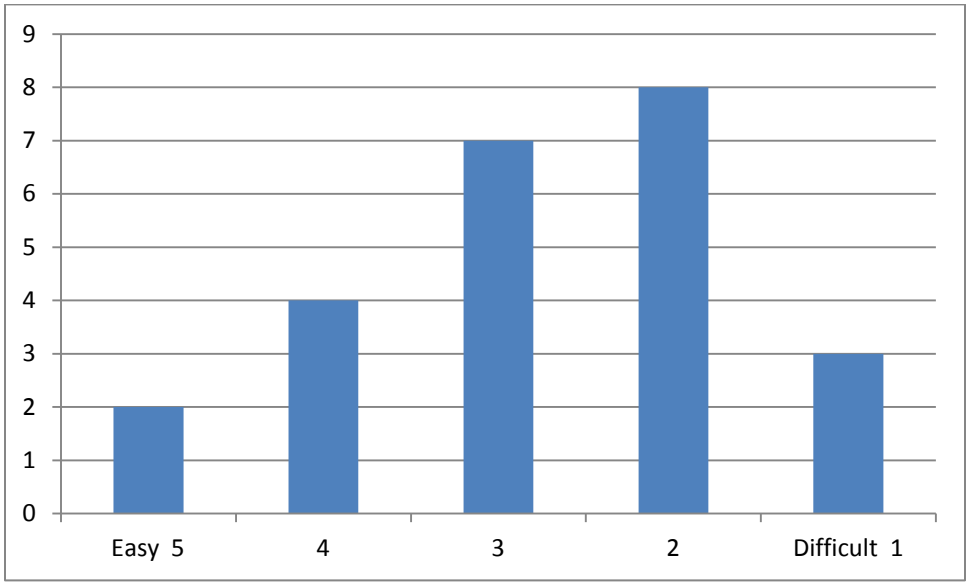

Figure 51. How the participants felt about learning with a mobile device.

Chapter 5: Discussion and Conclusion

Participants

The results of the mobile device usage data relative to the young adult participants of this study provide an interesting view of the first generation to grow up with the computer and the internet. All the participants (N = 27) owned their own mobile device, 78% owned more than one. Seven percent of the participants used a tablet for this study, 63% used a smart phone and 30% used a laptop with mobile internet access. All the participants reported using a mobile device daily. While out of the scope of this study, it is interesting to observe that with the growth of local wireless networks for internet access, including common areas of the campuses of the students in this study, students are using laptops with USB devices for accessing the internet. In this study 30% of the participants used laptops with mobile internet access as their main mobile computing device.

With this generation it appears mobile technology is blurring the line between work and pleasure, as the majority of participants responded they use their device for connecting socially with others, using it for pleasure and for performing work or school activities. The overall results suggest the participants find their mobile devices easy to use and pleasurable to use. They use most of the features on their mobile device(s) regularly. Their comfort and expertise with their mobile devices suggests using it to learn may be a natural seamless extension of how they are already using their mobile devices. Interestingly, for communication purposes the participants reported preferring to use their device more for emailing and texting than as a telephone.

Discussion Research Question One

The first research question relates to the learner's reactions to learning. The post questionnaire provided specific results in accordance with the direction provided by Kirkpatrick (1998) to answer this study's first research question; "What will the learner's reaction be to learning with mobile devices, as measured by Kirkpatrick's evaluation model (level one)?" Several lines of questioning were applied, to separate out biases a participant may have developed toward the mobile device for learning, resulting from negative experiences from the content and support. For example, if the participants found the content to be of very poor quality, their reaction to using a mobile device for accessing that content would likely be less favourable as well, resulting in potentially a biased lower score for using the device to learn with.

Overall the participant's reaction to the nutritional content was positive. More specifically, the participants found it overall to be slightly better than just "Interesting" almost a quarter found it "Very Interesting" and lowest rating given was a "Little Interesting" and this was provided by only 7% of the participants. In rating the non-video content the mean response was slightly better than "Good" with only 4% of the participants scoring it "Fair" and 4% giving it a "Poor" rating. The mean rating of the video content was almost directly between being "Very Good" and "Good." With only 7% of the participants rating it as "Fair" and none rating it as "Poor". These results show the participants felt positive about the course content. This provides a good indication that the participant's reaction to the content would not lead to the participant's having a negative bias toward using a mobile device for learning the nutritional content. The positive reactions may lead to the participant's having a

more positive reaction to learning the content with a mobile device. This potential positive bias should not be considered an issue, as any mobile learning should be created to illicit a similar over all positive reaction.

Another avenue of questioning determined the participant's reaction to the support they received. If the participants felt isolated, or were frustrated by not having their questions answered or any issue they had resolved, they would likely not feel as positive about learning with a mobile device. The average rating for the support they received was approximately half way in between "Very Good" and "Good" with only one person rating it as "Fair" and none of the participant rating it as "Poor." This result suggests the participant's reaction to learning with a mobile device should not be negatively biased resulting from inadequate support.

Seven percent of the participants had a negative reaction towards the design, presentation and methods used for the mobile learning, while 30% had a neutral reaction and 59% responded with a positive reaction. The participant's reactions about whether or not they felt they would be able to apply the learning in a beneficial way were mostly positive, with the mean response being roughly half way between "Neutral" and "Very Much." These are positive reactions that do not have the potential to negatively affect the participant's reactions to learning with a mobile device.

All these previously mentioned reaction results depict a result that paves the way to accept the reactions to learning the content with a mobile device, as being unbiased by other elements related to learning with a mobile device. In examining all the reactions, 81% of the participants reported having an overall positive reaction to

using a mobile device for learning. Seven percent of the participants reported a neutral response and 11% had an overall negative reaction to the elements surrounding learning the nutritional content with a mobile device. Regardless of what learning delivery method is used, it's not likely everyone would respond positively. Similarly, Brookes (2010) research on using podcasts for learning delivery found that not everyone liked learning via podcasts. Brooks (2010) study suggested offering students choices, as no single instructional approach is best for everyone. In this study the high favourable response rate for learning via a mobile device, does add support to the idea of further studying the use mobile learning in more wide spread applications.

The participant's reaction to how they rated using a mobile device for learning in terms of comfort and convenience was positive. The average response was slightly better than "Good" and none of the participant's rated it with a negative response. The overall reactions to using a mobile device to learn with in terms of it being enjoyable and an interesting way of learning resulted in a neutral response. From this we can ascertain that the participants liked the convenience of learning anywhere and anytime that it suited them, and the comfort of being able to choose when and where to do the learning, but that the mobile device itself was not considered to be any better or worse for learning with, than other means of delivery within the participants previous experiences.

These results support Knowles et al. (2005) adult learning theory, in that the learning received an overall positive reaction and this learning was designed and delivered according to Knowles et al. (2005) adult learning theory. The introductory video focused on why the learner's would want to learn the content, it explained in

general the ways it would be beneficial, and the decisions of what to learn, when and where were left up to the learner's. The results suggested the majority of participants felt intrinsically motivated to learn. These results describe the self directed adult learner as put forth by Knowles et al., (2005) in their adult learning theory.

Previous findings from several studies were incorporated into the learning design for this study. The overall positive reaction to the learning agrees with similar findings from these previous studies. Based on the findings from Lin et al., (2006) this study's learning content included interactivity with the use of a discussion forum, it was easy to navigate in that it only had two web page levels and both text and graphics for links, and the learning website contained several strongly related links. These concepts are all consistent with the recommendations from the study by Lin et al., (2006). The content was arranged in the way Ally et al., (2006) described in their study with learning objects, making the finding and retrieval of learning material in this study quick and easy for the learner's. McCombs (2010) found the use of short podcasts to be effective, based on his findings this study used short video podcasts, which in turn were well received by the study's participants. Along with the video podcasts, this study supplied supporting text material that covered the same material as the podcasts based on the study by Brookes (2010) who found not all learner's will use video podcasts for various reasons. Brookes (2010) study did result in positive reactions from the learner's to the five to seven minute podcasts. This study used videos from three to seven minutes in length, and received similar positive reactions. The studies by Rekkedal et al., (2007) and Vyas et al., (2010), found users have problems with the small screen size and keyboards of smart phones. This study sized

the text, web pages and video with the small screen size as an important consideration. The reaction results noted no issues or problems with the small screen sizes and the learning content.

Discussion Research Question Two

The second research question relates to gaining new knowledge; this is level two of Kirkpatrick's evaluation model. The pre-questionnaire and the post-questionnaire contained an identical ten questions that queried the participants for their knowledge on sports nutrition that was contained in the mobile learning. The post-questionnaires responses were compared to the pre-questionnaire responses to evaluate if the participants had increased their knowledge as a result of the mobile learning in order to answer the second research question "Can m-learning result in knowledge gain as measured by Kirkpatrick's evaluation model (level two)?"

Eighty-five percent of the participants scored higher on the post questionnaire knowledge questions. In each of the ten questions the mean score improved. Overall the improvement from pre-questionnaire scores to post-questionnaire scores was found to be statistically significant ($p < .001$). The results unambiguously demonstrate the participants as a group significantly increased their knowledge as a result of the mobile learning.

According to Kirkpatrick (1998) success at learning or level two of his model is a pre-condition for there to be success at level three of his model. This study's results show learning success at level two. However the pre and post-questionnaire test questions could be answered correctly based on simple recall from the mobile

learning content, this would be described in the lower levels of learning in the learning objectives taxonomies of Bloom et al., (1956), Krathwohl (2002) and Quellmalz (1987). For behaviour change to occur the participants will need to make value judgments based on their recall of knowledge from the mobile learning. This degree of learning comes from the higher end of the learning objective taxonomies of Bloom et al., (1956), Krathwohl (2002) and Quellmalz (1987). If this degree of learning did take place then behaviour change should then be observable at Kirkpatrick's evaluation level three, unless a barrier to applying the learning exists (Kirkpatrick, 1998).

Discussion Research Question Three

The third research question, "Can m-learning result in behavior change as measured by Kirpatrick's evaluation model (level three)?" relates to behavior change occurring as a result of the knowledge gained from the learning. To answer this research question, two approaches in questioning were applied. First the participants self-reported their nutritional behavior on both the pre-questionnaire and the post-questionnaire. The two sets of responses were compared for positive changes that would have occurred as a result of the mobile learning content. Secondly, on the post-questionnaire the participants self-reported if they had made any conscious nutritional changes as a result of the mobile learning.

