

THE EFFECTS OF INTERACTIVE REVIEWS AND LEARNING STYLE ON STUDENT
LEARNING OUTCOMES AT A TEXAS STATE UNIVERSITY

Wesley Adams B.S., M.S.

Dissertation Prepared for the Degree of
DOCTOR OF PHILOSOPHY

UNIVERSITY OF NORTH TEXAS

May 2008

APPROVED:

Patsy Fulton-Calkins, Major Professor
Ron Newsom, Minor Professor
Kathleen Whitson, Committee Member
Allen Jackson, Committee Member
Janice Holden, Chair of the Department of
Counseling and Higher Education
M. Jean Keller, Dean of the College of Education
Sandra L. Terrell, Dean of the Robert B. Toulouse
School of Graduate Studies

Adams, Wesley. *The Effects of Interactive Reviews and Learning Style on Student Learning Outcomes at a Texas State University*. Doctor of Philosophy (Higher Education), May 2008, 100 pp., 8 tables, 1 figure, references, 38 titles.

This study investigated the effects of interactive lessons and learning style on student learning outcomes in self-defense education classes. The study utilized an experimental design that incorporated four self-defense education classes at the University of North Texas (UNT) during the fall semester 2007 ($N = 87$). A pre-test was administered during the first week of class to determine prior knowledge of the participants. The Visual Auditory Reading/Kinesthetic Inventory (VARK) was used to assess the learning styles of the students and was completed after the pre-test of knowledge was administered. The treatment group received the interactive lesson and the control received a paper review. The difference between the pre and posttest was used as a measure of improvement of the student's learning outcomes.

A 2 (treatment/control) by 2 (pretest/posttest) ANOVA with repeated measures was conducted to examine the differential improvement in knowledge across the intervention. Based on the 2-way ANOVA there was a significant difference between the treatment group and the control group based on their learning outcomes. A repeated measures ANOVA was conducted to determine if there was a significant difference between the groups based on the pre and post test scores. Based on the results of a one week study it was determined that interactive lessons do make a significant impact on learning outcomes compared to traditional reviews.

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CHAPTER 1

INTRODUCTION

Overview

In the past, state universities, in order to receive federal funding, were required to provide at least half of all classes in a traditional classroom setting. The fifty percent rule, as it was named, was recently repealed, which created the opportunity for more courses to be offered online (Dillon, 2006, p.1). The increase in online education is a recent trend in higher education and has increased the need for further research into quality online programs. The world is getting smaller due to globalization, and it is essential that technology based instruction is equivalent to traditional means of education. This is especially true in higher education with the increased need to make education applicable to many students from different cultures in many countries. Our current society relies heavily on technology and new methods of instructional delivery are evolving at a rapid pace. Educators need to be prepared and aware of the power of technology and the influence it can have on student learning outcomes. Numerous studies have shown that interactive lessons help engage students in the learning process.

Problem Statement

Due to the increased use of online education, it is necessary to determine the appropriate design of interactive lessons and to determine if interactive lessons have an equivalent effect compared to traditional reviews on learning outcomes.

Statement of Purpose

This research may be used to conduct future studies about appropriate design of computer-assisted and online education. Results from this study will help improve teaching strategies and course design. The results of this study are also important for traditional classroom settings. If learning style is shown to have an impact on the learning outcomes of students, then it will be important to assess learning style prior to starting a class. If interactive lessons reveal a significant improvement on learning outcomes compared to traditional means of instruction, integration of more interactive lessons will be important to future class design.

Research Questions and Hypothesis

The following are the research questions established to guide the study:

1. Will interactive reviews affect learning outcomes in self-defense education?
2. Does the participant's learning style affect learning outcomes in self-defense education?
3. Is there an interaction effect between groups and learning style on learning outcomes in self-defense education?

To address the research questions from the study an experimental design was used. The following provides the hypotheses used to test the theories that resulted from the genesis of the study.

Hypothesis for Main Effect A. The interactive lesson will have a positive effect on learning outcomes compared to traditional methods. The following is the null hypothesis.

There is no difference in learning outcomes between participants who are administered the interactive (i.e. treatment) and/or the traditional review (i.e. control group).

Ho: $\mu_{AT} = \mu_{AC}$ (AT: treatment; Ac: control)

Ha: $\mu_{AT} \neq \mu_{AC}$

Hypothesis for Main Effect B. The learning style of the participants will have a significant impact on learning outcomes for a one week study. The following is the null hypothesis for Main Effect B:

Learning style will not have a significant impact on the learning outcomes of participants.

Ho: $\mu_{B1} = \mu_{B2} = \mu_{B3} = \mu_{B4} = \mu_{B5}$ (B1: visual, B2: auditory, B3: reading, B4: kinesthetic, B5: multimodal)

Ha: At least one of the means for learning style will be significantly different than the other means.

Hypothesis for the Interaction Effect. The interaction between learning style and the treatment group will have a positive effect on learning outcomes in physical education. The following provides the null hypothesis:

There is no interaction between learning style and the treatment group.

Ho: The interaction between leaning style and the treatment group will not have a significant impact on learning outcomes in physical education.

Ha: The interaction between learning style and the treatment group will have a significant impact on learning outcomes in physical education.

Definition of Terms

The following are definitions of key terms used in the study:

- *Interactive review* is an interactive lesson that was created using Adobe® Flash® CS3 Professional software. The lesson incorporates different learning styles by allowing users to interact with the lesson. It also provides immediate feedback to users, which assists in the user's ability to retain information in this study.
- *Learning outcomes* were determined using the test scores from the pre and post-tests. The difference between the scores was used as a measure of improvement.
- *Learning style*. There are multiple levels of intelligence and most individuals have multiple ways they learn best. Learning styles are a general classification of an individual's primary means of learning for this study.
 - *Visual*. According to Sousa (2007), a large number of students, 45 percent or more in most American classrooms, prefer to receive information visually. "This includes both those who like pictures, video tapes, and charts and those who enjoy reading as the interpretation of symbols that translate into pictures in their minds" (p. 6).
 - *Auditory*. Sousa (2007), reported that "a relatively small number of students, 19 percent or so, now prefer either listening or discussing/talking as a way of receiving information" (p. 6).
 - *Reading*. Reading designates those individuals that learn best through reading and writing. Individuals that score high on reading tend to

learn best by writing information down or reading detailed instructions.

- *Kinesthetic*. Sousa (2007) stated that “some students, usually at least 35percent, learn most effectively while moving (kinesthetic) or handling (tactile) things.” This action and body involvement help them to perceive meaning (p. 6).
- *Multimodal*. Multimodal learners have multiple learning preferences. They utilize all forms of learning to some degree. Most individuals are multimodal learners.
- *Pretest*. The pre-test was used to determine the level of prior knowledge the participants had about the subject matter. Participants were tested over physical fitness principles related to exercise physiology. The pretest was given prior to any review process.
- *Posttest*. The post-test was used to determine how much the participants learned from the review they were given. The posttest was the same as the pre-test and was used to assess learning outcomes. The posttest was given to participants after the review process.
- *Traditional review*. The traditional review was a paper review that contained the same information as the interactive review. The difference between the traditional and interactive review was the interaction available in the interactive review and the outcome score required on the interactive review.

- *Visual auditory reading and kinesthetic (VARK)*. The VARK inventory assesses several different learning styles. VARK classifies learners into four distinct learning styles (visual, auditory, reading, and kinesthetic).

Study Design

The study utilized an experimental design and was conducted in the fall semester of 2007. There were four sections of students involved in the study who were randomly selected from self-defense education classes held at UNT. The students were randomly assigned into one of two possible groups. Then one group were randomly designated as the treatment group and given the traditional review instructions. The other group was labeled the control group and was given a traditional review. All four sections used in the study were daytime courses that met twice a week.

The primary researcher for the study was the instructor of record for the four sections. All participants will be administered a pretest to determine their base knowledge of the subject matter. An independent samples t-test was used to determine if both groups had equivalent knowledge of the subject matter. After the pre-test was administered all participants were given instructions to access the visual, auditory, reading, and kinesthetic (VARK) inventory to determine their primary learning style. From the results of the VARK inventory students were classified under their primary learning style (1- visual, 2- auditory, 3- reading, 4- kinesthetic, and 5- multimodal). All participants involved in the study took the same pre-test, inventory, and post-test. The difference between the pre and posttest will be used as a measure of learning outcomes. The post-test was administered exactly one class period after the pretest was administered.

A repeated measures analysis of variance (ANOVA) was conducted to determine if there was significant improvement between the groups and to determine if there were any correlation between the pre and post tests. A two way analysis of variance (ANOVA) was used to determine the amount of shared variance between the independent variables (learning style and interactive lessons) and the dependent variable (learning outcomes). The ANOVA was a 2x4 with two levels for the instructional method and four levels to record learning style. Auditory was excluded due to the limited number of auditory learners in the study. The treatment group will receive their review electronically and the control group will receive their review on paper. Both reviews contain the same information but presented in a different manner. The first two levels of the ANOVA will be labeled as the instructional method and the other levels will be labeled as learning style. The interaction effect will compare the interaction between instructional methods and learning style to determine if they have a combined effect on learning outcomes.

Significance of the Study

If the research hypothesis is confirmed by the study, current educational practices may need to be revised. Since the fifty-percent rule has been repealed, it is important to ensure that interactive lessons are equivalent to traditional means of education. The fifty-percent rule has important implications due to the fact that institutions receiving federal aid can now offer more than half of their courses online. In the past, institutions were limited on the number of courses they offered online, but since the fifty-percent rule was repealed there is no longer a limit.

To ensure interactive lessons are equivalent or better than traditional means of education, it is important to consider the design of interactive programs. Offering interaction and immediate feedback are essential to the success of education. Interactive lessons have the potential to enhance learning due to the power of technology. Current online technologies provide the opportunity to offer immediate feedback, interaction, and multimodal education. With the current technology present in online software, students can learn in their preferred mode of learning. The main problem with current methods of online education is the inability to use the resources online education can offer. Many online programs are replications of traditional lecture classes. Technology has the potential to reshape and improve education if used appropriately. There are so many educational tools available in current software packages that it was impossible to research all the possible influences technology can have on education.

Due to time constraints, this study was limited to researching the effects that learning style and interactive lessons have on learning outcomes. There are many more areas that need to be researched, such as interactive games, the role of motivation, and the access students will have to technology. It is hypothesized that learning style and interactivity will have the most impact on the participants learning outcomes. If there is a relationship between interactive lessons and learning style on learning outcomes, all methods of instruction may benefit. This study was designed to test interactive reviews to a traditional review process. If the interactive reviews and learning style show a significant improvement on learning outcomes, then traditional methods of teaching may need to be enhanced to take advantage of the benefits.

Study Limitations

The following provides a list of the limitations that may affect the replication and generalizability of this study:

- Participants who did not correctly complete the process set forth by the primary researcher had their data excluded from the statistical analysis.
- Participants were asked to study the review they were assigned. The treatment group was required to achieve a set outcome score before they complete the post-test. The control group was not required to achieve a certain level of proficiency, and it is possible that some participants will not review the information they will be given.
- The duration of the study was limited to learning over a one week period. Learning will be limited to the participant's ability to learn and retain information during a one week time span.

Study Delimitations

The following provides a list of delimitations that occurred as a result of the study:

- The sample consisted of freshmen through seniors. A few students could have prior knowledge of the subject matter.
- The primary researcher created the data collection forms except for the VARK inventory.
- The VARK inventory only measures visual, auditory, reading, and kinesthetic modes of learning. There are many different elements that compose an individuals

learning style. It is possible that one or more learning style elements were not included.

