Scott Angarola

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Effects of various learning methods on skill acquisition

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CHAPTER I

THE RESEARCH OBJECTIVE

Introduction to the Problem

Al Davis, the legendary sports owner of the Oakland Raiders football team, sums up the attitudes of many sports coaches throughout the world today with his famous phrase, "just win baby!" In the world of competitive sports, coaches will seek out any possible way to give their team a better chance of winning. Any competitive edge a team or coach can gain over the opponents, no matter how small, will be taken advantage of to the fullest. This attitude is not much different from passionate educators who want to reach out to each of their students and have them develop to the fullest. Technology and multimedia tools are constantly evolving and providing instructional designers new ways to present instruction. While the evolution of technology is full of instructional design potential, more research is needed to understand the cognitive processes when learning with different combinations of multimedia (Kozma, 1991). Current studies (Mayer & Anderson, 1991, 1992; Moreno & Mayer, 2000) and literature (Mayer, 2001; Engelkamp & Zimmer, 1994) support the use of concurrent visual (image) and verbal (narration) modalities as an effective way to present instruction. Animation is a more recent visual innovation that has the ability to show movement and dynamic characteristics of an object. Animations are used during professional sports television broadcasts to display strategy and for special effects, but can they be useful in an instructional setting? "Animation can provide learners with explicit dynamic information that is either implicit or unavailable in static graphics" (Lowe, 2003, p.158). But is animation more effective than static images in certain instructional contexts? There have been mixed results reported when comparing animation and static images. Some studies (Large, Beheshti, Breuleux, & Renaud, 1996; Rieber, 1990) found benefits with the use of animation because it had the ability to convey temporal and spatial characteristics that static images do not, which resulted in a deeper understanding of the content. On the other side, Tversky and Morrison

(2002) provided evidence for the "Apprehension Principle," in which they stated that animation might have been too complex for certain learners to understand. Lowe (2003) cites an increase in cognitive load as a problem with animation. Cognitive Load can be described as the mental energy exerted on the cognitive processes. Too much cognitive load hinders the learning process. Many of the studies that have been conducted in this area are in academic domains such as science and mathematics. There is a lack of research in the area of motor skills and physical education when learning from different types of media. Experiment One of the current study compared the use of static images and animation in a motor skill environment. How could a computer based multimedia and/or traditional coaching method be implemented to enhance learning? The chosen sport in this study was basketball, and players were tested on how they learned with different combinations of multimedia and/or traditional coaching methods.

In order to set up the study, the first step was to understand how people acquire knowledge on a cognitive level. Kintsch (1994, 1998), Schnotz and Kulhavy (1994), and Mayer (1984), to name a few, have provided research on how people comprehend text and images to understand a story when reading. Paivio (1986) introduced the concept of dual coding that described how people have verbal and non-verbal channels that absorb and process information. Mayer has provided research that extends knowledge on how people learn from different types of multimedia such as narration and animation. If multimedia learning and the use of dual coding have been shown to increase the capability of learning in cognitive and affective environments (Sharon, Tindall, Ford, & Sweller, 1997; Mayer & Moreno, 2000, 2002), then the question arose of what the effect would be when testing different learners in the psychomotor domain (Bloom, 1956; Harrow, 1972). Not only were the subjects in the current study tested on recall and transfer tests, but they were also tested to determine if they could demonstrate what they learned using motor skills. Do the principles of the *Cognitive Theory of Multimedia Learning* and *Dual Coding Theory* extend to motor skill functions in the initial stages of acquisition? For example, understanding from a multimedia presentation of where a player should be positioned on the court does not necessarily mean, that when the player is on the court, the person will demonstrate correctly where he or she should be. This study measured the effectiveness of different types of instruction, involving multimedia instruction and coaching, on different types of learning outcomes, cognitive knowledge and motor skills.

The second step in setting up this study was to understand skill acquisition and different methods that can be used to assist in this process. Schmidt (1988) stated that physical practice is the best way to acquire a motor skill. However, problems may arise when physical practice is not an option. Bandura (1969) believes that the method of observational learning can be effective in teaching a person to learn a motor skill. Observational learning involves different types of modeling and demonstrations in which learners observe desired behavior. As the learners observe, they form a cognitive representation of the skill that is being taught. The cognitive representation is then recalled and used to guide movement when the observers are instructed to perform. This study looked for evidence of alternative or complementary ways to teach a motor skill by a computer-based multimedia presentation and observational learning. Is observational learning/coaching enhanced with integrated sequences of multimedia presentations? Do different conditions provide better cognitive representations that the learner can use to enhance performance? For example, would a multimedia presentation before a coaching demonstration be more effective than a coaching presentation before a multimedia presentation? Could a computer-based presentation fulfill the same instructional needs as a live presentation? Some studies (Brown & Messersmith, 1948; Martens, Burwitz, & Zuckerman, 1976) have compared conditions where students observed a filmed presentation as opposed to a live presentation and found no differences between a filmed or live model. Would a computer-based environment be an equal or more effective than a live model? To athletic coaches, practice time and meaningful instruction is essential; and, if time can be saved or learning can be enhanced with the observation of a computer based model, then this can be vital information for coaches as they design their method of instruction. My experiment used different types of research studies to design a program of observational learning to teach a basketball drill.