In comparing the data, 78% of the participants self-reporting to specific nutritional behavior questions, reported an overall positive nutritional change that could be attributed to the mobile learning. Sixty-three percent reported making

deliberate nutritional changes as a result of the m-learning. In total, 96% of the participants reported positive nutritional behavior change and or reported making conscious nutritional changes as a result of the mobile learning. This shows a large majority of the participants had positive nutritional behavior change that can be attributed to the m-learning. A Chi-square test was performed to determine that the change was significant and likely related to the mobile learning and not simply due to chance. The Chi-square test showed the behavior change to be significant ($p < .05$).

The questions measuring specific behaviour did not capture as much behavior change as was reported overall by the participants. A likely reason that the self-reported responses to the specific nutritional behavior questions did not yield a higher number of positive changes was a result of the questions not covering enough area and not being detailed enough. However both sets of results clearly demonstrate substantial behaviour change did occur as a result of the mobile learning.

The most reported self-regulated learning strategy employed by the participants was goal setting. Locke and Latcham (1990) found setting goals intrinsically motivates people by energizing them to achieve something beneficial. The initial driving motivator for the participants in this study was the relevance of the content. Once this motivation was in place, it was further strengthened by the learners through the application of learning strategies. Cox (2007) states setting goals in a cognitive process can increase motivation. The results of this study support this statement, as the majority of participants felt mostly intrinsically motivated and 96% of the participants reported making intentional behavior change. The next top three learning strategies used by the participants were, time management, self-evaluation,

and self-monitoring, and all of the strategies were reported as being used by at least some of the learner's. This indicates the learners were autonomous in their learning. The instructional design chosen for this study included central characteristics of several other researchers work. This study's instructional design followed approaches of Knowles et al. (2005) adult learning theory, Hannafin et al. (2009) student centred learning approach, and Keller (1987) ARCS model for instructional design. The self-reported autonomous learning by the participants coupled with the high success rate for learning and behaviour change supports the type of instructional design used in this study for adult m-learners.

Research by Milne, Rodgers, Hall and Wilson, (2008), Bargh and Chartrand, (1999), Gollwitzer, (1993), and Sheeran (2002) reveal behavioral intention is the most important predictor to behaviour change. An intention is formed before pre-contemplated behavior change occurs (Brehm, 2004). According to Brehm (2004) for the participants in this study to want to make conscious nutritional change(s), the intention to change had to come from new found knowledge. It is important to note the new found knowledge did not necessarily have to come from the mobile learning provided. If new found knowledge is relevant to a learner, then an intention to change can result (Brehm, 2004). The amount of relevance influences the level of motivation to change. This study supports the concept, by the self reported feedback of the participants who said they gained more energy after having learned something in the mobile learning that was useful for them.

Significant learning ($p < .001$) preceded the behavioral changes and the learning was reported to have been the reason for the nutritional behavior change(s)

by 63% of the participants, supported by 78% reporting positive nutritional change linked to the m-learning content. The intention to change becomes fully formed when a person makes a decision, based on examining and seeing a preponderance of positive benefits (Janis & Mann, 1977). The participants in this study learned of benefits through the mobile learning. Consistent with Janis and Mann (1977) the new found knowledge from the mobile learning content led to the reported behaviour change.

Discussion Research Question Four

The post-test had several lines of questioning to examine connections between m-learning and motivation, self efficacy, relevance and the use of self-regulated learning strategies in order to address the fourth research question, "Are there connections between learning with a mobile device and motivation, self efficacy, relevance, and the use of self-regulated learning strategies?" To produce an accurate picture the self-reporting addressed these elements from the perspective of both the content and the mobile devices. For example a participant might have high self-efficacy for using a mobile device to learn with, but have low self-efficacy for learning nutrition.

Motivation. The participants overall self-reported stronger motivation for learning the content, than for using a mobile device to learn it with. Eighty-five percent of the participants rated their motivation for learning with a mobile device to be moderate or lower. While 78% of the participants rated their motivation for learning the content to be moderate or higher. This confirms the participant's reactions

from research question one, that the mobile device itself was not a significant factor for the students motivation or interest in learning, but the relevance of the content was a noticeable factor in being a motivating force.

Fifty-nine percent of the participants reported they felt they were the main source of motivation for taking the mobile learning in this study. Seventy-four percent of the participants reported they controlled their learning by deciding what area of the content to learn, when to learn and where. These results show the participants to be mostly autonomous and self-directed in their learning and to be intrinsically motivated. This is consistent with Knowles et al., (1998) adult learning theory. The learner's were left on their own to accomplish the mobile learning as they saw fit. This meant they set their own goals, timelines and determined their own success and when to move on to the next learning topic. This follows Hannafin et al. (2009) definition of student centred learning. Hannafin et al. (2009) found that student centred web based learning required effective learning support. The results of this study indicated the participants felt they had more than adequate support, and the learning achieved was significant as Hannafin et al. (2009) would have predicted given the support requirement was met.

Self Efficacy. The results of the participant's self reported feelings of self efficacy for their ability to learn with a mobile device showed an overall neutral response. Only 11% of the participants reported they felt not at all confident about learning with a mobile device. However this lack of confidence did not reduce their motivation to the point that they did not pursue the learning. At the end of the study, 7% of these participants knowledge scores were above the average for knowledge

gained and the other 4% had scores just below average. Given the learning was significant from pre-test to post-test, it is suffice to say self-efficacy for using a mobile device to learn with is not a determinant factor in motivation for learning with a mobile device.

The participants responses to what their self- efficacy levels were for being able to learn nutritional content were also close to an overall neutral response, although slightly higher than for their self-efficacy to learn with a mobile device. Given the significant amount of learning that occurred, as measured by Kirkpatrick's evaluation model and neutral self efficacy level for both the mobile device and the ability to learn the content, there does not appear to be a strong connection between self-efficacy and learning the content, or for learning with a mobile device.

The self-efficacy findings of this study are not consistent with the findings that students having positive self-efficacy correlate strongly to higher academic results in online learning (Artino, 2010; Lynch, 2003; Wang & Newlin, 2002). Given students with self-reported low self-efficacy succeeded in learning at a significant level, and that self efficacy was determined not to be a factor from the results of this study. In examining the results on the participant's ownership and usage of mobile devices, it is seen that every participant owns at least one mobile device and use most of the features fairly regularly. When the participants replied with an overall neutral feeling of self efficacy for learning with a mobile device, given their vast experience with mobile devices, this may simply equate to a similar level of self-efficacy that they would respond with for classroom learning. We can assume that as they are university students their classroom learning ability would be quite accomplished. With this

generation of newly arrived adults we need to consider mobile devices for them are easy and intuitive to use, as a result what they would consider to be a neutral or average level of self-efficacy in using one to learn with may equate to what in the past equaled a high level self-efficacy, due to their years of experience with and having grown up with mobile devices. Another consideration is what or who would these students use as a reference or comparison for their perceived ability to learn with a mobile device. It is most likely they would compare their ability with that of their peers. As their peers are quite accomplished at using mobile devices, this would lead to each participant then feeling their ability and self efficacy being relatively similar to their peers, thereby reporting a neutral type of response. This might explain why the findings of this study in the area of self-efficacy are not aligned with the previous work of Artino (2010), Lynch (2003), Wang and Newlin (2002) whose findings would not have predicted high student success with neutral and low student self-efficacy.

Relevance. Twenty-six percent of the participants reported that their motivation to pursue the learning changed during the course of the study. Four percent of these participants gave no reason for the change nor did they state whether it went up or down. The other 22% of the participants all reported their motivation went up and that this was a result of learning something relevant for them. Forty-one percent of the participants reported that after learning something relevant their motivation went up, none reported that their motivation was reduced. Ninety-six percent of the participant's initial reaction was that the nutritional learning would be relevant, after doing the mobile learning 19% of the participant's reported they did not find the nutritional content relevant. The statistical analysis using the Mann-Whitney *U*-test

with the pre- and post-test results revealed significant learning did occur ($p < .001$). These findings strongly indicate relevance relates directly to motivation, which in turn relates directly to success in learning. The main reason cited for those males who failed to complete the study was that once their season had come to an end, their motivation dropped as the nutritional content was far less relevant to them. A similar reason was given by the NHL organization, once the NHL strike ended other factors that did not exist prior, became more relevant to the organization and its athletes, as result their motivation to work through the study waned to the level they dropped out of the study. The self-reported results on relevance show that there is a strong connection between relevance of the content and the participant's motivation to learn both the content and with a mobile device. It suggests the mode of learning delivery in itself is not very important in terms of motivation, while the content is highly important to their motivation. If the content is relevant, there will be a level of motivation to pursue the learning and to learn by whatever delivery method is available. The greater the perceived relevance, the greater the level of motivation will be.

The results fit well with Keller (1987) ARCS model. Keller's model has four conceptual areas that need to be covered in order for the learner's to have the motivation to start and follow through and complete the learning of a topic. In this study, the learners attention (A) was gained from the very start as the learner's saw the learning as relevant (R). This was achieved in the introduction video of the m-learning. It was shown the nutritional content would be relevant in helping them play hockey better. As observed with the male team, once the hockey season was over the

relevance dropped substantially, causing their motivation to drop and for 20 of the 24 it dropped to the point they did not complete the learning. Confidence (C) was observed in the results as the learner's commented when they learned something useful it gave more energy to carry on. The majority of the students felt they were intrinsically motivated, the significant learning that took place suggests they stayed motivated as a result of getting satisfaction (S) from the learning. This study applied Keller's model in a similar way that Shih and Mills (2007) did in their mobile learning study, and got similar results further validating Keller's model.

Wosnitza and Volet (2005) examined the impact of emotions in social online learning. Their study revealed that an online topic to be learned could be perceived to be anywhere from familiar and easy, to unfamiliar and difficult. Regardless of where on the continuum the online course was perceived to be, if the topic was also perceived to be relevant to the learner's personal goals, the generated emotion would result in an emotional arousal that resulted in the person's motivation to pursue the learning. These findings are supported by the results of this study, and both fit with Keller's ARCS model (1987), in that relevance of the content is a motivating force.

Bandura (1982, 1997) developed social cognitive theory, which predicts that a person is more likely to behave or do a certain thing if he or she fully expects that it will deliver positive benefits. If something is related to helping a person achieve a personal goal it has relevance. The greater something is seen as helping to achieve that personal goal, the greater the relevance it has. In this study, a more appropriate diet for hockey players is relevant to the participants as it relates to their goals of being better hockey players.