- The primary researcher was the instructor of record for the sections of self-defense education classes used in the study.
- The interactive review was created by the primary researcher.
- The research sample was drawn from the four sections of self-defense education courses during the fall 2007 semester.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Overview

The Internet and the advent of distance education have dramatically changed education. “Computer technology has affected the way we communicate, perform research, and perform business transactions” within education (Lenear & Johnson, 2002, p. 1). Technological changes are occurring at an extremely rapid pace and higher education must keep up with the changes. “Technological change is common in contemporary organizations” and will continue to occur (Osman-Gani, 2002, p.18). These types of changes are more likely to impact dynamic organizations such as large businesses and universities. In 2000, one in three U.S. colleges offered an accredited degree online (McCoy, 2003 p. 1). “Higher education institutions are now using the Internet to offer courses to students who are located anywhere in the world” (Lenear & Johnson, 2002, p. 1). Web-based instruction continues to develop at an extremely rapid pace and it is important that online education offers equivalent education to traditional means of instruction.

There are several important reasons online education needs to be evaluated to insure it provides quality education. The fifty-percent rule was recently repealed and has opened the doorway for more online courses to be offered. Many online courses are not designed properly and are nothing more than postings of traditional lecture courses. It is

also important to make sure many modes of learning are reached with the use of applications available to online courses.

The need for policy regarding distance education has increased since the repealing of the fifty percent rule. In the past colleges were required to deliver at least half of their courses on a campus to qualify for federal student aid. This rule is no longer in place and there is no limit on the amount of distance education an institution can offer. This policy change has enormous implications for higher education and distance education research (Dillon, 2006).

Technology

According to Osman-Gani (2002) technology can be classified into three major types: product, process, and management (p. 18). When designing an online class, designers should be primarily concerned with product technology. Product technologies are defined as “ideas that are incorporated into a concrete object.” Process technologies are the “sequential steps used to produce a product or deliver a service” (Osman-Gani, 2002, p. 18). Product technologies have had a dramatic impact on education in recent years. New product technologies have led to the introduction of electronic telecommunications and computer equipment. New forms of education have taken advantage of new product technologies and have developed innovative ways of delivering education. One of the most popular forms of product technology used today in higher education is distance education (Osman-Gani, 2002, p. 18).

Characteristics of Technology

“According to Muir (2006), using technology as a medium to transfer information has several advantages. It allows the user to control the mode of delivery and presentation rate” (p. 8). It also allows one to “control the order of the presentation, pace of learning, and selection of learning activities.” Most technologies available today can “monitor learning responses, store responses, and conduct assessment.” “Many provide simulations that are low-cost and risk free.” Most Blackboard® courses “provide collaborative learning groups by linking the learner to the instructor and to other students.” Online courses “allow convenient access to learning materials and resources via the Internet” (Muir, 2006, p. 18).

According to Kirk & Waltermeyer (2002), “Education is being reengineered through the introduction of web-based learning”(p. 6). Learners have the ability to participate in a course at any time. Technology has increased the convenience of education. Now instead of spending hours trying to research information in a library, students can access the same information by the web. The information being researched can be contained within the course itself or students can use electronic resources to research information. “New technologies include archiving, searching, replicating, hypertext, linking, communication devices, and modeling tools” (Kirk & Waltermeyer, 2002, p. 6). Archiving information within a DVD-ROM or website makes research more convenient. Instructors can have relevant research articles linked to a website or saved to a DVD-ROM so students can retrieve the information when needed. “According to

Wilson (2001), “new technologies serve a number of functions: they empower people and open up new possibilities for action” (p. 6).

“Many business organizations and academic institutions have turned to online learning using the Internet and other web-based technologies in order to provide needed learning” (Benson, 2002, p. 443). One of the main concerns with regard to online universities is that they may “bypass some of the traditional decision-making processes due to their lack of brick and mortar mindset” (McCoy, 2003, p. 90).

Greenagel (2002) stated that “e-learning has not kept pace with the development of increasingly rich IP (internet protocol) based delivery platforms for a number of reasons, including an apparent lack of awareness on the part of developers of the ways in which people learn, and an interest in keeping cost low, which precludes expenditures on effectiveness measures and development of new strategies for delivery” (p. 3). It is important that developers create online education that is equivalent to traditional education due to the increased use of distance education as a means of instruction. “Dropout rates for e-learners are much higher (70 percent) than for standard instruction in four year colleges (15 percent)” (Greenagel, 2002, p. 3). The problem for developers is to create a platform for online education that is equivalent to or better than traditional education. With the power of technology, there is potential for online instruction to be equivalent to traditional education. “There is no such thing as a generic e-learning model, but the potential for developing models that are highly suitable for a wide variety of learners” (Greenagel, 2002, p. 8).

Types of Distance Education

There are three major distance-learning models in practice today. The distributed classroom, independent learning and open learning + class model are the most commonly used models in existence. “These models are built around the instructional process; presentation of content; interaction with faculty, peers, and resources; practical application, and assessment” (Lenear & Johnson, 2002, p. 1038).

“The distributed classroom model involves interactive telecommunications technologies which extend a classroom-based course from one location to groups of students at one or more other locations” (Lenear & Johnson, 2002, p. 1038). The distributed classroom model works best if the delivery system is by satellite. Classes that use satellite as opposed to closed circuit television report greater satisfaction with the technology. In the distributed classroom model the learning is real time. Students are able to participate as if they were present in the classroom. The newest equipment can transmit two-way audio and video between the two classrooms. This allows students to interact with the instructor and other students. Out-of-class communication is supported by telephone, mail, fax, and computers. Some distributed classroom models do not require the student to have face-to-face contact with the instructor. All exchanges by the students and instructors are via technology.

The independent learning model is different than the distributed learning model. “It does not require students to be in a particular place at a particular time” (Lenear & Johnson, 2002, p. 1038). “Students are able to access course information, interact and collaborate with faculty and classmates, and submit course assignments from anywhere in

the world” (Lenear & Johnson, 2002, p. 1038). The independent learning model is more common in higher education. It has become the most popular of the three models. The reason for its popularity is the fact that there is no need for students to be in one particular place at one particular time. Students can learn information at a pace that works best for them, and they are not restricted to certain class times. This frees up their schedule and is more convenient for a lot of students, especially graduate students.

There are many advantages to the independent learning model. There is no need for in-class technologies. Students are responsible for obtaining access to the needed technology. Students are not required to have face-to-face interaction with the instructor. This allows students to schedule classes that are convenient to their lifestyle. The most common technology to deliver the course is a computer connected to the Internet. Almost every student at any university has access to a computer and the Internet. The independent learning model is ideal for large universities and colleges. It is convenient, cost effective, and can be combined with traditional education to maximize learning outcomes.

The “open learning + class model is a combination of the distributed classroom and independent learning models” (Lenear & Johnson, 2002, p. 1038). “Students use printed class materials and media, such as video tapes and CDs while learning at their own pace” (Lenear & Johnson, 2002, p. 1038). This model can also use interactive telecommunications technologies for meetings among students. The open learning + class model uses the same communication technologies as distributed learning, but the technology is used less often. In this model, students rely less on distributed learning and

more on other forms of technologies such as CDs and DVD-ROMs. The telecommunications equipment only supplements the other technologies and is used as a form of communication between the instructor and students. Recently, computers have taken the place of telecommunications equipment as the preferred manner of communication. The open learning + class model has potential for higher education. DVD-ROMs and instructional CDs can be used in conjunction with traditional approaches to education. The content on the DVD-ROMs can also be linked to external content on the web. These types of connection provide many ways for distance education technologies to be linked to training.

Greenagel (2002) provided a separate classification for distance education. According to Greenagel (2002), distance education can be broken down into the presentation, programmed instruction/tutorial, and the hybrid model. The presentation model is based on information transmission. This type of model is nothing more than an electronic form of a lecture course. Courses use audio, video, and/or Microsoft® PowerPoint® software to deliver course content (p. 6-8). The problem with the presentation model is that “most of the time explaining does not increase understanding, and may even lessen it in some instances” (Greenagel, 2002, p. 9).

The programmed instruction/tutorial is the most common model in use today. The programmed instruction/tutorial model allows for asynchronous learning and typically chops content into manageable chunks. The students are allowed to go through the course at their own pace and are offered immediate feedback. Frequent questions are contained within that allow students to test their learning as they go through the lesson. The lessons

can be individualized by use of a pre-test or inventory. Most of the lessons are consistent with basic learning theory. The main problem with the programmed/instruction model is that the content is mostly text and learners have limited interaction with other students. Combining the programmed instruction/ tutorial model with case studies, projects, and simulation increases the potential for learning (Greenagel, 2002, p. 7).

The third most common method is the hybrid model. The hybrid model is a mix of lecture and the presentation method. Many Blackboard courses have adopted the hybrid model. Hybrid models have become increasingly important at large universities due to the reduced cost of the courses. Traditional courses require classrooms to house the students. Hybrid courses are a viable solution to large classrooms. Providing lecture online allows institutions to save money and space.

According to Muir (2006) there are many uses for technology within distance education. The following provides a sample of current uses of technology in distance education (p. 8):

- Notice boards
- Public tutorial
- Individual projects
- Free flow discussion
- Structured seminar
- Peer counseling
- Collective database
- Group projects

- Community decision making
- Inter-community networking

Importance of Design

There are some problems associated with distance education that policy makers need to be aware of before making decisions regarding distance education. Some designers of distance education programs get stuck in traditional education practices and apply those designs to programs they develop. Following traditional education designs can lead to a lack of creativity and neglect the potential educational power of technology. Many distance education programs are just recreations of the education that takes place in traditional classrooms. They focus more on one-way transfer of information from instructor to the student. Some good examples of traditional models converted to distance learning are: online delivery that includes recorded lectures, online reading assignments, online homework assignments, and online tests. Technologies that are in use today can do much more than regurgitate information to the student. The distance learning technologies can be interactive and, if designed correctly, can improve the organization and delivery of information. They can help guide a learner to answer questions themselves and allow for complex thought. Policies need to be in place to help guide distance education designers.

The best approach for instructional designers is to make use of the power of technology. Instructional designers need to adopt a new approach to teaching and learning. They need to take advantage of the different approaches new technology can offer. Designers need to “match their desired learning goals and instructional methods to

the appropriate learning theories” (Johnson & Aragon, 2002, p. 2). Designers need to develop a new philosophy that builds on a “combination of learning theories rather than being confined to one preferred perspective” (Johnson & Aragon, 2002, p. 2). They need to think outside the box and come up with new and innovative ways of teaching and learning.

“Traditional education and older forms of distance education have presented difficulties for non-traditional learners” (Benson, 2002, p. 443). According to Torracco (2002), “new technologies have been shown to place unique cognitive demands on those that use them” (p.3). Greenagel (2002) reinforced those same beliefs when he stated “developers don’t seem to be aware of how people learn, for they continue to use mostly flawed models. At a moment when higher education has become increasingly convinced that standard classroom lecture is not a particularly effective way of teaching, how ironic that many of those responsible for e-learning say the ultimate goal is to mimic the classroom setting as much as possible”(p. 3).

Instructional designers can follow some basic principles when developing new distance education courses to make sure specific cognitive demands are addressed. There are seven general principles that need to be followed in order to develop a distance education program. The first step is to make sure the distance learning program addresses individual differences. People have different ways of learning and some people have specific ways of learning that work best for them. The second general principle is to motivate students. Some students can motivate themselves and others need a stimulus to keep their interest. The third principle is to avoid information overload. Too much

information too soon can inhibit learning. The fourth general principle is the need to create real-life context. The learner needs to know why the information they are learning is important and understand how it will be applied. Understanding why information is important will make learning meaningful and increase retention of the knowledge. The fifth principle is to encourage social interaction. Social interaction helps students learn from others students that are studying the same information. Peers can help others within the same class understand the information and also help students learn how to interact within a group. The sixth general principle is to provide hands-on activities. This allows the learner to relate the knowledge to real world skills and also helps the learner to apply the knowledge that is learned. The seventh and final general principle is to encourage student reflection. Reflecting on what has been learned can help the student develop a deeper understanding of the content of the information or skill.