Different variables were created that tested and extended the principles of observational learning, in an effort to find a more efficient way to acquire a skill.

The third step in this study involved the understanding of individual differences, and how they could affect knowledge and skill acquisition. The individual differences that were examined in this study were *spatial ability* and *verbal ability*. Hegarty and Sims (1994) compared high and low spatial ability learners when viewing static pictures with arrows to teach the operation of a pulley system. Hays (1996) took that study a step further by investigating how high and low spatial ability learners reacted and learned from animation during the diffusion process. In both studies there was a significant difference in comprehension between high and low spatial ability learners. This experiment extended these other studies by determining how these differences translated into physical performance results. Many current software programs on the market do not consider people with individual differences; thus my results will add to the body of knowledge on how to design instruction for people with different types of cognitive abilities.

Purpose of Study

The purpose of this study was to investigate how different types of multimedia (animation, images, narration) instruction and/or traditional coaching methods (observational learning) affect knowledge and skill acquisition for different types of learners. On the practical side, this study seeks a better way to teach athletes and possibly give them an advantage that could be the difference between winning and losing. In an educational setting, this could be the difference between a student passing or failing a test. On the theoretical side, this study parallels and extends research on how people learn from different types of visual and verbal multimedia instruction. Results can not only be generalized to other sports and motor skill learning domains, but also provides continuing research on how to create more effective multimedia learning tools for any type of learning.

CHAPTER II

CONCEPTUAL FRAMEWORK

Dual Coding Theory (Paivio, 1986), Cognitive Theory of Multimedia Learning (Mayer, 1997), and Observational Learning Theory (Bandura, 1969, 1986) provided the foundation for the different treatments that were administered to the athletes in my study. The theories provided an understanding about the cognitive processes of learning from text and multimedia, as well as external conditions that affected knowledge and skill acquisition. Past research surrounding these theories was the basis for the design of the study and allowed me to apply their principles to the domains of my experiment.

Dual Coding Theory

The Dual Coding Theory was proposed by Paivio in 1971, and later revised in 1986 as technology continued to evolve. Like many learning theories, the Dual Coding Theory highlights three components of learning: how information is *received*, *processed*, and *stored* by the human cognitive systems (Paivio, 1986).

The first part of DCT is how information is *received*. Dual Coding Theory states that there are two separate processing systems for information coming into the brain, which are called the *verbal system* and *non-verbal system*. Verbal information can be described as information represented in abstract form as a language. Reading text and listening to narration are the most common examples of verbal information. The most common examples of non-verbal information are images and graphics. In this study, a multimedia presentation administered to subjects contained verbal information in the form of text to read. The experiments in this study also contained multimedia presentations that included images and diagrams with animation, which represented non-verbal information.

The second part of DCT describes how information is *processed* by human cognitive systems. Once information enters either the verbal or the non-verbal channel, the information is represented in hypothetical units called *imagens* and *logogens*. Paivio uses the word hypothetical because the terms for the channels can be interrelated; but, for the purpose of understanding his theory, imagens (non-verbal information) refer to natural and holistic objects, and logogens (verbal information) refer to words or text received and stored. According to Paivio, there are three different kinds of processing connections that can be identified: *representational*, *referential*, and *associative* (Figure 1). *Representational* processing is the direct function of recognizing verbal and non-verbal information and absorbing the information into the cognitive systems. *Referential* processing is the crossover process that connects the verbal information received with the non-verbal information received. Matching a name with an image is an example of referential processing. *Associative* processing is a "within systems" activation, which connects verbal information with other verbal information, or non-verbal information with other non-verbal information. Paivio (1986) states that a given task can require any or all three types of processing. How the processing procedures work and react is the core of ability to take in information, translate it, and then recall and transfer the knowledge. The end product results in the student being able to learn from some form of instruction after the processing and connections take place. In this study, it was tested how efficiently and accurately the basketball players made these important connections compared with the different presentations.

The third part of DCT concerns how information is *stored* by the human cognitive system. Once information is coded as a logogen or imagen, the information can be chunked together and stored into compact units of information called mental models (Johnson-Laird, 1983) or schemata (Rumelhart, 1980). For example, if I were to show a picture of a dog and ask what breed the dog is, the different types of processing connections will be made in the brain to connect the image of the dog (imagen) with the name of the breed that was previously read (logogen). Connections can be made to chunk information together about characteristics of the dog. Similarly, if I were to show an image of a basketball court with players positioned in certain areas (imagen), would players be able