Self Regulated Learning Strategies. Seventy-four percent of the participants reported using self-regulated learning strategies. Each strategy was used by at least 2 of these participants. The five most used strategies were goal setting by 48% of the participants, self-monitoring by 44%, self-evaluation by 40%, time management by 35%, controlling their learning environment by 30%, and organizing by 22%. These numbers are based on the assumption that those who did not respond did not use any self regulated learning strategies, as opposed to choosing not to report. The findings Artino and Stephens (2006) predicts students with high self efficacy for a topic that has high relevance for them will strongly adopt the use of these cognitive self-regulated learning strategies. With 74% of the participants reporting the use self-regulated learning strategies, a good connection between m-learning and the use of self-regulated learning strategies was observed. This coincides with the reporting of high levels of topic relevance and a neutral level of self-efficacy for the topic and using a mobile device.

Limitations

Limitations are the weaknesses in a study that cannot be controlled (Thomas et al., 2005). Relying on self reporting of the participants was a limitation for this study. The participants may have exhibited social desirability bias in their reporting for a number of reasons including, as a result of feeling they knew what the researcher's expectations were, or what their coach would expect of them. Errors in reporting have a negative effect on a study's internal validity (Cohen et al., 2007). A step taken by the researcher to minimize the effects of this limitation was to involve as many

participants as possible, from different teams, different leagues, all lead by different coaches. If one team, gender, coach, or league was more conductive to social desirability bias the strategy of the researcher was to limit this influence by having participants from different environments involved. This serves to limit, not remove the limitation.

This study had the relatively low number of participants. The larger the sample size, the greater the reliability (Cohen et al., 2007). While there is no definitive answer on what the sample size should be in a research study, it is suggested that the minimum number of participants in study using statistical analysis should be 30 (Cohen et al., 2007). Ideally this study would have had over 30 male and 30 female participants. The qualitative data collected on why a large number of males did not complete this study did help to answer the relevance aspect of the fourth research question.

Lincoln and Guba (1985) provide four threats to external validity, which in turn can invalidate or reduce the validity. To varying degrees these are limitations to any study. The first threat, is the constructs cannot only be relative to the one particular group. In the case of this study, sports nutrition is of interest beyond just the university and college participants in this study, sports nutrition is of interest to most elite university athletes (Hamilton et al., 2012). Secondly the results cannot be mainly a result of the situation they occurred in. Given the results from this study came from three different teams, in three separate leagues and included both male and female athletes, the likelihood of this is substantially reduced. Thirdly, the context from which the results came, cannot be arrived at due to some unique circumstance. Given

the variety of players, teams and leagues the degree of this limitation is low . Lastly, the constructs cannot be specific to a certain group. This study used participants from three different teams, in three separate leagues and of both sexes in order to minimize this possible limitation.

Conclusion

This quantitative study used a quasi-experimental design to examine a mobile learning intervention used by elite hockey players. The mobile learning was examined using the first three levels of Kirkpatrick's evaluation model. The role that self efficacy, relevance and motivation played in mobile learning was also examined. The athlete's reactions to the mobile learning were generally positive, these positive responses related to not just the content and instructional design but to using mobile devices to learn with. The learning the participants achieved was statistically significant ($p < .001$) and there was noticeable behavior change ($p < .05$). The degree of self-efficacy the athletes had for learning with mobile devices did not appear to be a factor of any consequence relative to their success in learning the content delivered via a mobile device. Relevance of the learning content did however prove to be a noticeable driver of motivation for the athlete participants of this study.

Recommendations for Future Research

The participants in this study came from a narrow population group. They were all elite athletes, ranging in ages from 18 to 26 years and predominantly female. Future mobile learning research needs to consider broader and or different segments

of the population. A question that remains is whether relevance would play such a large role for children or older adult learners. Would the role of self-efficacy change in magnitude for children or older adults?

Future research should explore the relationships between self-efficacy, relevance and motivation for using mobile devices to learn. The level of self efficacy needs to be established. What does a neutral response to self-efficacy mean, how does a neutral level for mobile learning correspond to a participant's level for another type of learning they are accomplished at? In doing so the use of a control group needs to be considered. The relationships between self-efficacy, relevance and motivation need to be examined in different and broader populations.

This study's results showed participants preferred the use of certain self regulated learning strategies. Future research could examine connections between these preferences. For example, is the use of goal setting common for adult learners, athlete learners, and or mobile learning learners? Similar questions could be asked about the other self regulated learning strategies that the participants in this study reported a preference for.

This study examined mobile learning using the first three levels of Kirkpatrick's Evaluation model. Level four of Kirkpatrick's model evaluates the results that occurred as a result of the learning and behavior changes from the learning. Future research could evaluate mobile learning with Kirkpatrick's fourth level of evaluation.

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Appendix A: Bloom et al. (1956) Educational Objectives Taxonomy

1.0 KNOWLEDGE
- 1.10 Knowledge of specifics
  - 1.11 Knowledge of terms
  - 1.12 Knowledge of specific facts
- 1.20 Knowledge of ways and means of dealing with specifics
  - 1.21 Knowledge of conventions
  - 1.22 Knowledge of trends and sequences
  - 1.23 Knowledge of classifications and categories
  - 1.24 Knowledge of criteria
  - 1.25 Knowledge of methodology
- 1.30 Knowledge of universals and abstractions in a field
  - 1.31 Knowledge of principles and generalizations
  - 1.32 Knowledge of theories and structure

2.00 COMPREHENSION (grasping the meaning)
- 2.10 Translation (converting from one form to another)
- 2.20 Interpretation (explaining or summarizing material)
- 2.30 Extrapolation (extending the meaning beyond the data)

3.00 APPLICATION (using information in concrete situations)

4.00 ANALYSIS (breaking down material into its parts)
- 4.10 Analysis of elements (identifying the parts)
- 4.20 Analysis of relationships (identifying the relationships)
- 4.30 Analysis of organizational principles (identifying the organization)

5.00 SYNTHESIS (putting parts together into a whole)
- 5.10 Production of a unique communication
- 5.20 Production of a plan or proposed set of operations
- 5.30 Derivation of a set of abstract relations

6.00 EVALUATION (judging the value of a thing for a given purpose using defined criteria)
- 6.10 Judgments in terms of internal evidence
- 6.20 Judgments in terms of external criteria

Appendix B: Krathwohl (2002). Revised Educational Objectives Taxonomy

KNOWLEDGE DIMENSION

A. Factual knowledge – the basic elements that students must know to be acquainted with a discipline or to solve problems with it.

A.a Knowledge of terminology

A.b Knowledge of specific details and elements

B. Conceptual Knowledge – the interrelationships among the basic elements within a larger structure that enable them to function together.

B.a Knowledge of classifications and categories

B.b Knowledge of principles and generalizations

B.c Knowledge of theories, models, and structures

C. Procedural Knowledge – how to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.

C.a Knowledge of subject-specific skills and algorithms

C.b Knowledge of subject-specific techniques and methods

C.c Knowledge of criteria for determining when to use appropriate procedures

D. Metacognitive Knowledge – knowledge of cognition in general as well as awareness and knowledge of one's own cognition.

D.a Strategic knowledge

D.b Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge

D.c Self-knowledge

_ _

COGNITIVE PROCESS DIMENSION

1.0 Remember – retrieving relevant knowledge from long term memory

1.1 Recognizing

1.2 Recalling

2.0 Understand – determining the meaning of instructional messages, including oral, written, and graphic communication.

2.1 Interpreting

2.2 Exemplifying

2.3 Classifying

2.4 Summarizing

2.5 Inferring

2.6 Comparing

2.7 Explaining

3.0 Apply – Carry out or using a procedure in a given situations

3.1 Executing

3.2 Implementing

4.0 Analyze – breaking material into its constituent parts and detecting how the parts relate to one another and to the overall structure or purpose.

4.1 Differentiating

4.2 Organizing

4.3 Attributing

5.0 Evaluate – making judgments based on criteria and standards
- 5.1 Checking
- 5.2 Critiquing

6.0 Create – putting elements together to form a novel, coherent whole or make an original product.
- 6.1 Generating
- 6.2 Planning
- 6.3 Producing

Appendix C: Quellmalz Framework Taxonomy

Recall - Remembering or recognizing key facts, definitions, concepts, etc.; repeating verbatim or paraphrasing information that has already been provided to the student

Analysis - Understanding relationships between the whole and its component parts and between cause and effect; sorting and categorizing; understanding how things work and how the parts of something fit together; understanding causal relationships; getting information from charts, graphs, diagrams, and maps. Analysis is more than rote repetition; instead it involves reflectively structuring knowledge in new ways.

Comparison - Explaining how things are similar and how they are different. Comparisons may be either simple or complex. Simple comparisons are based on a small number of very obvious attributes. Complex comparisons require an examination of a more extensive set of attributes of two or more things. Comparisons start with the whole/part relationships in the analysis category and carry them a step further.

Inference - Reasoning inductively or deductively. In deductive tasks, students reason from generalizations to specific instances and are asked to recognize or explain the evidence. In inductive tasks, students are given the evidence or details and are required to relate and integrate the information to come up with the generalization.

Evaluation - Expressing and defending an opinion. Evaluation tasks require students to judge quality, credibility, worth or practicality using established criteria and explain how the criteria are met or not met.

Appendix D: Pre-test Questionnaire

Instructions: Circle or check your best response to the questions.