Each general principle listed above has at least three subcomponents that should be considered when developing a distance education program. When developing a program, the designers need to make sure that “content is provided in multiple formats” to allow for individual differences (Johnson & Aragon, 2002, p. 3). Instead of just providing the learner with one-way information exchange, designers need to use the power of technology to make the learning experience more interactive. Developers need to use 3D diagrams, video, PowerPoint, and interactive training lessons to provide a more meaningful learning experience for students. Designers should also allow for “individual locus of control” (Johnson & Aragon, 2002, p. 3). The navigation through the course can be designed as hierarchical, but needs to allow users to be able to learn out of sequence.

The course should allow the student the control to learn the information in any order they deem necessary. The user does not necessarily need to be encouraged to learn out of sequence, but they should not be discouraged. “The asynchronous quality of online courses allows learners time to consider an idea and formulate a response, thereby eliminating the problem of having to create ideas during face-to-face discussion” (Cifuentes & Hughly, 2003, p. 17).

The technology used should also be designed to “encourage active and collaborative interactions” among users (Johnson & Aragon, 2002, p. 3). The course should be designed for individual and group work. Lesson and activities can be set up so users work individually on some activities and work with a group on others. The group work can be through Blackboard courses like WebCT® and group activities can be conducted through postings or chat rooms.

Motivation must also be considered when a new course is being designed. “Motivation is broken down into attention, relevance, confidence, and satisfaction” (Johnson & Aragon, 2002, p. 4). One way to help users maintain motivation is to make learning fun. Incorporating games into the online learning environment is just one approach to help users maintain motivation. Using multimedia is another way to help increase motivation. “Students have reported that they would prefer to see online course-management systems, like WebCT and Blackboard, operate faster and be more interactive by presenting information in video or audio formats.” In the future educational software may be able to “learn how students learn, and adapt to their style” (Carlson,

2005, p a34). Multimedia such as videos, photographs, and graphic images help enhance student motivation.

Information overload is extremely important to consider when developing a new distance education course. Too often designers try to pack as much information as they can into a course. This makes it hard for students to retain information because it overwhelms short-term memory. “Providing too much information in a short period of time contributes to memory overload which leads to confusion and poor retention” (Johnson & Aragon, 2002, p. 4). Course designers need to stick with the rule of seven so they do not overload short-term memory (Johnson & Aragon, 2002, p. 5). Designers need to chunk instructional content into small groups (Johnson & Aragon, 2002, p. 5). Designers also need to limit the amount of content and activities. A good example would be limiting lectures to 10 to 12 minute lectures. This will cause the lecturers to focus on relevant information and the learners will be able to maintain their attention due to the shorter periods of time. Designers need to organize instruction around learning cycles. A good example of learning cycles is reading an article, watching a video and playing a game about the same information. All of the course instruction instruments are centered around the same information to help students retain important information. Providing a graphic organizer for the course is another good way to help alleviate information overload. Providing organized buttons and links allows users to navigate the information in an organized manner and helps to minimize confusion.

Context is important to learning because “knowledge is a product of activity, context, and culture” (Johnson & Aragon, 2002, p. 5). There are three general ways to

ensure that contextual learning is included in a distance-learning course. One way is to “create virtual learning teams” (Johnson & Aragon, 2002, p. 5). Virtual learning teams allow the instructor to provide group experience found in face-to-face settings. Students work together on group projects. The group meetings can be once or twice a week to provide enough time for group members to interact together. Another way to increase contextual learning is to simulate reality using case studies (Johnson & Aragon, 2002, p. 5). One of the best ways to create contextual learning within a course is to “require collaborative projects with schools, businesses, or other organizations” (Johnson & Aragon, 2002, p. 5). This gives learners a chance to interact with people in their future field and provides an opportunity for real life experience. Learners are able to apply what they have learned and this makes the educational process more meaningful. A good example of this type of project would be to require students to develop a training program that represents an 8-hour training day. Students would need to develop their own training program and this would require them to apply the knowledge they had previously learned in the course.

Active learning is one of the most important elements that need to be included in a distance education program. Cooperative and project-based learning are excellent examples of active learning techniques. These types of activities normally take a long time to complete and students need to work within groups. The length of time, combined with group work provides opportunities for sustained thought and creativity. “Several research studies have indicated that having online audiences for one’s messages in online

courses provides students with a purpose to write well; that is convey messages clearly and eloquently” (Cifuentes & Hughly, 2003, p. 16).

There are several ways to include active learning within a course. The first would be to “organize online courses around projects” (Johnson & Aragon, 2002, p. 6). This requires students to work together and apply what they have learned. Another convenient way is to require think-pair-share groups that meet in a virtual environment (Johnson & Aragon, 2002). This allows students to brainstorm and reach a final goal or conclusion about a particular problem. This can be accomplished in distance education by using chat rooms or message boards. Another method also relies on chat rooms. “Using small group discussions during synchronous sessions” allows individuals to share thoughts and ideas about the information they have studied (Johnson & Aragon, 2002, p. 7). This requires students to meet at a particular time and get into groups. This works well for large group discussions and provides an opportunity for the whole class to meet at one particular time.

Reflective learning is important for distance education. Students need to know how they’re performing in order to improve. Reflective learning provides an opportunity for students to think back on what they learned and what they need to focus on in the future. Instructors and designers need to make sure students are “provided extensive and timely feedback” (Johnson & Aragon, 2002, p. 7). Making use of the power of technology can ensure students receive feedback in a timely manner. DVD-ROMs and Internet courses can have programs that allow students to test their knowledge to see if they are retaining the information. Practice exercises can give immediate feedback to the

learner about information that is correct or incorrect. Designers can also set up the programs to show the student where to look for the correct information. The course can also “incorporate short writing exercises” (Johnson & Aragon, 2002, p. 7). Short writing assignments inside a chat room can be used as a source of knowledge assessment by the instructor. Students are required to meet in a chat room once a week. The instructor then assigns a topic that provides the students the opportunity to write a short response.

Another way to include reflective learning within a distance education course is to assign online journals (Johnson & Aragon, 2002, p. 7). Online journals provide a source of continuous reflection for the student. This type of exercise goes far beyond what normal instructor and student interactions can achieve. It requires deeper thought on issues and experiences that the student encounters during their participation in the course. Many online courses allow “participants the time to think through their ideas and have time to think through their entries before carefully constructing messages and replies to other messages and journal entries.” “The online environment allows learners to shape understanding or socially construct meaning based on feedback they get from other students and/or moderators of the course” (Cifuentes & Hughly, 2003, p. 17).

Muir (2006) provided a detailed account of what should be included in an online course. The following lists general content that should be included in an online course (p. 7):

- Syllabus
- Course outline
- Readings or lectures

- Classroom or threaded discussion
- Quizzes, tests, and/or assessments
- Feedback (student/student and student/ instructor).

Learning Styles

Different learning styles need to be considered when developing curriculum.

Originally IQ tests were given to determine intelligence. The problem with IQ tests is that they only measure verbal/linguistic and mathematical/logical ability. There are multiple levels of intelligence, and most individuals have multiple ways they learn best. Gardner was one of the first individuals to look at the many different learning styles individuals possess. Gardner drew on findings from evolutionary biology, anthropology, developmental and cognitive psychology, neuropsychology, and psychometrics (Barrington, 2004, p. 422). From his findings Gardner redefined intelligence. According to Gardner (1993), “intelligence is the ability to solve problems and fashion products that are valued in a particular cultural setting or community.”

“Teaching and learning that is informed by Multiple Intelligence (MI) is an inclusive pedagogy because it takes a very wide view of intelligence and works toward teaching and assessing students using more than two intelligences. This allows students to use their own strengths and not be marginalized by having to focus on traditional ways of learning” (Barrington, 2004, p. 423). Howard Gardner first published his theory of Multiple Intelligences in his book entitled *Frames of Mind* in 1983. In his book he identified seven distinct and independent intelligences: linguistic, logical-mathematical, spatial, bodily kinesthetic, musical, interpersonal, and intrapersonal. In 1998, he

identified an eighth intelligence called the naturalist. Gardner's (1993) theory of multiple intelligences indicates that all individuals "have a repertoire of skills for solving different kinds of problems" (p. 26). This approach also provides the ability to match technology to learning style. "Gardner's work indicates that only 30 percent of adults say they learn best by listening, while another 30 percent prefer to read and reflect" (Greenagel, 2002, p. 9). Gardner's research found that when "students work in one of their stronger domains, they may undergo a strong positive affective reaction, and that young adult students may benefit from explicit instruction in a notational system of their specific type of intelligence" (Cifuentes & Hughey, 2003, p. 18).

The VARK® learning style inventory assesses several different learning styles. The VARK inventory is more general when compared to Gardner's multiple intelligence theory; it provides a simplified approach for labeling individuals to their dominant learning style. VARK classifies individuals into visual, auditory, reading, kinesthetic, and/or multimodal learners. According to Sousa (2007), a large number of students, 45% or more in most American classrooms prefer to receive information visually. "This includes both those who like pictures, video tapes, and charts and those who enjoy reading as the interpretation of symbols that translate into pictures in their minds." "A good learning style test will measure both types of visual preferences, pictures and reading" (Sousa, 2007).

Muir (2006) provided several ways in which courses could be designed to enhance visual learning. Instruction should make "use of videos, diagrams, images or maps". Testing should allow for "identification on diagrams, drawings, or read and

responses.” Assignments could use “mind mapping of concepts, diagramming, and/or construction of PowerPoint presentations.” The course should also allow for referencing by using “reference maps, pictures, diagrams, and articles.” Communication within the course should include “teleconferencing, Web-cam conferencing, or video posting” (Muir, 2006, p. 5).

Sousa (2007) reported that “a relatively small number of students, 19% or so, now prefer either listening or discussing/talking as a way of receiving information” (p. 6). Unfortunately, there are classrooms in which most information is presented with the spoken word even though that is not the most effective presentation form for a majority of students. In fact, most traditional classroom settings rely mainly on lecture as the primary means of instruction. Due to this fact, many students may not be learning at their highest potential.

Muir (2006) had several suggestions to incorporate auditory learning into the curriculum of a course. Instructors need to include lecture and/or audio clips in their course. Sound identification or verbally administered tests can help auditory learners understand the information. “Classroom assignments should consist of interviews, seminars, PowerPoint with embedded audio, speeches, or presentations.” For references “video or audio clips are a good choice and communication between individuals in the class need to be available by phone or audio conferencing in online courses” (Muir, 2006, p. 5).

Sousa (2007) stated that “some students, usually at least 35%, learn most effectively while moving (kinesthetic) or handling (tactile) things” (p. 6). This action and

body involvement help them to perceive meaning. Muir (2006) provided several suggestions to accommodate kinesthetic learners within an online environment. First, instruction within class should include “in class exercises, simulations, and demonstrations.” Second, testing should allow for “multiple choice exercises, portfolio, interactive lessons, and project work”. Third, “assignments should allow for self assessment quizzes, model building, and presentations. Finally, most of the communication in the course should be done via “video conferencing or group work” (Muir, 2006, p. 5).

Muir (2006) also suggested that online courses have certain key elements. The following provides a list of essential elements for online education (p. 7-8).

- Instructor
- Student
- Curriculum
- Infrastructure (Technology)

According to Muir (2006) it is important for the instructor to know how to teach. Instructors must employ strategies that help them pass information to the students. There are some best practices designers need to integrate into online courses (p. 13). Best practices that are important for traditional courses are the same for online courses. Courses need to allow for “self-paced, individualized tracks that allow for frequent practice and immediate reinforcement” (Greenagel, 2002, p. 8). “We teachers, perhaps all human beings, are in the grip of an astonishing delusion. We think that we can take a picture, a structure, a working model of something constructed in our minds out of long

experience and familiarity; and by turning it into a string of words, transplant it whole into the mind of someone else” (Greenagel, 2002, p. 7). Individuals need repetition with information that is unfamiliar. They need time to play with the information without any fear of retribution to truly understand and process it. Interactive lessons allow individuals to work with the information at a speed with which they are comfortable. It allows for repetition without any fear of penalty and they can access the information anytime.