1. As your body starts to lose water (dehydrates),
    a. Your muscles cramp
    b. Your blood carries less oxygen
    c. Your brain function decreases
    d. Your body uses more protein for energy
    e. You become thirsty
    f. I am not sure

    How confident are you in the correctness of your response(s)

    Strongly 1 2 3 4 5 Not at all

2. A pre-game meal should be,
    a. High in protein and be eaten 1-1.5 hours before the game
    b. High in carbohydrates and be eaten 1-1.5 hours before the game
    c. Be high in both protein and carbohydrates and be eaten 2-3 hours before the game
    d. High in protein and be eaten 2-3 hours before the game
    e. High in carbohydrates and be eaten 2-3 hours before the game
    f. High in both carbohydrates and fat, and be eaten 1-2hours before the game
    g. I am not sure

    How confident are you in the correctness of your response(s)

    Strongly 1 2 3 4 5 Not at all

3. Which of the following would be the <u>best</u> choice(s) for a pre-game drink to improve athletic performance for a hydrated athlete,
    a. Chocolate Milk
    b. Cola
    c. Water
    d. Gatorade
    e. Powerade
    f. Orange Juice
    g. I am not sure

    How confident are you in the correctness of your response(s)

Strongly 1 2 3 4 5 Not at all

4. Which of the following would be the best choice(s) for a post-game drink,
    a. Chocolate Milk
    b. Cola
    c. Water
    d. Gatorade
    e. Powerade
    f. Orange Juice
    g. I am not sure

    How confident are you in the correctness of your response(s)

    Strongly 1 2 3 4 5 Not at all

5. How long after an intense game of hockey does it take for the human body to fully restore its energy levels (assuming proper food and liquid intake),
    a. 4 hours
    b. 6 hours
    c. 8 hours
    d. 12 hours
    e. 18 hours
    f. 24 hours
    g. 36 hours
    h. I am not sure

    How confident are you in the correctness of your response(s)

    Strongly 1 2 3 4 5 Not at all

6. A hockey player's diet should be high in,
    a. Carbohydrates
    b. Fat
    c. Protein
    d. Answers a & b
    e. Answers b & c
    f. Answers a & c
    g. I am not sure

    How confident are you in the correctness of your response(s)

    Strongly 1 2 3 4 5 Not at all

7. If a hockey player was not doing any strength training would Creatine be beneficial to their play on ice?
    a. Yes
    b. No
    c. It would make no difference
    d. I am not sure

    How confident are you in the correctness of your response(s)

    Strongly 1 2 3 4 5 Not at all

8. Which statements are true about consuming alcohol after games or practices,
    a. Contributes to dehydration
    b. Contributes to protein breakdown
    c. Impairs glycogen replacement
    d. Increases any swelling
    e. Makes the body absorb more fat
    f. Has no effect on athlete after 24 hours
    g. Drinking Gatorade after alcohol consumption will help reduce amount of dehydration
    h. I am not sure

    How confident are you in the correctness of your response(s)

    Strongly 1 2 3 4 5 Not at all

9. Pre-game nutrition should ensure the hockey player is taking in enough,
    a. Carbohydrates
    b. Proteins
    c. Fats
    d. Hydration(taking in water)
    e. vitamins
    f. Potassium
    g. Creatine
    h. Answers a, b & d
    i. I am not sure

    How confident are you in the correctness of your response(s)

    Strongly 1 2 3 4 5 Not at all

10. If a player chooses to consume caffeine prior to playing a game or practice they should ensure they limit themselves to a maximum of dose of ,
    a. 50mg (about what's in a can of coke)
    b. 100mg (average cup of coffee)
    c. 120-150 mg (can of Red Bull)
    d. 200mg
    e. 300mg
    f. Doesn't matter it has no effect, that's why it's been removed from IOC banned list
    g. I am not sure

    How confident are you in the correctness of your response(s)

    Strongly 1 2 3 4 5 Not at all

11. During the day **before practice** what do you typically drink and approximately how much (in litres) on average?
    a) It varies I have no set amount, it changes from day to day, on average I would drink about this much fluid_____
    b) Soda pop (other than cola) how much? _____
    c) Cola (Coke, Pepsi, etc.), how much ?_____
    d) Juice, how much ?_____
    e) Gatorade (Perform, or G2), how much?_____
    f) Gatorade (Recover), how much?_____
    g) Other hydration fluids, e.g. Powerade, how much?_____
    h) Energy Drinks (Red Bull, Rockstar, etc.), how much?_____
    i) Water, how much?_____
    j) Chocolate Milk, how much?_____
    k) White Milk, how much?_____
    l) Alcohol (beer, wine, hard liquor, etc.), how much?_____
    m) Other beverage_____, how much?_____

12. During the day **before a game** what do you typically drink and approximately how much (in litres) on average?

    a) It varies I have no set amount, it changes from day to day, on average I would drink about this much fluid_____
    b) Soda pop (other than cola) how much? _____
    c) Cola (Coke, Pepsi, etc.), how much ?_____
    d) Juice, how much ?_____
    e) Gatorade (Perform, or G2), how much?_____
    f) Gatorade (Recover), how much?_____
    g) Other hydration fluids, e.g. Powerade, how much?_____
    h) Energy Drinks (Red Bull, Rockstar, etc.), how much?_____
    i) Water, how much?_____
    j) Chocolate Milk, how much?_____
    k) White Milk, how much?_____
    l) Alcohol (beer, wine, hard liquor, etc.), how much?_____
    m) Other beverage_____, how much?_____

13. Within 4 hours **after a practice** what do you typically drink and approximately how much (in litres) on average?

    a) It varies I have no set amount, it changes from day to day, on average I would drink about this much fluid_____
    b) Soda pop (other than cola) how much? _____
    c) Cola (Coke, Pepsi, etc.), how much ?_____
    d) Juice, how much ?_____
    e) Gatorade (Perform, or G2), how much?_____
    f) Gatorade (Recover), how much?_____

g) Other hydration fluids, e.g. Powerade, how much?_____
h) Energy Drinks (Red Bull, Rockstar, etc.), how much?_____
i) Water, how much?_____
j) Chocolate Milk, how much?_____
k) White Milk, how much?_____
l) Alcohol (beer, wine, hard liquor, etc.), how much?_____
m) Other beverage_____, how much?_____

14. Within 4 hours **after a game** what do you typically drink and approximately how much (in litres) on average?

a) It varies I have no set amount, it changes from day to day, on average I would drink about this much fluid_____
b) Soda pop (other than cola) how much? _____
c) Cola (Coke, Pepsi, etc.), how much ?_____
d) Juice, how much ?_____
e) Gatorade (Perform, or G2), how much?_____
f) Gatorade (Recover), how much?_____
g) Other hydration fluids, e.g. Powerade, how much?_____
h) Energy Drinks (Red Bull, Rockstar, etc.), how much?_____
i) Water, how much?_____
j) Chocolate Milk, how much?_____
k) White Milk, how much?_____
l) Alcohol (beer, wine, hard liquor, etc.), how much?_____
m) Other beverage_____, how much?_____

15. Is your diet high in:
a) Protein
b) Carbohydrates
c) Fat
d) Carbohydrates and protein
e) Carbohydrates and fat
f) Protein and fat

g) Balance (relatively equal amounts of carbohydrates, protein and fat)
h) I don't know

16. Are there particular times when you eat carbohydrates, protein or fat?

a) No

b) Protein, when
_____

c) Carbohydrates, when
_____

d) Fat, when
_____

17. Do you take any supplements?

a) No

b) Multi vitamin, how much and how often?_____
c) Protein (powder or tablets), how much and how often?_____
d) Creatine, how much and how often?_____
e) Caffeine, how much and how often?
_____
f) Other_____, how much and how often?_____

18. How many days a week do you consume alcohol?
_____

19. How much alcohol do you consume in a week (on average)?
_____

20. Are you a vegetarian? Yes_____ No _____

21. Would you like to weigh?

a) more b) less c) the same d) don't really care

22. Do you use tobacco products? If so how much per day, and how days per week on average?

_____

Appendix E: Post Questionnaire

Instructions: Circle or check your best response to the questions.

1. Did you use a mobile device to learn the nutritional information provided?

   Yes_____ No_____

2. Did anything significant interfere with your learning in this study? (examples: heavier than normal school/work load, illness, personal relationship issue).

   Yes_____ No_____

3. Have you taken a course using a mobile device in the past?

   Yes_____ No_____

4. If you answered YES to having used a mobile device to take a course in the past, how did you feel about learning that way?

   Really liked it 1 2 3 4 5 Did not like it at all

5. How motivated were you to learn using a mobile device?

   Strongly 1 2 3 4 5 Not at all

6. How motivated were you to learn the contents of the nutritional course?

   Strongly 1 2 3 4 5 Not at all

7. Did your motivation level change (up or down) during the learning of the material?

   Yes___ No____ It went up _____ It went down _____

8. If you felt your motivation changed, why do you feel your motivation changed?

   A You found the learning relevant/useful
   B You did not find the learning relevant/useful
   C Other, explain:
   _____
   _____

9. How confident did you feel about being able to learn using your mobile device before beginning the learning? (How strongly did you believe you could learn using a mobile device?)

   Strongly 1 2 3 4 5 Not at all

10. Did you gain confidence in being able to learn using a mobile device as you moved along through the nutritional learning?

    Yes_____ No_____ Remained the Same_____

11. How confident did you feel about being able to learn about the topic of nutrition before beginning the learning?

    Very 1 2 3 4 5 Not at all

12. Did you find learning using your mobile device,

    Difficult 1 2 3 4 5 Easy

13. Did you go anywhere outside of the supplied learning material to learn more or find something else out about nutrition as a result of taking this mobile nutrition course?

    Yes_____ No_____

14. Which of the following if any did you find you useful in relation to taking the nutritional learning material on your mobile device? (Circle all that apply)

A Goal Setting – did you set targets for learning? e.g. I will learn hydration well enough to teach others, or learn it well enough to apply it without having to look at course information.
B Strategic Planning – did you decide on a plan to learn what you wanted to?
C Self Monitoring – did you mentally check your behavior, focus, concentration and motivation
D Self Evaluation – did you judge yourself on how well you felt you were doing?
E Cognitive Rehearsal – did you self check that you were remembering the material?

G Organization – did you connect the new learning's on nutrition to things you already knew about nutrition?
H Elaboration - did you seek out nutritional information from other sources and add that knowledge, to the nutritional information from this course?
I Time Management –did you make any plans in advance of when would be a good time to study, or make changes to your normal schedule to make a good time for study, e.g. give up 5 minutes of card playing on the bus to do this learning?
J Environment – did you make any efforts to organize your study environment to be, efficient and/or free of distractions?
K Effort Regulation – did you make efforts to control your attention in the face of distractions and uninteresting tasks, did you stick with the learning through difficult times?
L Help Seeking – did you obtain help from others to overcome academic difficulties? eg. did you seek help from any of your team mates or instructor either in person or online?

15. Before you started, did you feel learning more about nutrition would be helpful to you?

Yes_____ No_____

16. Was the motivation to learn the nutritional content coming from you, or was there someone else persuading you to learn it?

a) mostly from me
b) mostly from someone else

17. Did you learn what you wanted when you wanted, or was someone else providing direction for a topic to be learned and by when? (other than the study's request to be complete by a certain date)

a) You set the direction and timing
b) Someone else was driving the direction and timing

18. After you learned something you found useful, did that give you more energy and desire to learn more?

a) Yes it gave me more energy to learn
b) It resulted in less energy to learn more
c) Energy level stayed more or less the same
d) I didn't learn anything useful

19. Did you experience problems or difficulties in using the mobile device to learn with?

    Yes_____
    No_____
    Explain,
    _____
    _____
    _____ .

20. During the day **before practice** what do you typically drink and approximately how much (in litres) on average?

    a) It varies I have no set amount, it changes from day to day, on average I would drink about this much fluid_____
    b) Soda pop (other than cola) how much? _____
    c) Cola (Coke, Pepsi, etc.), how much ?_____
    d) Juice, how much ?_____
    e) Gatorade (Perform, or G2), how much?_____
    f) Gatorade (Recover), how much?_____
    g) Other hydration fluids, e.g. Powerade, how much?_____
    h) Energy Drinks (Red Bull, Rockstar, etc.), how much?_____
    i) Water, how much?_____
    j) Chocolate Milk, how much?_____
    k) White Milk, how much?_____
    l) Alcohol (beer, wine, hard liquor, etc.), how much?_____
    m) Other beverage_____, how much?_____

21. During the day **before a game** what do you typically drink and approximately how much (in litres) on average?

    a) It varies I have no set amount, it changes from day to day, on average I would drink about this much fluid_____

b) Soda pop (other than cola) how much? _____
c) Cola (Coke, Pepsi, etc.), how much ?_____
d) Juice, how much ?_____
e) Gatorade (Perform, or G2), how much?_____
f) Gatorade (Recover), how much?_____
g) Other hydration fluids, e.g. Powerade, how much?_____
h) Energy Drinks (Red Bull, Rockstar, etc.), how much?_____
i) Water, how much?_____
j) Chocolate Milk, how much?_____
k) White Milk, how much?_____
l) Alcohol (beer, wine, hard liquor, etc.), how much?_____
m) Other beverage_____, how much?_____

22. Within 4 hours **after a practice** what do you typically drink and approximately how much (in litres) on average?

a) It varies I have no set amount, it changes from day to day, on average I would drink about this much fluid_____
b) Soda pop (other than cola) how much? _____
c) Cola (Coke, Pepsi, etc.), how much ?_____
d) Juice, how much ?_____
e) Gatorade (Perform, or G2), how much?_____
f) Gatorade (Recover), how much?_____
g) Other hydration fluids, e.g. Powerade, how much?_____
h) Energy Drinks (Red Bull, Rockstar, etc.), how much?_____

i) Water, how much?_____
j) Chocolate Milk, how much?_____
k) White Milk, how much?_____
l) Alcohol (beer, wine, hard liquor, etc.), how much?_____
m) Other beverage_____, how much?_____

23. Within 4 hours **after a game** what do you typically drink and approximately how much (in litres) on average?

a) It varies I have no set amount, it changes from day to day, on average I would drink about this much fluid_____
b) Soda pop (other than cola) how much? _____
c) Cola (Coke, Pepsi, etc.), how much ?_____
d) Juice, how much ?_____
e) Gatorade (Perform, or G2), how much?_____
f) Gatorade (Recover), how much?_____
g) Other hydration fluids, e.g. Powerade, how much?_____
h) Energy Drinks (Red Bull, Rockstar, etc.), how much?_____
i) Water, how much?_____
j) Chocolate Milk, how much?_____
k) White Milk, how much?_____
l) Alcohol (beer, wine, hard liquor, etc.), how much?_____
m) Other beverage_____, how much?_____

24. As a result of learning the nutritional information in the mobile learning course have you intentionally changed your fluid intake, type of drinks, amount and timing of drinks?

Yes_____ No_____

25. Is your diet high in
    a) Carbohydrates_____
    b) Protein_____
    c) Fat_____
    d) Carbohydrates and protein_____
    e) Carbohydrates and fat_____
    f) Protein and fat_____
    g) Balance (relatively equal amounts of carbohydrates, protein and fat_____
    h) I don't know_____

26. As a result of learning the nutritional information in the mobile learning course have you intentionally changed your intake of carbohydrates, or protein, or fat?

    Yes_____ No_____

27. Are there particular times when you eat carbohydrates, protein or fat?

    a) No
    b) Protein, when
       _____
    c) Carbohydrates, when
       _____
    d) Fat, when
       _____

28. As a result of learning the nutritional information in the mobile learning course have you intentionally decided to consume protein or carbohydrates or fat any particular times?

    Yes_____ No_____

29. Do you take any supplements?

    a) No
    b) Multi vitamin, how much and how often?_____
    c) Protein (powder or tablets), how much and how often?_____
    d) Creatine, how much and how often?_____
    e) Caffeine, how much and how often?
    f) Other_____, how much and how often?_____

30. As a result of learning the nutritional information in the mobile learning course have you intentionally started or stopped taking any supplements?

    Yes_____ No_____

31. How many days a week do you consume alcohol?

    _____

32. Do you use tobacco products? If so how much per day, and how days per week on average?

    _____

33. As a result of learning the nutritional information in the mobile learning course have you intentionally changed the amount, or times you consume alcohol?

    Yes_____ No_____

34. Are you a vegetarian? Yes_____ No _____

35. As a result of learning the nutritional information in the mobile learning course have you intentionally changed your vegetarian diet?

    Yes_____ No_____

36. If you are a female athlete, did you study the Female Athlete Triad material in the mobile learning course?

    Yes_____ No____

37. As a result of what you learned about the Female Athlete Triad, have you made any changes to your diet or training?

    Yes_____ No_____

Mobile Device General use Questionnaire

A mobile device (also known as a handheld device, handheld computer or simply handheld) is a pocket-sized computing device, typically having a display screen with touch input and/or a miniature keyboard. Please note: Tablets (e.g. Playbook, iPad, etc.) are considered to be mobile devices for the purpose of this study.

1. How long have you been using mobile devices?
    a) 0-6 months

b) 6-12 months
c) 1-2 years
d) 2-3 years
e) 3-5 years
f) 5-10 years
g) more than 10 years

2. How many mobile devices do you currently use?

a) 1
b) 2
c) 3
d) 4 or more

3. Select the mobile device that you used MOST OFTEN in learning the nutritional content.

a) Mobile computer (laptop with mobile internet access)
b) Mobile computer (notebook with mobile internet access)
c) Tablet computer (e.g. iPad, Playbook)
d) Mobile phone/Smartphone
e) Other (please list):
_____ .

5. What brand is the mobile device that you used MOST OFTEN taking this course?

a) Apple iPad
b) Apple iPhone
c) Android
d) LG
e) Motorola
f) Nokia
g) Blackberry phone
h) Blackberry Playbook tablet
i) Samsung
j) Sanyo
k) Sony Ericcson
l) Other (please specify):_____ .

6. What do you generally use this mobile device for? Please select all that apply.

a) Learning (formally like this course and school work)
b) Learning (informally, to learn about things you're curious about)
c) Work
d) Pleasure

e) Socialization
f) Other (please specify): _____ .

7. How long have you been using your current mobile device?

a) 0-6 months
b) 6-12 months
c) 1-2 years
d) 2-3 years
e) 3-5 years
f) 5-10 years
g) more than 10 years

8. How often do you use this mobile device?

a) Never
b) Less than once a month
c) Once a week
d) Two-three times a week
e) once or twice a day
f) three or more times a day

FRAME: This section examines the relationship between mobile devices, users and learning environments.

9. Please select how much you agree or disagree with each of the following statements.

0 = not applicable
1 = strongly disagree
2 = disagree
3 = neither agree or disagree (neutral)
4 = agree
5 = strongly agree

____ I used this mobile device to interact with course content in a manner that is pleasing to me.
____ This mobile device has adequate data storage features (e.g. storage on the device, or option to use detachable, portable storage devices such as USB drives, CDs, DVDs and SD cards).
____ I enjoy using my mobile device to complete tasks.
____ I use my prior expertise to find solutions to novel problems that I encounter in using my mobile device.
____ This mobile device responds quickly to input demands (e.g. consider file storage

speed, system configuration, opening and closing applications).
____ I use collaborative tools on this mobile device to co-author documents.
____ I use this mobile device to retrieve information from web-based resources.
____ This mobile device allows me to engage socially in my online learning with others.
____ I adjust the INPUT settings on this mobile device to suit my unique needs and preferences (e.g. font size, volume, adding new applications).
____ I adjust the OUTPUT settings on this mobile device to suit my unique needs and preferences (e.g. print preferences, sound volume).
____ This mobile device allows reliable access to the personal, social, institutional and global networks that I want to connect to.
____ This mobile device provides easy input, selection and positioning of objects and data (e.g. adequate keyboard, touch screen, track ball, pen/stylus, voice recognition, etc.).
____ I use this mobile device to interact with the course instructor in ways that foster my learning experience.
____ I enjoy using my mobile device to communicate with others.
____ I use this mobile device to share relevant information effectively with others.
____ I relish the challenge in learning how to use new mobile devices.
____ My mobile device allows me to concentrate on the task at hand rather than spend time on learning how to use the device's various tools and applications.
____ This mobile device provides adequate auditory INPUT.
____ This mobile device provides adequate auditory OUTPUT.
____ I use this mobile device to help complete authentic (i.e. "real world") tasks that are included in my learning the course.
____ This mobile device is easy to manipulate (e.g. consider size, weight, shape, button placement, right/left hand requirements, one/two hand operability).
____ I use this mobile device to interact with other students in the course in ways that foster my learning experience.
____ I am keen to explore how to use new features and applications on my mobile device without seeking help from others.
____ I am satisfied with the connectivity access that I have when using this mobile device.
____ I find my mobile device easy to use.
____ I use this mobile device to retrieve information when it is needed.
____ I use this mobile device to communicate effectively with others (e.g. consider the quantity, quality, relation and manner in which this device allows you to communicate).
____ I can transfer information in the secure manner required when using this mobile device.
____ I use this mobile device to coordinate activities with others through such technologies as shared calendars, project management tools, Facebook, GooglePlus.
____ I use most, if not all of the features that this mobile device offers.
____ I use this mobile device to store information when I need to.
____ I use this mobile device in most environments where I am.

____ I use this mobile device to share relevant information at appropriate times with others.
____ I use this mobile device to store information where I need to.
____ This mobile device provides easy viewing of objects and data.
____ I use this mobile device to retrieve a wide variety of information in file formats that are useful to me.
____ I seek help from others when learning how to use various features, tools and applications on this mobile device.
____ This mobile device enhances my ability to learn new things.
____ I enjoy learning how to use new applications on my mobile device.

10. Please rate the frequency of mobile device use for each activity below.
0 = I do not believe that my device supports this function/application
1 = never
2 = less than once per month
3 = once per week
4 = two to three times per week
5 = daily

____ Attending virtual classes/meetings
____ Blogging
____ Brainstorming/mind mapping/notes to self
____ Calendar/schedule planning
____ Emailing
____ GPS/maps/driving directions
____ Graphic interfacing (e.g. capturing, sending and receiving photos, video clips)
____ Music
____ Online chat/Instant messaging
____ Phoning
____ Podcasts (e.g. news, weather)
____ Reading online journals, e-books and other digital text-based literature
____ Text messaging
____ Web browsing
____ Writing digital documents, including assignments

Course activity and mobile device comfort level: This section considers how comfortable you are using your mobile device for the CURRENT course that you are completing this questionnaire for.