Current methodologies can be adapted or modified for online education. It is important that students get the same type of interaction they would receive in traditional classroom settings. When designing an online course it is essential “that student learning styles are identified and addressed. This is important so the curriculum can be modified to address all teaching and learning styles” (Muir, 2006, p. 6).

The subjective difficulty of the material for the student affects the learning style; as does gender and perhaps culture in certain areas. On complex topics/judgment issues, people need to get comfortable, to mess around with the topic before they can understand it; understanding does not necessarily flow in a linear manner from breaking the task/object into simpler component parts. Learning is often a gradual process that happens through a series of shaping activities, which are not always instructor initiated. This is sometimes called tacit learning. The coaching process recognizes this, and so do many lab courses where we expect student skills will develop over the semester without explicit focus on those skills (Greenagel, 2002, p. 4).

Another important element of online education is the infrastructure. The infrastructure (technology) must be able to “support the learning and teaching style. It is also important that it support the delivery of the content” (Muir, 2006, p. 14-15).

Interactive Lessons

Several studies have reported the inadequacies of traditional forms of education. Most articles mention the lack of knowledge transfer that results from traditional lectures. Hestenes report on over 1500 high school students and 500 university students who took the FCI as a pre and posttest for an introductory physics course. The results of the study demonstrated that “students did poorly on both the pre and posttest, and more importantly that conventional lecture-style instruction obviously provided minimal means for improvement” (Hestenes, 1992, p. 6).

This study only advances the notion regarding traditional lecture-style instruction: “Information passes from the notes of the instructor to the notes of the student and through the minds of neither.”(Hestenes, 1992, p. 2). Another popular study reinforced Hestenes (1992) study with similar findings. Philip Sadler from Harvard University developed a study using his video “Private Universe” in 1987. In this video, “eighth grade students and Harvard graduates were asked fundamental astronomical concepts and both groups of students performed very poorly”.

Interactive lessons have been shown to improve student’s learning and retention of information. “Curriculum that allows students to participate in a process of investigation and discovery has been shown to improve students’ understanding” (Hake, 1998; Thornton and Sokoloff, 1990, 1998; Redish and Steinberg, 1999,). A prime

example of the impact interactive lessons have on learning has been compiled by Hake (1998). “He collected pre- and posttest scores on the FCI from 6,542 students nationwide in 62 different introductory classes. On average, the interactive engagement courses were more than twice as effective as traditional courses in promoting fundamental conceptual understanding (Hake, 1998, p. 1). Current technology has the power to increase interactivity within the classroom. The instruction can be more comprehensive and efficient than traditional forms of education (Bransford, 2000, p. 6).

Summary

Technology has several aspects that have the potential to influence education. It is important that technology is used correctly and efficiently to make use of its powerful application in education. Designers of distance education need to be well versed in learning theory to make use of technology so that it is used in an appropriate manner. Some current uses of technology in education are nothing more than postings of traditional lectures. Online education should incorporate interaction and include different forms of learning to include all learners in the educational process. Students will only benefit by making use of all the potential influence technology can have on education and learning. The interactive lesson used in the treatment group was designed based on the opinions from the experts cited in the literature review of the study.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

An experimental design was used for the research on the four sections of self-defense classes in the study during the fall 2007 semester. Two groups were created. One group was the control group; this group was given a traditional review and the other group received an interactive review. Random selection was used to determine which participants were assigned to each group. A pretest was used to determine each participant's base level of knowledge of physical education principles. The pretest was completed on the first day of class by the students. Participants were given no information concerning physical fitness principles prior to taking the pretest. Knowledge of physical fitness principles was the dependent variable and was determined by the difference between the pretest and the posttest. The posttest was given to the participants one class period after the pretest was administered. Those participants who received the interactive review and failed to turn in their scores before the posttest was administered were excluded from the study.

An Intercollegiate Review Board (IRB) application for experimental research was submitted and approved on August, 2007. All processes required by the IRB were followed and addressed prior and during the administration of the study. As part of the IRB process the research was submitted and its elements reviewed by the IRB. The research was approved by the Intercollegiate Review Board and was considered to be low risk to participants based on the cost-benefits of the study. A copy of the approved IRB

Research Project Forms is provided in the appendix. The IRB Research Project Forms contain all of the information needed to get the study approved.

Informed consent (voluntary participation of individuals in the research based on the cost/benefits to the participants) was obtained from the participants for the study. Informed consent provided information to participants in regard to their rights in the study. A copy of the informed consent is provided in the appendix.

The primary researcher was the instructor of record for the four sections that were used in the study. The instructor randomly assigned groups based on the first class day pretests. The participants were issued an ID number and their data were entered into a statistical database. A random number generator was used to randomly assign participants into one of two groups. The first group was designated as Group 1 based on the results of a flipped coin and was labeled the control group. The control group was given the traditional review. The second group was labeled Group 2 by default and is the treatment group. The treatment group was given the interactive review. Both groups were allotted the same amount of time to study the information. All participants completed the study by the next class period. One condition was created for Group 2. Group 2 had to score 80% or higher before the posttest was administered. It was determined that a score of 80% or greater was sufficient for Group 2 to retain the information. The individuals in Group 2 who did not record their required score were still given the post-test; however their data were excluded due to the extended length of time they had to study the information. Both groups had equal access to the information in the reviews and the same length of study time for the data to be valid and reliable. Setting outcome scores for the

interactive lessons was essential; instructors could be more confident that students had studied the information. This feature of interactive lessons may have important implications in future studies.

Procedures for the Collection and Analysis of Data

Population and Sample

The target population for this study was students at a large state university. The accessible population was students enrolled in self-defense education classes at the University of North Texas during the fall 2007 semester. UNT is a large public institution with the main campus located in Denton. The UNT system also has a Dallas campus and a Health Science Center located in Fort Worth. Within UNT there are 11 colleges and schools, offering 96 bachelors, 111 masters and 50 doctoral degree programs.

The total enrollment consisted of four sections with a total of 105 students enrolled in the sections. All sections were taught by the instructor and were held in a traditional classroom setting. Of the 105 students enrolled in the four sections only 87 completed the study. The sample used for the study consisted of 87 students selected from the four sections in which 105 students were enrolled. The four sections for the study were held at the main campus of UNT in Denton. Of the students enrolled in the fall 2007 semester an adequate sample size was selected to assure reliable results. The data collection for the study was completed during the first week of class.

Instrumentation

Four instruments were used in the creation of this study. To gather the needed data, a pretest and posttest were constructed to gather the scores from participants. A

traditional and an interactive review were created to determine the difference in learning outcomes between the groups. The VARK® learning style inventory was used to assess learning style or the students preferred mode of learning.

Pretest

The pretest and posttest were created by the instructor of the course. The assumption made was that the average student population had no prior knowledge of the physical fitness principles. The principles used in the pretest are health related aspects of fitness, energy systems, and type of flexibility. An independent samples t-test was conducted to determine if the two groups had equivalent scores on the pretest. If the two means were similar it was concluded that the two treatment groups had similar background knowledge of the physical fitness principles selected for the two tests. The students were asked to complete a 10 question multiple choice pretest along with the VARK inventory. The tests were graded by hand with a possible score of 100. A copy of the pre-test and post-test are provided in the appendix.

Posttest

The posttest was the same as the pretest. The only difference between the two tests was the time they were administered. The post was administered to the participants after the treatment was given to each group.

VARK Learning Style Inventory

The visual, auditory, reading, and kinesthetic (VARK) is a learning style inventory that helps individuals understand their preferred mode of learning. The sixteen item VARK inventory can be accessed online by going to www.vark-learn.com or a

printed version can be obtained for traditional classroom settings. The printed version is hand scored and contains 13 items. Both the online and printed copies are multiple-choice and allow participants multiple selections to the same questions. The scores represent the participants' preferred mode of learning and allow for a multimodal score. There are four independent learning styles variables that can be combined into a multimodal approach to learning. The five learning styles generated by the VARK inventory are visual, auditory, reading, kinesthetic, and multimodal. For efficiency the online self scoring inventory was used for the study. The results provide an estimate of learning styles. Knowledge of one's learning style can help lessen anxiety and increase productivity, achievement, and responsibility in learning (Dunn, 2000 p. 269).

VAR K is not a complete learning style. It does not measure motivation, social, physical, or environmental elements to learning. VARK deals with only one dimension of learning. It focuses on a general learning style that is broken into visual, auditory, reading, kinesthetic, and multimodal learning. Other learning styles like Gardner's (1988), multiple intelligence theory are more specific. Howard Gardner's multiple intelligence theory is discussed in detail in previous chapters.

Multimodal learning is included in the VARK inventory due to the fact that few individuals have singular learning styles. Most have some combination of learning style.

For example students may choose a read/write response because the situation is biased toward the particular event. Intuitively this makes sense, as we seldom act on the basis of input or output from only one mode. For that reason, multimodality (bi-, tri- or quad-) is likely to be the "normal" condition and single-

preferences are likely to be less common. Those who have a mild, strong or very strong preference for one mode are still multimodal just one of their preferences is a little stronger than the others. For example a person with VARK scores of 6, 3, 3, 3, is said to have a single preference for V but is, in fact, still multimodal, though not categorized as such by the VARK algorithm. Some modes, notably K, is itself an amalgam of senses and could be said to be multimodal in the broadest sense of that word (Fleming, 2007).

Single Learning Style

Participants were allowed to determine their primary learning style using the VARK inventory. If one learning style was more popular than the others, the participants were classified by their primary learning style. The online version of VARK contains 16 questions designed to determine the individual's unique learning style. Table 1 shows the amount of responses for each question on the online version of VARK, along with the percentage of selections for each learning style. The table was generated from the October 2006 database ($N=6033$).

Table 1

October 2006 Database

Questions	Number					
	Selected					
	<i>V</i>	<i>A</i>	<i>R</i>	<i>K</i>	Most Popular	Least Popular
1	42	55	31	149%	<i>A</i>	<i>K</i>
2	18	21	63	139%	<i>R</i>	<i>V</i>
3	34	50	34	160%	<i>A</i>	<i>V & R</i>
4	40	21	48	147%	<i>R</i>	<i>A</i>
5	31	28	43	144%	<i>R & K</i>	<i>A</i>
6	36	27	49	159%	<i>R</i>	<i>A</i>
7	20	47	25	158%	<i>K</i>	<i>V</i>
8	36	61	13	156%	<i>A</i>	<i>R</i>
9	37	38	47	158%	<i>R</i>	<i>V & K</i>
10	54	34	35	168%	<i>V</i>	<i>A</i>
11	25	52	32	148%	<i>A</i>	<i>V</i>
12	56	24	52	163%	<i>V</i>	<i>A</i>
13	26	48	35	172%	<i>K</i>	<i>V</i>
14	17	56	39	146%	<i>A</i>	<i>V</i>
15	22	26	66	156%	<i>R</i>	<i>V</i>
16	29	36	50	157%	<i>R</i>	<i>V</i>

Traditional Review

The traditional review was designed to offer the participants the same experience they may encounter in a traditional classroom setting. The review provided the same information as the interactive review, but without the feedback and other learning styles incorporated into the design. The traditional review was a keyed review and contained the information on which the participants in each group were tested. It simulates the same information students could download or record from a traditional classroom lecture. The lecture contained information about health related components of fitness, energy systems, and flexibility.