11. Please rate how comfortable you feel using your current mobile device for the following applications in your CURRENT course.
0= I do not believe that my device supports this function/application
1= very uncomfortable
2= uncomfortable

3= somewhat comfortable
4= comfortable
5= very comfortable

____ Attending virtual classes/meetings
____ Blogging
____ Brainstorming/mind mapping/notes to self
____ Calendar/schedule planning
____ Emailing
____ GPS/maps/driving directions
____ Graphic interfacing (e.g. capturing, sending and receiving photos, video clips)
____ Music
____ Online chat/Instant messaging
____ Phoning
____ Podcasts (e.g. news, weather)
____ Reading online journals, e-books and other digital text-based literature
____ Text messaging
____ Web browsing
____ Writing digital documents, including assignments

12. How would you rate the content of the nutritional learning?

a) Very interesting
b) Somewhat interesting
c) Interesting
d) A little interesting
e) Not very interesting

13. How would you rate the videos?

a) Excellent
b) Very good
c) Good
d) Fair
e) Poor

14. How would rate the non video content?

a) Excellent
b) Very good
c) Good
d) Fair
e) Poor

15. How would rate learning using a mobile device (convenience, comfort)?

a) Excellent

b) Very good
c) Good
d) Fair
e) Poor

16. How would rate the support (being able to ask questions and how they were answered or not answered, did you like this approach)?

a) Excellent
b) Very good
c) Good
d) Fair
e) Poor

17. The nutritional learning was how relevant for you?

Yes very much 1 2 3 4 5 No not at all

18. The method of delivery (via mobile devices) used to teach the nutritional learning was an interesting and enjoyable method for me?

Yes very much 1 2 3 4 5 No not at all

19. I will be able to apply the nutritional learning in a beneficial way,

Yes very much 1 2 3 4 5 No not at all

20. The content (videos, text docs, and methods used to ask and answer questions) was well prepared and easy to use?

Yes very much 1 2 3 4 5 No not at all

21. As your body starts to lose water (dehydrates),

a. Your muscles cramp
b. Your blood carries less oxygen
c. Your brain function decreases
d. Your body uses more protein for energy
e. You become thirsty
f. I am not sure

How confident are you in the correctness of your response(s)

Strongly 1 2 3 4 5 Not at all

22. A pre-game meal should be,
    a. High in protein and be eaten 1-1.5 hours before the game
    b. High in carbohydrates and be eaten 1-1.5 hours before the game
    c. Be high in both protein and carbohydrates and be eaten 2-3 hours before the game
    d. High in protein and be eaten 2-3 hours before the game
    e. High in carbohydrates and be eaten 2-3 hours before the game
    f. High in both carbohydrates and fat, and be eaten 1-2hours before the game
    g. I am not sure

    How confident are you in the correctness of your response(s)

    Strongly 1 2 3 4 5 Not at all

23. Which of the following would be the <u>best</u> choice(s) for a pre-game drink to improve athletic performance for a hydrated athlete,
    a. Chocolate Milk
    b. Cola
    c. Water
    d. Gatorade
    e. Powerade
    f. Orange Juice
    g. I am not sure

    How confident are you in the correctness of your response(s)

    Strongly 1 2 3 4 5 Not at all

24. Which of the following would be the <u>best</u> choice(s) for a post-game drink,
    a. Chocolate Milk
    b. Cola
    c. Water
    d. Gatorade
    e. Powerade
    f. Orange Juice
    g. I am not sure

    How confident are you in the correctness of your response(s)

    Strongly 1 2 3 4 5 Not at all

25. How long after an intense game of hockey does it take for the human body to fully restore its energy levels (assuming proper food and liquid intake),

a. 4 hours
b. 6 hours
c. 8 hours
d. 12 hours
e. 18 hours
f. 24 hours
g. 36 hours
h. I am not sure

How confident are you in the correctness of your response(s)

Strongly 1 2 3 4 5 Not at all

26. A hockey player's diet should be high in,
    a. Carbohydrates
    b. Fat
    c. Protein
    d. Answers a & b
    e. Answers b & c
    f. Answers a & c
    g. I am not sure

How confident are you in the correctness of your response(s)

Strongly 1 2 3 4 5 Not at all

27. If a hockey player was not doing any strength training would Creatine be beneficial to their play on ice?
    a. Yes
    b. No
    c. It would make no difference
    d. I am not sure

How confident are you in the correctness of your response(s)

Strongly 1 2 3 4 5 Not at all

28. Which statements are <u>true</u> about consuming alcohol after games or practices,
    a. Contributes to dehydration
    b. Contributes to protein breakdown
    c. Impairs glycogen replacement

d. Increases any swelling
e. Makes the body absorb more fat
f. Has no effect on athlete after 24 hours
g. Drinking Gatorade after alcohol consumption will help reduce amount of dehydration
h. I am not sure

How confident are you in the correctness of your response(s)

Strongly 1 2 3 4 5 Not at all

29. Pre-game nutrition should ensure the hockey player is taking in enough,
a. Carbohydrates
b. Proteins
c. Fats
d. Hydration(taking in water)
e. vitamins
f. Potassium
g. Creatine
h. Answers a, b & d
i. I am not sure

How confident are you in the correctness of your response(s)

Strongly 1 2 3 4 5 Not at all

30. If a player chooses to consume caffeine prior to playing a game or practice they should ensure they limit themselves to a maximum of dose of ,
a. 50mg (about what's in a can of coke)
b. 100mg (average cup of coffee)
c. 120-150 mg (can of Red Bull)
d. 200mg
e. 300mg
f. Doesn't matter it has no effect, that's why it's been removed from IOC banned list
g. I am not sure

How confident are you in the correctness of your response(s)

Strongly 1 2 3 4 5 Not at all

31. Is there anything else that you would like to add about the use of your mobile device or the nutritional learning?

Additional information: Please use this section for any further thoughts or questions that you may have.

Appendix : F Cover Letter

Dated: xx/yy/zzzz

Dear Hockey Player;

I am conducting research for my doctoral dissertation which involves using mobile devices (smart phone, tablet) to teach sport nutrition specific to hockey. I am looking for elite level hockey players who would be interested in participating in this study. The time commitment would be 20-30 minutes to fill out a questionnaire, then over a 3 week period to take a series of learning's using their mobile phone or tablet device. The learning material can be taken in any order, at anytime, and at any place that would have internet access. The total time for the learning's would be approximately one hour. After the 3 week period for learning the material the participants would be given another questionnaire to fill out, this should take approximately 25-40 minutes to complete.

All information would remain confidential. The final report and a summary would be made available to all participants. Benefits for the participants would be increased knowledge of nutrition specifically as it relates to their ability to play hockey at a high level.

I would very much appreciate your participation.

Regards,
K. Dave Crowder
Doctoral Student, Athabasca University
Hm # 780 416 0339
Cell # 780 203 3417
email: dave.crowder@shaw.ca

APPENDIX G: Informed Consent

CONSENT TO PARTICIPATE IN RESEARCH

Outcomes of Mobile Learning Used to Train Elite Hockey Players as Measured by Kirkpatrick's Evaluation Model

You are asked to participate in a research study conducted by K. Dave Crowder, a doctoral student in the Centre of Distance Education at Athabasca University. This study is in partial fulfillment of the requirements for the Doctorate in Education (Distance Education) program.

If you have any questions or concerns about the research, please feel free to contact: Dr. Martha Cleveland-Innes, who is the study supervisor. She may be reached at martic@athabascau.ca or 1-800-788-9041, ext. 6426
Or
K. Dave Crowder, researcher. He may be contacted at dave.crowder@shaw.ca or call 1-780-416-0339

AGE OF RESEARCH PARTICIPANT

This study is open only to those who are 18 years of age or older.

Are you 18 years of age or older (please circle appropriate response) YES NO

If "YES", please proceed. If "NO", thank you for your time.

PURPOSE OF THE STUDY

This research study will evaluate the effectiveness of mobile learning for elite level hockey players. Sports nutrition content delivered through mobile devices will be evaluated to determine the reactions learners have to the mobile learning, knowledge gained and any behavior change resulting from the new knowledge.

PROCEDURES

If you volunteer to participate in this study, I would ask you to do the following things:

- Agree to this consent form through signature or through return, identifiable email.
- Complete a 15 minute paper and pencil questionnaire prior to taking an online sports nutrition course to describe your knowledge, and nutritional habits.
- Participate in a 3-week online course on sports nutrition. This will involve approximately 90 minutes of time over the 3 week period. The m-learning will consist of 14 videos ranging in length from 2 minutes and three seconds to seven minutes and 54 seconds, each video is supported with one page or less of text and one to four external web links.
- It is requested that you take the online sports nutrition course using a smart phone or tablet device
- Complete a 25 minute paper and pencil questionnaire following completing the online course to describe your reactions toward the learning, your nutritional knowledge and nutritional

habits

- Both questionnaires will be hand given to you at a pre agreed to time and place by myself, or will be provided by email. I will pick the questionnaires up in person at a pre agreed to time and place or I will provide a self addressed pre-paid postage return envelope.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

It is anticipated that this study will benefit the education sector in the form of improved knowledge in the area of mobile learning. It will also benefit sport nutritionists and elite athletes by testing a convenient way to offer important nutritional information. As a participant you will receive sports nutrition learning from expert registered dieticians who have extensive experience working with National Hockey League (NHL) players.

PAYMENT FOR PARTICIPATION

There will be no payment for participation in this study.

CONFIDENTIALITY

Every effort will be made to ensure confidentiality of any identifying information that is obtained in connection with this study. You will only be identified yourself on the questionnaires by a code name/number assigned to you.

No individual participant names or their team names will be associated with the data collected or published. Players will identify themselves via their own code name which will only be known to themselves and the researcher. The researcher's supervisor will have access to the raw data and analysis for verification, but not individual identification.

Results of this research may be published/disseminated through academic papers, conference presentations, and publishing of final report online through AU library digital thesis and project room.

All data will be stored on a password protected computer kept in a locked physical location. Data back-up will be stored on portable storage devices secured in a locked file cabinet. Only the researcher will have access to these devices. All data will be securely destroyed within one year of the study's completion.

PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study prior to the data analysis commencing. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise that warrant doing so.