Interactive Lessons

The interactive lesson was developed using Adobe® Flash® Professional software. It has the same information as the traditional review. The main difference between the interactive and traditional review is that participants can interact with the content. The review contained drag and drop, multiple choice, and true and false questions. The 24 questions are based on topics of basic exercise physiology and physical fitness principles. The questions were developed based on advanced physical education knowledge to eliminate the possibility that participants would have prior knowledge of the subject matter. The information was based on common subjects taught in exercise physiology. Each item on the review requires participants to utilize different learning styles. Kinesthetic and visual learning styles were utilized when participants responded to the drag and drop questions. All questions required the participants to read to some extent

and utilize the reading portion of the VARK inventory. Audio was imbedded into each slide of the interactive lesson. Participants were required to listen to brief audio lectures before they could access the questions. Auditory learning was excluded from the analysis due to the limited numbers of auditory learners in the control. All of the questions provided the participants with some feedback. It was important that participants received immediate feedback so they would know if they got the question correct or incorrect. The feedback allowed participants to do a self assessment on their learning progress. The majority of the participants gave the correct answer after the incorrect response was chosen. The interactive lesson forces repetition and provides interaction so that participants may develop a basic competency level of the subject matter. Requiring an outcome score for completion helps the researcher and the instructors know if the participants or students have mastered the content at the required level. The interaction was designed and based on recommendations from Johnson & Aragon, (2002). Johnson & Aragon recommended that designers needed to “match their desired learning goals and instructional methods to the appropriate learning theories” (Johnson & Aragon, 2002, p. 2). Designers also need to develop a new philosophy that builds on a “combination of learning theories rather than being confined to one preferred perspective” (Johnson & Aragon, 2002, p. 2). Instructors and designers need to make sure students are “provided extensive and timely feedback” (Johnson & Aragon, 2002, p. 7). The interactive lesson was based on design recommendations from Muir (2001) and learning styles developed by Howard Gardner (1993). The interactive lesson was designed based on recommendations from several experts in the field.

Instructional Model

Most physical education classes are designed to teach basic physical education principles. Traditionally, instructors in most classes use the lecture method to deliver course content. Online courses tend not to be very different, and tend to be recreations of traditional lecture courses that are posted online. It is important to link the information being taught to real world examples so that the learner may process and make sense of the information.

Both the traditional and interactive review contained the same information. The content was listed in the same order to help minimize any differences between the two reviews. The following is a list of the instructional content used in both reviews:

Basic Physical Fitness Principles

- Individuality
- Overload
- Reversibility
- Specificity

Energy Systems

- ATP-PC system
- Glycolysis
- Aerobic/oxidative

Types of Flexibility

- Ballistic/dynamic
- Proprioceptive neuromuscular facilitation (PNF)

- Static

Interactive Review

The interactive lesson was created in Adobe Flash 8. The action scripts provide multiple forms of interaction. The user is able to physically manipulate items on the screen, view diagrams and pictures, and read text. Audio was imbedded in the review for auditory learners. The review allows the learner to respond using multiple answering capabilities. The users are able to answer questions using multiple choice, drag and drop, fill in the blank, selection, and true or false. The participant must access the review online using a personal computer. The review is available at <http://www.wmadams.com/tests.html>. For specific information to recreate the interactive lesson see, Appendix A.

Study Implementation

Experimental Setting

The experimental research for this study was conducted during the fall 2007 semester at UNT. The study included four sections of self-defense education classes held at the main UNT campus in Denton. Of the total participants enrolled in the combined four sections, only the participants who completed the process correctly are included in the study.

Control Group

The participants in the control group were randomly assigned. All sections met twice a week during normal daytime hours. The courses used in the study met twice a week for 80 minutes. The control group was given the pretest and instruction for the

online VARK learning style inventory. Once the pretest was completed, the students in class were given the traditional review along with instructions to prepare themselves for the posttest. Both groups were given until the next class period to study the information contained in the reviews. Participants were encouraged to use their normal study habits to review the information. The traditional review was administered on paper and could be downloaded from the instructor's web site if the participant misplaced the review. The posttest was administered exactly one class period after the pretest was given.

Treatment Group

The treatment group was randomly assigned from the original sample that was selected from the four sections of self-defense education classes. The treatment group was provided instructions on how to access the interactive review and VARK inventory. They were given a choice of accessing the review online or receiving a copy on a CD. In the instructions provided to the participants, they were advised that they must score 80 percent or greater in order to take the posttest. One class period after the pretest was administered, the participants took the posttest.

Administration of Forms

Participating students were asked to complete the following forms and inventories:

- Informed consent form (filled out in class).
- Visual, auditory, reading and kinesthetic (VARK) inventory (online).
- Pre-test (taken in class).
- Review (treatment or control taken outside of class).

- Post-test (taken inside of class).

The participants were informed of the purpose of the study and that involvement was voluntary. The informed consent forms were distributed in class to all participants. Participants were given time in class to read and sign the informed consent form. Participants were required to sign the form if they wanted to participate in the study. The informed consent form is provided in the appendix. Participants were asked to take the VARK inventory online. The VARK inventory measures the student's primary learning style. Students that did not wish to participate in the study were instructed to turn in a blank sheet of paper. The students were asked to complete the inventory and print off their scores. Participants were required to have their VARK inventory before they took the pretest.

The pretest was taken in the first class session. The participant's level of knowledge of basic physical education principles was measured by the pretest. The pretest was given in class in paper format. Students were asked to do their best and reminded that their score on the pretest would be for data collection and would have no impact on their grades for the course. Participants completed the pretest in class. The pretest was graded by the primary researcher, and the scores were entered into SPSS® for statistical analysis. A copy of the pretest is located in the appendix.

Students were assigned a number that was generated from a random number generator. Students were assigned into one of two possible groups based on their assigned number. Participants were asked to select instructions for their review based on the number they were given. Students who were randomly assigned a zero were provided the

instructions for the traditional review. Students that were randomly assigned a one were given the instructions for the interactive review.

The traditional review was provided on paper. It contained information of basic physical fitness principles, energy systems used during exercise, and the different types of stretching. The information on the traditional review was used to simulate notes taken during a traditional lecture class or posted lecture in an online course. The information in the traditional review was the same as the information in the interactive review.

The interactive review was created using Adobe Flash 8. The interactive lesson contained the same information as the traditional review. The main difference from the traditional review was the use of interactive tools and the requirement of an outcome score. The interaction allowed participants to receive immediate feedback and to learn using multimodal learning. The requirement that participants achieve 80% or better is one of the strengths of the interactive review. Requiring set outcome scores allows the instructor to be confident that students reviewed the information before testing.

Data Collection

Participants were selected from four sections of self-defense education classes at the University of North Texas. During the first day of class, participants were asked to complete the VARK inventory to assess their primary learning style. Participants were provided instructions about how to access the VARK inventory. The VARK inventory separated students into one of four different learning styles. The learning styles were classified into visual, reading, kinesthetic, or multimodal. Auditory was left out due to the underrepresentation of auditory learners in the sample. The learning styles were coded

and plugged into SPSS for future analysis. The learning style of the participants was one of the two predictor variables in the study. Before the participants took the pretest on the second day of class they were required to have completed the VARK inventory.

During the first day of class the participants of the study were given the pretest in class to assess their prior knowledge of physical fitness principles. Once the participants completed the pretest, SPSS was used to generate random numbers for each of the students. Participants were classified into one of two groups based on the scores from the random number generator. If the participants were assigned a zero they were classified into Group 1 (control group). If the participant were assigned a one, they were placed into Group 2 (treatment). The pretest consisted of ten multiple choice questions and was hand graded by the primary researcher. The means of each group were compared to determine if the two groups were equal.

The posttest was administered exactly one class period after the participants completed the pretest. The posttest consisted of the same information as the pretest. Once the post-test was completed the participants' tests were hand graded and the scores entered into SPSS for further analysis. Once the scores for the pre and post test were entered into SPSS, a two way ANOVA and repeated measures ANOVA was conducted to determine the main effects and interaction effect of the study.

Threats to Internal Validity

The main problem when conducting an experimental design is establishing controls so that any changes that occur during the study can be attributed entirely to the experimental treatment. "First it is important to determine potential sources of internal

validity” (Gall, Gall, & Borg, 2003, p. 367). The following situations provide possible threats to the internal validity of the study:

Testing

The two tests used in the data collection were similar. Due to the similarity of the pre and post test, participants could have improved on the post test based on their experience with the pre-test.

Statistical Regression

It is possible that statistical regression threatened the internal validity of the study. It is possible that some participants improve based on lucky guessing.

Experimental Mortality

Some of the participants in the study did not complete the study correctly and were excluded from the study. Other participants failed to return the next class period or dropped the class. This limited the amount of participants who originally started the study.

Threats to External Validity

Several elements of the study may have threatened the external validity of the study. The following provides a list of factor that may have threatened the external validity of the study:

- Sample size
- Location of the experiment
- Pretest sensitization
- Posttest sensitization

- Measurement of the dependent variable

Pilot Study

“The purpose of conducting a pilot study is to develop and try out data-collection methods and other procedures (e.g., training procedures to be used in an experiment)” (Gall, Gall, & Borg, 2003, p. 37). Conducting the pilot study allowed the primary researcher to identify problems and refine the data collection process. Data gathered from the pilot study also allowed for a comparison of the results from the main study to determine if the results were replicated with the second study.

A repeated measures ANOVA was conducted to determine if there was a significant difference between the groups based on the pre and post test scores. The independent sample t-test showed that both groups were initially the same in regards to their base knowledge of the subject matter. The independent sample t-test also showed that the treatment group’s post test was numerically higher than the control group’s post test. To determine if the improvement in the treatment group was significantly different than the control, it was necessary to run the repeated measures ANOVA. Based on the results from the repeated measures ANOVA there was no interaction between the grouping variable and the pre and posttest variable. Based on this information the groups were not statistically different. Although the post test scores for the treatment group were numerically higher than the control, there was not a statistically significant difference between post tests of each group.

Based on the results from the pilot study, several key improvements were made to the data collection process. First the data was gathered at the beginning of the semester to

limit the possibility that the participants might learn the information from class lecture rather than from the reviews. From the data collection process, it also became evident that the instructions for completing the process needed to be revised. The data collection process also needed to be streamlined. The data collection for the pilot study had too many forms. The interactive lesson also needed to be improved before the final study was conducted for the dissertation. During the pilot study there was no audio imbedded in the interactive lesson. In order for auditory learners to do their best on the interactive lessons, it was necessary to include short audio lectures. There were only 3 participants who reported auditory learning as their primary learning style in the pilot study. It may be necessary to remove auditory learners in the analysis due to the numbers observed.

Data Analysis

Descriptive Statistics

The descriptive statistics include the following:

1. Means and standard deviations of the pre-test.
2. Means and standard deviations of the post-test.

Inferential Statistics

A data analysis was run in Statistical Package for the Social Sciences (SPSS). The purpose for the analysis was to determine if the means of the pre-test differ between the control group and the treatment group. An independent samples t-test was used to determine if the two groups were equivalent on their understanding of physical education principles. An alpha level of .05 was set to test the three research hypothesis using a multi-way ANOVA and repeated measures ANOVA.

Independent Variables:

Main Effect A –Review

2 levels:

0 – traditional (control)

1 - Interactive (treatment)

Main Effect B – Learning Style

4 levels:

1 – Visual

2 - Reading

3- Kinesthetic

4 -Multimodal

Dependent Variable:

Achievement is based on learning outcomes from the pre-test to the post-test (Main Effect C) with a maximum score of 100.

CHAPTER 4

RESULTS

Introduction

This chapter provides the analysis of the data collection conducted during the study. This chapter is separated into two sections. The first section of this chapter reports the descriptive statistics from the data collection. The second part of this chapter provides a detailed analysis of the inferential statistics.

Sample Description

The demographics of the sample were collected using the data collection tool. All data collection was conducted during the first week of classes in the fall 2007 semester. The characteristics of the participants were provided and discussed. The failure and success rate of participants are also provided during this section.

Sample Size and Gender

Originally ($N=105$) participants were selected to participate in the study. Out of the 105 participants that started, 87 remained after the data collection was complete. Of the 87 participants that completed the study, ($N=59$) were female and ($N=28$) were male. The control group consisted of ($N=35$) females and ($N=9$) males. The treatment group consisted of ($N=24$) females and ($N=19$) of males. Information about the gender of the sample is provided in Table 2.