RIGHTS OF RESEARCH PARTICIPANTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. This study has been reviewed and received ethics clearance through the Athabasca University Research Ethics Board. If you have questions regarding your rights as a research participant, contact the Research Ethics Administrator by e-mail to rebsec@athabascau.ca or by telephone at

1-780-675-6718 or Toll Free: 1-800-788-9041 ext. 6718.

SIGNATURE OF RESEARCH PARTICIPANT

I have read the information provided for the study 'Outcomes of Mobile Learning Used to Train Elite Hockey Players
as Measured by Kirkpatrick's Evaluation Model' herein. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

_____	_____	_____
Name of Participant (please print)	Signature of Participant	Date

SIGNATURE OF WITNESS

_____	_____	_____
Name of Witness (please print)	Signature of Witness	Date

APPENDIX H: Ethics Approval

Athabasca University
Canada's Open University

MEMORANDUM

DATE: January 28, 2013

TO: K. Dave Crowder

COPY: Dr. Martha Cleveland-Innes (Research Supervisor)
Janice Green, Secretary, Athabasca University Research Ethics Board
Dr. Simon Nuttgens, Chair, Athabasca University Research Ethics Board

FROM: Dr. Rick Kenny, Chair, CDE Research Ethics Review Committee

SUBJECT: **Ethics Proposal #CDE-13-01: "*Examining the Outcomes of Mobile Learning Used to Train Elite Level Hockey Players as Measured by Kirkpatrick's Evaluation Model*"**

Thank you for providing the revised application received January 24, 2013. The Centre for Distance Education (CDE) Research Ethics Review Committee, acting under authority of the Athabasca University Research Ethics Board to provide an expedited process of review for minimal risk student researcher projects, has reviewed the above-noted proposal and supporting documentation.

On behalf of the CDE Research Ethics Review Committee, I am pleased to confirm that this project has been granted **FULL APPROVAL** on ethical grounds, and you may **proceed immediately.**

The approval for the study is **valid for a period of one year from the date of this memo.** If required, an extension must be sought in writing prior to the expiry of the existing approval. **A Final Report is to be submitted when the research project is completed.** The reporting form can be found online at http://www.athabascau.ca/research/ethics/ .

This approval of your application will be reported to the Athabasca University Research Ethics Board (REB) at their next monthly meeting. The REB retains the right to request further information, or to revoke approval at any time.

As implementation of the proposal progresses, if you need to make any significant changes or modifications please consult with your supervisor to obtain their support for those changes, then please forward this information immediately to the CDE Research Ethics Review Committee via rebsec@athabascau.ca , for further review.

If you have any questions, please do not hesitate to contact Janice Green at janiceg@athabascau.ca or rebsec@athabascau.ca .

Centre for Distance Education
Research Ethics Review Committee
(A Sub-Committee of the Athabasca University Research Ethics Board)

CDE-FullApproval-Proceed

Page 1 of 1

APPENDIX I: FRAME Model Mobile Laptop Users

Table 1. Provides the responses from the eight participants who used laptop computers with mobile internet access. The first of three FRAME question sets asks:... Please select how much you agree or disagree with each of the following statements (5 = strongly agree, 4 = agree, 3 = neutral, 2= disagree 1= strongly disagree, and 0= not applicable).

Statement	0	1	2	3	4	5
I used this mobile device to interact with course content in a manner that is pleasing to me		1		3	2	2
This mobile device has adequate data storage features (e.g. storage on the device, or option to use detachable, portable storage devices such as USB drives, CDs, DVDs and SD cards).		1			3	4
I enjoy using my mobile device to complete tasks.			1		3	4
I use my prior expertise to find solutions to novel problems that I encounter in using my mobile device.	1			1	2	4
This mobile device responds quickly to input demands (e.g. consider file storage speed, system configuration, opening and closing applications).				4	3	1
I use collaborative tools on this mobile device to co-author documents.	1	2	2	1	1	1
I use this mobile device to retrieve information from web-based resources.				2	1	5

Statement	0	1	2	3	4	5
This mobile device allows me to engage socially in my online learning with others.		2			1	5
I adjust the INPUT settings on this mobile device to suit my unique needs and preferences (e.g. font size, volume, adding new applications).		2		1	1	4
I adjust the OUTPUT settings on this mobile device to suit my unique needs and preferences (e.g. print preferences, sound volume).		1		2	1	4
This mobile device allows reliable access to the personal, social, institutional and global networks that I want to connect to.		1			1	6
This mobile device provides easy input, selection and positioning of objects and data (e.g. adequate keyboard, touch screen, track ball, pen/stylus, voice recognition, etc.).			2			6
I use this mobile device to interact with the course instructor in ways that foster my learning experience.		1		2	1	4
I enjoy using my mobile device to communicate with others.				2	1	5
I use this mobile device to share relevant information effectively with others.					3	5
I relish the challenge in learning how to use new mobile devices.			2	3	2	1

Statement	0	1	2	3	4	5
My mobile device allows me to concentrate on the task at hand rather than spend time on learning how to use the device's various tools and applications.			2	2	2	2
This mobile device provides adequate auditory INPUT.				2	3	3
This mobile device provides adequate auditory OUTPUT.				2	3	3
I use this mobile device to help complete authentic (i.e. "real world") tasks that are included in my learning the course.		1	1	1	3	2
This mobile device is easy to manipulate (e.g. consider size, weight, shape, button placement, right/left hand requirements, one/two hand operability).			1	2	2	3
I use this mobile device to interact with other students in the course in ways that foster my learning experience.		1			4	3
I am keen to explore how to use new features and applications on my mobile device without seeking help from others.			1	3	3	1
I am satisfied with the connectivity access that I have when using this mobile device.			3	1	2	2
I find my mobile device easy to use.				2	1	5
I use this mobile device to retrieve information when it is needed.				1	2	5

Statement	0	1	2	3	4	5
I use this mobile device to communicate effectively with others (e.g. consider the quantity, quality, relation and manner in which this device allows you to communicate).					2	6
I can transfer information in the secure manner required when using this mobile device.				4		4
I use this mobile device to coordinate activities with others through such technologies as shared calendars, project management tools, Facebook, GooglePlus.			1	3	1	3
I use most, if not all of the features that this mobile device offers.		1		5	1	1
I use this mobile device to store information when I need to.		1		2	2	3
I use this mobile device in most environments where I am.			3	1	1	3
I use this mobile device to share relevant information at appropriate times with others.				3	3	2
I use this mobile device to store information where I need to.			1	2	3	2
This mobile device provides easy viewing of objects and data.				3	2	3
I use this mobile device to retrieve a wide variety of information in file formats that are useful to me.			1	1	2	4

Statement	0	1	2	3	4	5
I seek help from others when learning how to use various features, tools and applications on this mobile device.			1	2	4	1
This mobile device enhances my ability to learn new things.				1	3	4
I enjoy learning how to use new applications on my mobile device.			1	3	2	2

Table 2. The eight mobile laptop participants were asked to respond to: Please rate the frequency of mobile device use for each activity below.

Use	Don't believe device supports this function	Never (1)	< 1/month (2)	1/wk (3)	2-3/wk (4)	Daily (5)
Attending virtual classes/meetings	1	4	1	2		
	1	5	1		1	
Brainstorming/mind mapping/notes to self		4	1	1	1	1
Calendar/schedule planning		4	2	1		1
Emailing					3	5
GPS/maps/driving directions		2		2	3	1
Graphic interfacing (e.g. capturing, sending and receiving photos, video clips)		1		3	2	2
Music		2		1		5
Online chat/Instant messaging		3			2	2
Phoning	2		2		1	3
Podcasts (e.g. news, weather)	1	5	1			1
Reading online journals, e-books and other digital text-based literature		2		2	2	2
Text messaging	3	1		1	1	2
Web browsing		1		1		6
Writing digital documents, including assignments		2			1	5

Table 3. The eight mobile laptop participants responded to: Please rate how comfortable you feel using your current mobile device for the following applications in your CURRENT course.

Use	Don't believe device supports this function	Very un-comfortable (1)	Un-comfortable (2)	Somewhat comfortable (3)	Comfortable (4)	Very comfortable (5)
Attending virtual classes/meetings	1	1		1	2	3
Blogging	2	2		2	1	1
Brainstorming/ mind mapping/notes to self	2	1	1	1	2	1
Calendar/schedule planning	2			1	2	3
Emailing	1				3	4
GPS/maps/driving directions	1	1		1	1	4
Graphic interfacing (e.g. capturing, sending and receiving photos, video clips)	1			1	2	4
Music	1				1	6
Online chat/Instant messaging	1		1		3	3
Phoning	2				3	3
Podcasts (e.g. news, weather)	2	2		1	1	2
	1	1			2	4

Reading online journals, e-books & other digital text-based literature					
Text messaging	3		1	1	3
Web browsing	1	1		1	5
Writing digital documents, including assignments	1			2	5

APPENDIX J: FRAME Model Smartphone Users

Table 4. Provides the responses from the 16 participants who used smart phones with mobile internet access. The first of three FRAME question sets asks: Please select how much you agree or disagree with each of the following statements. (5 = strongly agree, 4 = agree, 3 = neutral, 2= disagree 1= strongly disagree, and 0= not applicable).