Table 2

Gender of the Sample

Gender	Females	Males
Total	59	28
Treatment	24	19
Control	35	9

Participant Age

The participant ages ranged from 18 to 29 years of age. The majority of the participants were between the ages of 18 through 23. The age range of the 18-23 year olds accounted for 86% of the participants in the study. The large percentage of students in the 18-23 year old age range is likely to have resulted from UNT's wellness requirement. UNT requires that all majors fulfill a wellness requirement as part of their core requirements. Many freshman and sophomores take physical education courses as part of their core requirement. UNT also requires all students below 21 years of age to live on campus in residential housing. The wellness requirement combined with a large residential program for freshman and sophomores may account for the age distribution in the study. Table 3 provides the age distribution for the participants used in the sample.

Table 3

Participant Age and Group Distribution

College	18-23	22-26	26-32
Total	75	9	3
Control	35	5	2
Treatment	40	4	1

Participant Ethnicity

The sample that was used for the study was similar to the overall population of UNT. UNT has a diverse student body and the sample was reflective of the overall student population. The participants included in the sample consisted of 86 percent Caucasian, 10% African American, 2% Hispanic, and 1% Asian. The treatment group had more Caucasian students. The majority of both groups consisted of Caucasian students (Control 71%, Treatment 78%). The learning styles and learning outcomes should not be affected by the ethnicity of the two groups due to the similarity of both groups. Table 4 shows the ethnicity of the sample.

Table 4

Sample Ethnicity

College	Total	Control	Treatment
White	75	36	39

(table continues)

(continued).

Table 4

Black	9	7	3
Hispanic	2	2	0
Asian	1	0	1
Other	0		

Source: Ethnicity obtained from data collection

Excluded

Out of the 105 students sampled for the study, 18 students did not complete the process. Some of the excluded students voluntarily withdrew and some were due to the participant's failure in completing the process. Nine participants did not fill out the informed consent so their data was not used in the study. Three students were not present on the day the pretest was administered and so they were excluded from the rest of the study. Six students were not present for the posttest so they did not complete the process necessary to be included in the study. The remaining eighty seven participants completed the process correctly and their data was used in the study. Table 5 represents the completion and dropout rate for the study.

Table 5

Completion and Dropout Rate of Participants

College	Total	Control	Treatment
Total	105	n/a	n/a
Participants that Completed the Process	87	44	43
No Informed Consent	9		
No Pretest	3		
No Posttest	6		

Learning Style

From the total participants eleven scored visual as their primary learning style. Seventeen recorded reading as their primary learning style, followed by kinesthetic. There were more kinesthetic learners than any other learning style assessed in the study. Kinesthetic was higher than the multimodal learning style. This was not surprising since the participants in the study were enrolled in a physical education class. Five of the participants had auditory learning as their primary means of learning. This was not unexpected based on the limited amount of auditory learners observed in the pilot study. Auditory learners were excluded from the analysis due to the limited number of auditory learners in the control. Table 6 provides a list of the learning styles recorded during the study.

Table 6

Learning Styles of Participants

Learning Style	Numbers	Control	Treatment
Visual	11	6	5
Auditory	5	1	4
Reading	17	8	9
Kinesthetic	31	19	12
Multimodal	23	10	13

Descriptive Statistics

Based on the descriptive statistics from the independent samples t-test, the pre-test for the control group ($N=44$) resulted in a mean of 58.86 for the raw scores. The pre-test for the treatment group ($N=43$) yielded a mean of 57.67. The post-test of the control group generated a mean of 77.73 and the post test from the treatment group resulted in a mean of 85.35. Clearly the two means were similar for the two pre-tests of both groups. There was a noticeable difference between the posttest of the control and treatment groups. Based on the information from the means between the two groups, it was concluded there was a need for further investigation of the results.

Standard Deviation

Based on the standard deviations for both groups' pretests they were equally distributed around the mean. Group 1 ($SD=16.31$) had a standard deviation similar to the standard deviation of Group 2 ($SD=14.45$). The posttest scores for both groups also had

similar distributions. Group 1 ($SD = 12.92$) had a similar standard deviation on the post test to Group 2 ($SD = 12.60$).

Inferential Statistics

As a result of the descriptive statistics a 2 (treatment vs. control) by 4 (learning style) ANOVA was conducted. The ANOVA was used to determine if there was an interaction effect between the two independent variables (Groups and Learning Style). Before analyzing the result it was necessary to look at Levene's Test of Equality of Error Variance to determine if the test of homogeneity of variance was confirmed. Levene's Test reported a $sig. = .368$ and did not violate the homogeneity of variance. Main Effect B (learning style) and the A by B interaction did not affect learning outcomes. According to the results from the ANOVA, there was no significant difference between the means of Main Effect B (learning style) and A by B interaction. The eta squared for main effect B ($\eta = .035$) and A by B interaction ($\eta = .071$) was also very small for the overall size of the sample. Both Main Effect B ($sig = .445$) and A by B interaction ($sig = .138$) were over the set alpha level of .05. Based on the analysis it was concluded that learning style and the interaction between group and learning style had no effect on learning outcomes. There was a significant difference between the means of the control and treatment group. The eta squared for Main Effect A was ($\eta = .105$) and was statistically significant ($sig. = .004$). The $F_{calc} = 4.00$ was greater than the $F_{crit} = 1.892$, and reinforced the statistical significance of the eta squared. The results of the data analysis reported that there was a significant difference between the means of Main Effect A (group). Table 7 provides a detail description of the learning styles for the control and treatment groups.

Table 7

Learning Styles Mean and Standard Deviation for the Control and Treatment Group

Group	Learning Style	Mean	Std. Deviation	N
Control	Visual	15.00	17.61	6
	Reading	27.50	13.89	8
	Kinesthetic	18.95	15.60	19
	Multimodal	11.00	15.95	10
	Total	18.14	16.07	43
Treatment	Visual	36.00	15.17	5
	Reading	27.78	15.63	9
	Kinesthetic	23.33	20.60	12
	Multimodal	30.00	10.80	13
	Total	28.21	15.87	39
Total	Visual	24.55	19.16	11
	Reading	27.65	14.37	17
	Kinesthetic	20.65	17.50	31
	Multimodal	21.74	16.14	23
	Total	22.93	16.67	82

Repeated Measures ANOVA

A 2 (treatment / control) by 2 (pretest / posttest) ANOVA with repeated measures was conducted to examine the differential improvement in knowledge across the intervention. A significant interaction effect ($p = .012$) was determined. An independent

sample t-test showed that both groups were initially the same ($p = .720$) in regard to their base knowledge of the subject matter. An independent sample t-test also showed that the treatment group's post test was higher ($p = .007$) than the control groups post test. Examining figure 1, both the treatment and control group improved numerically, but the treatment group improved more than the control creating a moderate effect size ($ES = .589$) for the post test difference between experimental conditions.

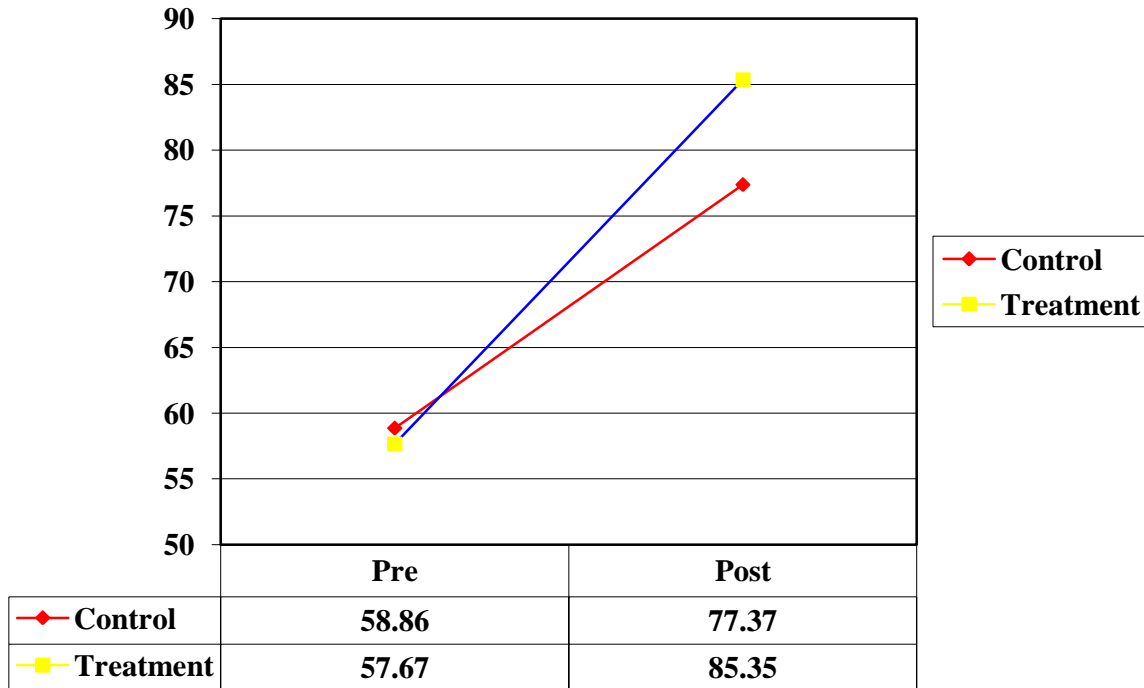


Figure 1. Interaction effect: (treatment / control) by (pretest / post test). Values are means.

CHAPTER 5

SUMMARY AND CONCLUSIONS

Summary of the Study

The purpose of this study was to measure the effect learning style and interactive lessons have on learning outcomes. The study was an experimental design that was conducted in the fall 2007 at the University of North Texas. The data collection was conducted using the VARK® learning style inventory and pre and post tests. Four sections of self-defense education classes were used as participants in the study. The primary researcher conducted all of the data collection and analysis.

The experiment was designed to measure the influence interactive lessons had on learning style compared to traditional means of teaching. The initial sample consisted of 105 participants, but during the course of the study it declined to 87 participants. All of the participants were separated into two groups. The first group was the control group; this group simulated the review process in a traditional classroom setting. The treatment group was the second group administered the interactive review. Both reviews covered the same information, but in a different way. The learning outcomes for the study were measured by determining the difference between the pre and post tests.

During the first day of class participants were administered a pretest to assess their base level of knowledge of the subject matter. The pretest scores were used to randomly assign participants into groups. After the pretest, participants were given instructions for their particular group. Participants were randomly assigned into either the

control or treatment group. Participants in the sample were required to take the VARK inventory before the second day of class to measure their primary learning style. The second class day participants were administered the posttest. The difference between the two tests was used to determine if learning outcomes improved.

Data was collected through the pre and post tests and the VARK inventory. The two tests consisted of the same ten multiple choice questions. Once the pretest was given participants were not given feedback on their scores. Only after the posttest was given were the participants informed about their scores. Both tests were hand graded by the primary researcher. An independent samples t-test, A 2 (treatment / control) by 2 (pretest / posttest) ANOVA with repeated measures was conducted to examine the differential improvement in knowledge across the intervention. The VARK inventory was used to assess participant's primary learning style. The VARK inventory classified participants into visual, auditory, reading, kinesthetic, or multimodal learners. The raw data collected from the inventory was used in the A 2 (treatment / control) by 2 (pretest / posttest) ANOVA with repeated measures was conducted to examine the differential improvement in knowledge across the intervention.

Summary of the Findings

There were a total of 105 participants who completed the study. Of the total, 44 were randomly assigned to the control group and 43 to the treatment group. There were 28 male participants and 59 female students who completed the study. There were 75 Caucasian students, 9 African American students, 2 Hispanic students, and 1 Asian student involved in the study. The average age for the participants who completed the

study was 23.98. The study originally had 105 participants; but due to dropout rates and withdrawals, the total number of participants was reduced to 87.