Statement	0	1	2	3	4	5
I used this mobile device to interact with course content in a manner that is pleasing to me.			1	6	8	1
This mobile device has adequate data storage features (e.g. storage on the device, or option to use detachable, portable storage devices such as USB drives, CDs, DVDs and SD cards).				5	8	3
I enjoy using my mobile device to complete tasks.			1	4	5	6
I use my prior expertise to find solutions to novel problems that I encounter in using my mobile device.			1	6	6	3
This mobile device responds quickly to input demands (e.g. consider file storage speed, system configuration, opening and closing applications).			1	4	5	6
I use collaborative tools on this mobile device to co-author documents.		3	5	4	3	1
I use this mobile device to retrieve information from web-based resources.				2	8	6

Statement	0	1	2	3	4	5
This mobile device allows me to engage socially in my online learning with others.			2	1	6	7
I adjust the INPUT settings on this mobile device to suit my unique needs and preferences (e.g. font size, volume, adding new applications).		1	1	4	7	3
I adjust the OUTPUT settings on this mobile device to suit my unique needs and preferences (e.g. print preferences, sound volume).		1	2	5	5	3
This mobile device allows reliable access to the personal, social, institutional and global networks that I want to connect to.				4	4	8
This mobile device provides easy input, selection and positioning of objects and data (e.g. adequate keyboard, touch screen, voice recognition, etc.).			1	3	5	7
This mobile device provides easy input, selection and positioning of objects and data (e.g. adequate keyboard, touch screen, voice recognition, etc.).			1	3	5	7
I use this mobile device to interact with the course instructor in ways that foster my learning experience.		1	2	5	3	5
I enjoy using my mobile device to communicate with others.			1	1	4	10
I use this mobile device to share relevant information effectively with others.				2	7	7

Statement	0	1	2	3	4	5
I relish the challenge in learning how to use new mobile devices.			3	4	5	4
My mobile device allows me to concentrate on the task at hand rather than spend time on learning how to use the device's various tools and applications.	1	1	5		5	4
This mobile device provides adequate auditory INPUT.	1		1	4	5	5
This mobile device provides adequate auditory OUTPUT.			1	4	7	4
I use this mobile device to help complete authentic (i.e. "real world") tasks that are included in my learning the course.				5	7	4
This mobile device is easy to manipulate (e.g. consider size, weight, shape, button placement, right/left hand requirements, one/two hand operability).			1	3	5	7
I use this mobile device to interact with other students in the course in ways that foster my learning experience.			1	8	4	3
I am keen to explore how to use new features and applications on my mobile device without seeking help from others.				6	6	4
I am satisfied with the connectivity access that I have when using this mobile device.		1	1	1	8	5
I find my mobile device easy to use.				2	7	7

Statement	0	1	2	3	4	5
I use this mobile device to retrieve information when it is needed.			1		3	12
I use this mobile device to communicate effectively with others (e.g. consider the quantity, quality, relation and manner in which this device allows you to communicate).				2	4	10
I can transfer information in the secure manner required when using this mobile device.				6	7	3
I use this mobile device to coordinate activities with others through such technologies as shared calendars, project management tools, Facebook, GooglePlus.		1		5	3	7
I use most, if not all of the features that this mobile device offers.		1	1	3	7	4
I use this mobile device to store information when I need to.		1	2	4	3	6
I use this mobile device in most environments where I am.			1	2	4	9
I use this mobile device to share relevant information at appropriate times with others.				6	3	7
I use this mobile device to store information where I need to.			1	6	4	5
This mobile device provides easy viewing of objects and data.			1	2	9	4

Statement	0	1	2	3	4	5
I use this mobile device to retrieve a wide variety of information in file formats that are useful to me.			1	8	4	3
I seek help from others when learning how to use various features, tools and applications on this mobile device.			5	6	3	2
This mobile device enhances my ability to learn new things.			1	4	8	3
I enjoy learning how to use new applications on my mobile device.			1	3	9	2

Table 5. The Second FRAME question set responded to by the 16 participants using smart phones was: Please rate the frequency of mobile device use for each activity below.

Use	Don't believe device supports this function	Never (1)	< 1 per month (2)	1/wk (3)	2-3/wk (4)	Daily (5)
Attending virtual classes/meetings	5	7	1	1	1	1
Blogging	5	8			1	2
Brainstorming/mind mapping/notes to self	2	4		5	1	4
Calendar/schedule planning			3	3	4	6
Emailing				1	4	11
GPS/maps/driving directions			4	4	6	
Graphic interfacing (e.g. capturing, sending and receiving photos, video clips)		1	1		9	5
Music		1		2	5	7
Online chat/Instant messaging		4	1	4	2	5
Phoning			1	2	3	10
Podcasts (e.g. news, weather)		5	4		2	5
Reading online journals, e-books and other digital text-based literature		5	2	5	2	2
Text messaging			1	1	1	13

Use	Don't believe device supports this function	Never (1)	< 1 per month (2)	1/wk (3)	2-3/wk (4)	Daily (5)
Writing digital documents, including assignments	1	6	2		3	4

Table 6. The Third FRAME question set responded to by the 16 participants using smart phones was: Please rate how comfortable you feel using your current mobile device for the following applications in your CURRENT course.

Use	Don't believe device supports this function	Very un-comfortable (1)	Un-comfortable (2)	Somewhat comfortable (3)	Comfortable (4)	Very comfortable (5)
Attending virtual classes/meetings	1	5	3	2	3	2
Blogging	2	4	3	2	2	3
Brainstorming/ mind mapping/notes to self			3	3	4	6
Calendar/ schedule planning			1	3	4	8
Emailing		1		2	1	12
GPS/maps/driving directions		1	1	3	2	9
Graphic interfacing (e.g. capturing, sending and receiving photos, video clips)		2	1	3	1	9
Music		1		2	2	11
Online chat/Instant messaging		2	5	3	2	4
Phoning		2		2	1	11
Podcasts (e.g. news, weather)		3	2	4	2	5

Use	Don't believe device supports this function	Very un-comfortable (1)	Un-comfortable (2)	Somewhat comfortable (3)	Comfortable (4)	Very comfortable (5)
Reading online journals, e-books and other digital text-based literature			3	3	1	7
Text messaging		1		1	3	11
Web browsing		1		1	2	12
Writing digital documents, including assignments	1	2	3	3	3	4

APPENDIX K: FRAME Model Tablet Users

Table 7. The following provides the responses from the two participants who used tablets. The first of three FRAME question sets asks: Please select how much you agree or disagree with each of the following statements. (5 = strongly agree, 4 = agree, 3 = neutral, 2= disagree 1= strongly disagree, and 0= not applicable).

Statement	0	1	2	3	4	5
I used this mobile device to interact with course content in a manner that is pleasing to me.					1	1
This mobile device has adequate data storage features (e.g. storage on the device, or option to use detachable, portable storage devices such as USB drives, CDs, DVDs and SD cards).					1	1
I enjoy using my mobile device to complete tasks.				1		1
I use my prior expertise to find solutions to novel problems that I encounter in using my mobile device.			1	1		
This mobile device responds quickly to input demands (e.g. consider file storage speed, system configuration, opening and closing applications).					2	
I use collaborative tools on this mobile device to co-author documents.		1		1		

Statement	0	1	2	3	4	5
I use this mobile device to retrieve information from web-based resources.			1		1	
This mobile device allows me to engage socially in my online learning with others.			1		1	
I adjust the INPUT settings on this mobile device to suit my unique needs and preferences (e.g. font size, volume, adding new applications).					2	
I adjust the OUTPUT settings on this mobile device to suit my unique needs and preferences (e.g. print preferences, sound volume).					2	
This mobile device allows reliable access to the personal, social, institutional and global networks that I want to connect to.					2	
This mobile device provides easy input, selection and positioning of objects and data (e.g. adequate keyboard, touch screen, track ball, pen/stylus, voice recognition, etc.).						2
I use this mobile device to interact with the course instructor in ways that foster my learning experience.			1			1
I enjoy using my mobile device to communicate with others.				1		1

Statement	0	1	2	3	4	5
I use this mobile device to share relevant information effectively with others.				1		1
I relish the challenge in learning how to use new mobile devices.				1		1
My mobile device allows me to concentrate on the task at hand rather than spend time on learning how to use the device's various tools and applications.					1	1
This mobile device provides adequate auditory INPUT.					1	1
This mobile device provides adequate auditory OUTPUT.					1	1
I use this mobile device to help complete authentic (i.e. "real world") tasks that are included in my learning the course.				1	1	
This mobile device is easy to manipulate (e.g. consider size, weight, shape, button placement, right/left hand requirements, one/two hand operability).					1	1
I use this mobile device to interact with other students in the course in ways that foster my learning experience.				1	1	
I am keen to explore how to use new features and applications on my mobile device without seeking help from others.				1		1
I am satisfied with the connectivity access that I have when using this mobile device.				1		1
I find my mobile device easy to use.					1	1

Statement	0	1	2	3	4	5
I use this mobile device to retrieve information when it is needed.						2
I use this mobile device to communicate effectively with others (e.g. consider the quantity, quality, relation and manner in which this device allows you to communicate).						2
I can transfer information in the secure manner required when using this mobile device.						2
I use this mobile device to coordinate activities with others through such technologies as shared calendars, project management tools, Facebook, GooglePlus.						2
I use most, if not all of the features that this mobile device offers.				1	1	
I use this mobile device to store information when I need to.					1	1
I use this mobile device in most environments where I am.					1	1
I use this mobile device to share relevant information at appropriate times with others.					1	1
I use this mobile device to store information where I need to.					1	1
This mobile device provides easy viewing of objects and data.					1	1

Statement	0	1	2	3	4	5
I use this mobile device to retrieve a wide variety of information in file formats that are useful to me.					1	1
I seek help from others when learning how to use various features, tools and applications on this mobile device.		1		1		
This mobile device enhances my ability to learn new things.				1		1
I enjoy learning how to use new applications on my mobile device.				1	1	

Table 8. The two participants who used tablets were asked to respond to: Please rate the frequency of mobile device use for each activity below.

Use	Don't believe device supports this function	Never (1)	< 1/month (2)	1/wk (3)	2-3/wk (4)	Daily (5)
Attending virtual classes/meetings			1			1
Blogging		2				
Brainstorming/mind mapping/notes to self	1					1
Calendar/schedule planning			1			1
Emailing					1	1
GPS/maps/driving directions			1		1	
Graphic interfacing (e.g. capturing, sending and receiving photos, video clips)				1	1	
Music			1		1	
Online chat/Instant messaging		1			1	
Phoning		1				1
Podcasts (e.g. news, weather)	1	1				
Reading online journals, e-books and other digital text-based literature	1			1		
Text messaging				1		1
Web browsing						2
Writing digital documents, including assignments				2		

Table 9. The Third FRAME question set responded to by the two participants who used tablets was: Please rate how comfortable you feel using your current mobile device for the following applications in your CURRENT course.

Use	Don't believe device supports this function (0)	Very un-comfortable (1)	Un-comfortable (2)	Somewhat comfortable (3)	Comfortable (4)	Very comfortable (5)
Attending virtual classes/meetings				1		1
Blogging	1					1
Brainstorming/ mind mapping/notes to self						2
Calendar/ schedule planning						2
Emailing						2
GPS/maps/ driving directions						2
Graphic interfacing (e.g. capturing, sending and receiving photos, video clips)						2
Music						2
Online chat/Instant messaging						2
Phoning				1		1
Podcasts (e.g. news, weather)	1				1	

Use	Don't believe device supports this function (0)	Very un-comfortable (1)	Un-comfortable (2)	Somewhat comfortable (3)	Comfortable (4)	Very comfortable (5)
Reading online journals, e-books and other digital text-based literature	1					1
Text messaging						2
Web browsing						2
Writing digital documents, including assignments	1					1