Measures of effect size in ANOVA are measures of the degree of association between an effect (e.g., a main effect, an interaction, a linear contrast) and the dependent variable. They can be thought of as the correlation between an effect and the dependent variable. If the value of the measure of association is squared it can be interpreted as the proportion of variance in the dependent variable that is attributable to each effect. Four of the commonly used measures of effect size in an ANOVA are:

- Eta squared,
- partial Eta squared,
- omega squared,
- the Intraclass correlation,

Eta squared and partial Eta squared are estimates of the degree of association for the sample. Omega squared and the intra-class correlation are estimates of the degree of association in the population (Becker, 1999).

R-Squared measurements from regression are also effect size estimates. “In practice, an effect size of .2 is often considered small, .5 moderate, and .8 large” (Cohen, 1988, p. 25). The population of the sample also plays a factor when interpreting effect size. Generally, the larger the population the more significant the effect size estimates. Small effect size estimates can yield significant results with large sample sizes.

A two factor ANOVA with repeated measures was used to test the null hypothesis of the study. The null hypothesis for main effect A stated there were no differences between the means of the control group and the treatment group. Based on the information from the two-way ANOVA with repeated measures the null hypothesis was rejected. The rejection of the null hypothesis for main effect A was based on the eta squared value ($\eta = .105$) for main effect A. Main effect A also had a significance level of ($sig. = .004$). The $F_{calc} = 4.00$ was greater than the $F_{crit} = 1.892$. Based on this information it was reasonable to reject the null hypothesis and accept the research hypothesis. These results were also confirmed using a repeated measure ANOVA. A significant interaction effect ($p = .012$) was determined. An independent sample t-test showed that both groups were initially the same ($p = .720$) in regard to their base knowledge of the subject matter. An independent sample t-test also showed that the treatment group's post test was numerically higher ($p = .007$) than the control groups post test.

The null hypothesis for Main Effect B stated that learning style would have a significant impact on learning outcomes. Based on the results from the multi-way ANOVA, learning style did not have a significant impact on learning outcomes of participants. For Main Effect B it was not possible to reject the null hypothesis. Main Effect B (learning style) and the A by B interaction did not affect learning outcomes. According to the results from the ANOVA, there was no significant difference between the means of Main Effect B (learning style) and A by B interaction. The eta squared for Main Effect B ($\eta = .035$) and A by B interaction ($\eta = .071$) was also very small for the

overall size of the sample. Both Main Effect B ($sig = .445$) and A by B interaction ($sig = .138$) were over the set alpha level of .05. Based on the analysis it was concluded that learning style and the interaction between group and learning style had no effect on learning outcomes.

Table 8

Null Hypothesis

Null Hypothesis	Decision	Sig.	η
Ho: $\mu_{AT} = \mu_{AC}$ (AT: treatment; Ac: control)	Reject Ho	.004	.105
Ho: $\mu_{B1} = \mu_{B2} = \mu_{B3} = \mu_{B4} = \mu_{B5}$	Fail to Reject Ho	.445	.035
Ho: No interaction effect on learning outcomes.	Fail to Reject Ho	.138	.071
Repeated Measures ANOVA			
Ho: No interaction effect on learning outcomes.	Reject Ho	.012	

Discussion of the Results

The following will summarize the results based on each of the research questions that were established at the beginning of the study.

Research Question 1

Research Question 1 asked if interactive lessons had an effect on learning outcomes. Based on the results from the data analysis, interactive lessons alone do have a significant effect on learning outcomes compared to traditional means of education. This conclusion was reached by conducting a two way ANOVA with repeated measures on

the data. In the two way ANOVA, the main effect A tested the effect of interactive lessons on learning outcomes. Based on the results of the ANOVA, interactive lessons alone do have a significant impact on learning outcomes. The effect size for main effect A was .105. Based on the number of participants in the sample a 10.5% effect size is significant. The effect size measures the amount of variance between the predictor variable (group) and the outcome variable (learning outcomes).

Research Question 2

Research Question 2 asked if learning style influenced learning outcomes. Based on the results from the 2 way ANOVA there was no statistical evidence that learning style alone influenced learning outcomes. This conclusion was based on the small effect size ($\eta = .035$) that resulted from the ANOVA. Due to the number of participants in the sample the effect size was not significant. The significance level (.445) was also above the alpha level of .05.

Research Question 3

Research Question 3 asked if there was an interaction effect between learning style and interactive lessons on learning outcomes. Based on the information from the data analysis there was no significant interaction between learning style and interactive lessons on learning outcomes. This decision was based on the effect size ($\eta = .071$) for the interaction effect. Based on the information from the effect size, 7.1% of the variance between the interaction and outcome variable was explained. Due to the number of participants used in the sample, the effect size was not significant. The significance level (.138) was below .05. A repeated measures ANOVA was also conducted to determine if

the improvement observed in the independent samples t-test between the pre and post test was significant. Based on the results from the repeated measures ANOVA, there was a significant improvement in the treatment group compared to the control.

Implications

The research conducted for this study is important due to the changes that are occurring in higher education as a result of technology. Technology is having a dramatic impact on how education is presented to students. It is important for researchers to determine if new technologies are equivalent to traditional means of education. Online classes are reshaping the way students' access information. Information needs to be organized in a manner that aids student learning rather than inhibits it. It is important that distance education be designed appropriately to facilitate learning. The research conducted for this study tested the difference between interactive and traditional lessons. Rather than simply lecturing, this study tested the influence of immediate feedback and organization of information to help participants learn at their primary learning style. The information gathered from the research may aid future online developers when they create classes for distance education. It shows the positive effects of interactive lessons compared to traditional lessons which allow students to learn using various learning styles, and setting outcomes. Based on the information contained in the study, future course designers can modify existing online programs by including interactivity and repetition in their lessons. The information may help designers include important elements of interactivity to enhance learning for students in self-defense education

classes. The finding may be generalizable to other subjects, but more research must be conducted in the area to be certain.

Study Limitations

The following provides the possible limitations of the study that may affect replication in the future:

- The sample was drawn from four sections of self-defense education classes. A future sample from different courses may offer different results.
- The final sample size was much smaller than originally intended due to drop outs and participants failing to complete the process correctly.
- The pre and post test consisted of 10 multiple choice questions. Participants' improvements could be the results of sheer luck or learning from the test itself. To limit this possibility, it would be desirable to have a pre and post test that consisted of many more questions.
- The primary researcher conducted the data collection. The results could have been influenced by researcher bias since the primary researcher developed the research hypothesis. The primary researcher also created the interactive and traditional reviews. He graded both groups of tests and conducted the data analysis. There is room for researcher bias since the primary researcher conducted all of the process involved in the study.
- Immediate feedback, learning style, and outcomes were used to influence learning outcomes in the treatment. The results of the data analysis could have been due to either of these areas. The only way to determine which area had the most

influence on learning outcomes would be to test each independently without the influence of the others. There is no way to determine which area had the most influence on learning outcomes with the current study.

Recommendations for Future Research

For future research in this area it would be reasonable to conduct the study with a larger sample. The same study could be conducted with a larger sample to increase the power of the study. It would be ideal if each group had an equal number of participants. This may be impossible or improbable with a random sample. Due to the nature of the randomization, it is probable that groups will be unequal. With large samples it is more likely that group membership will be closer in the number of participants that are contained in each group. The study that was conducted for this research had 44 participants in the control group and 43 participants in the treatment group. To get a good comparison of the groups to each other it would be desirable to have them as similar to one another as possible.

Future research should also consider the amount of time it took to complete the study. The length of time it took to complete the study could be considered a limitation due to the amount of time participants had to study the information. Although the data analysis revealed that there was a statistically significant difference between the treatment group and the control, the addition of more time might result in more significant results. If the treatment group improved significantly compared to the control in just one week, the addition of more time could increase the confidence of future research in this area. It is recommended that future research should include the addition

of more time for participants to study and retain the information. Since participants in the treatment group were able to improve significantly in only one week compared to the control, increasing the duration of the study might produce even more significant results.

During the study many of the participant's in the treatment group failed to complete the process correctly and their information was excluded from the study. The retention of participants was likely due to the intrinsic motivation of some participants compared to others. Future studies need to improve the data collection process to increase the number of participant's in the study. It may be necessary to increase the sample size if the study is conducted over several semesters. Increasing the sample size will increase the power and reliability of the results. Conducting the study over several semesters would also allow future researchers to increase the duration of the study.

Future studies should also separate the major areas of influence on learning outcomes to determine which area has the most influence on the dependent variable. The major areas of influence for this study were immediate feedback, repetition, setting outcome scores, and learning styles. Each area by itself may exert a heavy influence on learning outcomes. The other areas may have little or no influence on the outcome variable. The only way to determine if the results are due to a combination of the major areas or each one independently is to do a study to test the effects of each area individually. For example, the change in the learning outcomes of participants may have little to do with learning styles or with setting outcome scores on the review. The main influence on learning outcomes could be due to the amount of repetition and feedback participants receive during the review process. The only way to tell is to study each area

independently and in multiple combinations to determine which one or combinations of areas exert the most influence. The influence may be due to an interaction of these areas or may be due to just a single area. The only way to determine which area or areas exert the most influence is to conduct more research.

Future studies should also research the area of online gaming in relation to enhancing learning outcomes. New gaming technologies allow users to apply the information they are learning in real world settings. It allows individuals to get repetition with skills and get immediate reinforcement without undue risk. The best examples of this type of gaming are simulations. Simulations allow users to apply previous learned skills in real world settings. This type of learning is especially important for areas of study where failure of a skill can have disastrous consequences. For example, flight or surgery simulators help students prepare for the skills they need in their area of interest without undue risk to the students or future patients. Due to new gaming technologies, these types of simulators are not limited to the more dangerous careers. Games like Virtual U allow students in higher education administration to learn what it takes to run a major flagship university. The program allows the students to test theories and get repetition and interaction by running a simulated university.

The key to this type of training may be the amount of repetition participants get with the new skill. It could also be due to application of information in a real world setting. It may be due to the amount of multiple learning styles that are incorporated into the games. They allow for visual, auditory, reading, and kinesthetic learning. In fact simulations are prime examples of multimodal learning. Interactive simulations allow

participants to learn using their primary learning style or use the learning style most suited for the situation.

Summary

Few studies have investigated the impact interactive lessons have on learning outcomes in a short period of time. Based on the results from the study it will be important for future distance education designers and instructors to include interaction into their lessons. Due to the significant results from the study it may be possible to get significant improvements in learning outcomes in a short period of time by using interactive lessons. Interaction consists of several key elements that have an influence on learning outcomes. The main elements of the interactive lessons include repetition of information, allow for multimodal learning, setting outcomes scores, and immediate feedback. It is uncertain at this point which of these key elements exerts the most influence; but based on the findings of the research, they do have an interaction effect on learning outcomes.

The results also have implications for traditional education as well. Based on the findings, instructors could include more interaction with their students in class rather than just one way auditory lectures or reading from Microsoft Office® PowerPoint® software. Research shows very few individuals learn through listening alone. This was reinforced in the study by the limited amount of participants that scored as auditory learners. The interaction in traditional classrooms requires very little investment for the university. The major investment is the time it takes to plan out the curriculum for the course by the instructor of record. Making instruction interactive incorporates more learning styles into

the learning process and helps facilitate learning for the majority of the class. Interaction is more of a multimodal form of instruction and helps eliminate the possibility that learners are being left out during the instruction process. Future research should study the impact of interaction on learning. Interaction as a whole should be dissected into its components to determine which element exerts the most influence on learning outcomes. The more information that is gathered about technologies influence on learning the more reliable instruction will become.

APPENDIX A
QUIZ QUESTIONS

The following describes the process of constructing the interactive lesson using Adobe ® Flash®:

1. Open sample quiz document
2. Select the desired quiz template

The questions in the appendices are ordered in the same manner as the interactive lesson. Audio instruction precedes each of the large content areas. The types of questions used from the library pallet are listed in parentheses. The following list the intructions used in the interactive lesson.

Statement: Move the items to the correct position (Drag and Drop).

Selection: Specificity, Overload, Individuality, Reversibility (Left).

Selection: Increasing workload, Training for a sport, Genetics, Atrophy (Right).

Feedback: List the correct matches.

Question: Designing a workout around a sport is considered (Fill in the Blank).

Feedback: No, the correct answer is specificity.

Statement: Select the four training principles (Hot Spots).

Selection: Specificity, Personality, Overload, Trainability, Individuality, Reversibility.

Feedback: Provides the correct selection.

Question: Which of the following is a good example of atrophy (Hot Spots)?

Selection: Specificity, Overload, Reversibility, Individuality.

Feedback: No, the correct answer is reversibility.

Question: Which of the following describes reversibility (Multiple Choice)?

Selection: Muscle hypertrophy, muscle atrophy, reduction in aerobic endurance, increase in muscular endurance, decrease in muscular strength.

Feedback: Provides the appropriate selection.

Question: Does the muscle increase in size during muscle hypertrophy (True or False)?

Feedback: Incorrect, during muscle hypertrophy the muscle does grow in size.

Selection: Match the correct items (Drag and Drop).

Selection: Flexibility, muscular strength, cardiovascular endurance, muscular endurance

Selection: Pushups for 1 minute, running 2 miles in 12 minutes, lifting 1.25 times your body weight, touching past your toes.

Feedback: List the correct matches.

Question: Is running for 2 miles a good example of muscle endurance or cardiovascular endurance (Fill in the Blank)?

Feedback: No, the correct answer is cardiovascular endurance.

Statement: Select the examples of muscle endurance (Hot Spots).

Selection: Pushups for 1 minute, lifting heavy weight for 10 seconds, lunges for 2 minutes, squatting heavy weight for 10 seconds, sit ups for 2 minutes, plyometrics for 10 seconds.

Feedback: List correct responses.

Statement: select the examples of aerobic exercise (Hot Spots).

Selection: Lifting weights, racquetball, sprinting, marathon, plyometrics, triathlon.

Feedback: List the correct responses.

Statement: Select the anaerobic exercise (Multiple Choice).

Selection: Long distance running, weight training, racquetball, plyometrics, walking 2 miles.

Feedback: List the correct responses.

Statement: Aerobic exercise is continuous and repetitive (True or False).

Feedback: No; the correct answer is true.

Statement: Match the correct energy system to the appropriate health related component of fitness (Drag and Drop).

Selection: ATP-PC System, Aerobic Oxidative, Glycolysis (Left).

Selection: Muscle Strength, Muscle Endurance, Cardiovascular Endurance (Right).

Feedback: List the correct combinations.

Question: What is the primary energy system used during a marathon (Fill in the Blank)?

Selection: ATP-PC system, Glycolysis, or Aerobic Oxidative.

Feedback: No; the correct answer is aerobic oxidative.

Question: How long does the ATP-PC system last (Hot Spot)?

Selection: 1 hour, 30 minutes, 20 minutes, 10 minutes, 2 minutes, 10 seconds.

Feedback: No; the correct answer is 10 seconds.

Question: Which exercise will improve glycolysis (Hot Spots)?

Selection: Running for 12 minutes, lifting weights for 10 seconds, Pushups for 2 minutes.

Feedback: No; the correct answer is pushups for 2 minutes.

Question: Which of the following causes fatigue during exercise (Multiple Choice)?

Selection: Lack of oxygen, increased mitochondria, increased lactic acid, decrease in blood pH, increased oxygen to the muscle.

Feedback: Provides the appropriate selection.

Statement: Improving buffering capacity can enhance performance (True or False).

Feedback: No, the correct answer is true.

Statement: Match the appropriate stretch to the description (Drag and Drop).

Selection: Static, Ballistic, PNF (left).

Selection: Dynamic movements, holding a static position, pushing against resistance(right).

Feedback: Provides the appropriate selection.

Question: What type of stretch involves holding a static position (Fill in the Blank)?

Feedback: No, the correct answer is static stretching.

Question: Which stretch is considered the safest (Hot Spot)?

Selection: PNF, Static, Ballistic.

Feedback: No, the correct answer is static.

Question: When is it best to stretch (Hot Spot)?

Selection: Before exercise, During exercise, After exercise.

Feedback: No, the correct answer is after exercise.

Question: Stretching can.....(Multiple Choice)?

Selection: Improve range of motion, decrease resistance from muscles, reduce chance of injury, improve cardiovascular fitness, improve functional fitness.

Feedback: Provides the correct responses.

Statement: Yoga has nothing to do with flexibility (True or False).

Feedback: No the correct answer is false.

Results page (Action Script).

APPENDIX B
ACTION SCRIPT

Below is the action script for the interactive lesson. Copy and paste into the action layer for the submit button on the results page.

```
on (click) {  
  
    var correct:String = this._parent.Totalcorrect.text;  
    var incorrect:String = this._parent.Totalincorrect.text;  
    var score:String = this._parent.Totalscore.text;  
    var student_name:String = this._parent.name.text;  
    var section:String = this._parent.classsection.selectedItem.label;  
    var email:String = this._parent.email.text;  
    var school:String = this._parent.School.selectedItem.label;  
  
    var url:String = "http://www.wmadams.com/cgi-bin/gbook.cgi?"  
    url += "action=save" + "&"  
    url += "test_id=InteractiveReview" + "&"  
    url += "correct=" + correct + "&";  
    url += "incorrect=" + incorrect + "&";  
    url += "score=" + score + "&"  
    url += "name=" + student_name + "&";  
    url += "section=" + section + "&";  
    url += "email=" + email + "&";  
    url += "school=" + school;  
    trace(url);  
  
    var resp:String = loadVariablesNum(url, 0);  
    trace("response: " + resp);  
}
```

APPENDIX C
PRE AND POST TEST

Pre and Post Test

Name: _____

Group: _____

1. What are the four principles of muscular fitness?
 - A. Overload, reversibility, specificity, and individuality
 - B. Ballistic, static, plyometric, and dynamic.
 - C. Muscle endurance, muscle strength, aerobic, and oxidative
 - D. Atp-pc system, glycolysis, aerobic oxidative, and anaerobic threshold.
2. Select the example of static stretching.
 - A. Holding a stretch
 - B. Go through a range of motion
 - C. Bouncing while performing a stretch
3. Select the energy system used while performing pushups for 2 minutes.
 - A. Atp-pc system
 - B. Glycolysis
 - C. Aerobic-oxidative
4. Which energy system is used lifting heavy weight for 3-6 repetitions?
 - A. Atp-pc system
 - B. Glycolysis
 - C. Aerobic-oxidative
5. Sports performance based on genetics is an example of which of the following?
 - A. Overload
 - B. Plyometrics
 - C. Individuality
 - D. Glycolysis
6. Which energy system is the primary source of energy while running a marathon?
 - A. Atp-pc system
 - B. Glycolysis
 - C. Aerobic-oxidative
7. What type of stretch is performed during a round house kick?
 - A. Static
 - B. Ballistic/Dynamic
 - C. PNF (*proprioceptive neuromuscular facilitation*)

8. Select the response that describes a muscles response to weight training.
- A. Atrophy
 - B. Hypertrophy
 - C. ATP
 - D. Plyometrics
9. What health related aspect of fitness is running 2 miles in 12 minutes classified under?
- A. Muscle strength
 - B. Muscle endurance
 - C. Cardiovascular endurance
 - D. Flexibility
10. What health related aspect of fitness is lifting heavy weight for 10 seconds classified under?
- A. Muscle strength
 - B. Muscle endurance
 - C. Cardiovascular endurance

APPENDIX D
INFORMED CONSENT

University of North Texas Institutional Review Board

Informed Consent Form

Before agreeing to participate in this research study, it is important that you read and understand the following explanation of the purpose and benefits of the study and how it will be conducted. Your decision to participate in the study or to later withdraw your participation will have no effect on your course grade.

Title of Study: The Effects of Interactive Reviews and Learning Styles on Learning Outcomes.

Principal Investigator: Wes Adams, a graduate student in the University of North Texas (UNT) Department of Higher Education Administration

Purpose of the Study: You are being asked to participate in a research study which involves the assessment of interactive lessons and learning styles on learning outcomes.

Study Procedures: You will be asked to take a pre-test on basic physical education principles, then a treatment, and a post-test that will take about 30 minutes of your time. The treatment will be either a standard paper review or an interactive review. The interactive review will be conducted on a computer.

Foreseeable Risks: The potential risk involved in this study is test anxiety. Some students prone to test anxiety may experience a mild form of test anxiety due to the pre- and post-test.

Benefits to the Subjects or Others: Students may benefit from the study by improving their knowledge of basic physical education principles. The information contained in the study can assist anyone who enjoys physical fitness.

Procedures for Maintaining Confidentiality of Research Records: All information obtained from participants will be confidential. Participant's information will be coded using a numbering system and no identifiable information will be revealed. All identifiable information will be excluded from the study. Identifiable information will be stored in a locked file cabinet. The confidentiality of your individual information will be maintained in any publications or presentations regarding this study.

Questions about the Study

If you have any questions about the study, you may contact Wes Adams Principal Investigator at telephone number (940) 565-3940 or the faculty advisor, Dr. Patsy Fulton-Calkins, UNT Department of Higher Education Administration, at telephone number 903 369 7112.

Review for the Protection of Participants: This research study has been reviewed and approved by the UNT Institutional Review Board (IRB). The UNT IRB can be contacted at (940) 565-3940 with any questions regarding the rights of research subjects.

Research Participants' Rights: Your signature below indicates that you have read or have had read to you all of the above and that you confirm all of the following:

- Wes Adams has explained the study to you and answered all of your questions. You have been told the possible benefits and the potential risks and/or discomforts of the study.
- You understand that you do not have to take part in this study, and your refusal to participate or your decision to withdraw will involve no penalty or loss of rights or benefits. The study personnel may choose to stop your participation at any time. Your decision to participate in the study or to later withdraw your participation will have no effect on your course grade.
- You understand why the study is being conducted and how it will be performed.
- You understand your rights as a research participant and you voluntarily consent to participate in this study.
- You have been told you will receive a copy of this form.

Printed Name of Participant

Signature of Participant

Date

For the Principal Investigator or Designee: I certify that I have reviewed the contents of this form with the participant signing above. I have explained the possible benefits and the potential risks and/or discomforts of the study. It is my opinion that the participant understood the explanation.

Signature of Principal Investigator or Designee

Date

APPENDIX E
TRADITIONAL REVIEW

Traditional Review

- The four principles of muscular fitness are overload, reversibility, specificity, and individuality.
- Overload would consist of increasing the amount of resistance of a specified period of time.
- Reversibility would be analogous to atrophy and/or atrophy would be a good example of reversibility.
- An example of specificity is training for a particular sport.
- Sports performance based on genetics is an example of individuality.
- The three basic types of stretching are static, ballistic/dynamic, and P.N.F.
- The three energy systems are the ATP-PC system, Glycolysis, and Aerobic Oxidative.
- Four health related aspects of fitness are muscle strength, muscular endurance, cardiovascular endurance, and flexibility.
- An example of muscular strength and using the ATP-PC system would be lifting heavy weight with 3 to 6 repetitions.
- An example of the aerobic/oxidative energy system and cardiovascular endurance is running a marathon.
- An example of using glycolysis and muscle endurance is performing pushups for 2 minutes.
- Going through a range of motion is an example of ballistic/dynamic stretching.

APPENDIX F
GROUP 1 INSTRUCTION

Group 1

Read the review.

Use your typically study habits to learn the information in the review.

Go to www.vark-learn.com

Click on questionnaire

Take the questionnaire

Print off the results page (The results page will list your primary learning style).

Bring both the results page and score sheet to class the next class period.

APPENDIX G
GROUP 2 INTRUCTION

Group 2

Go to www.wmadams.com

Click on tests

Click on final

Achieve at least 80 percent or greater on the review

Print your score sheet

Go to www.vark-learn.com

Click on questionnaire

Take the questionnaire

Print off the results page (The results page will list your primary learning style).

Bring both the results page and score sheet to class the next class period.

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