UNIVERSITY OF CALGARY

A Simulation of Internet Enhanced Motor Learning

By

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

DEGREE OF DOCTOR OF PHILOSOPHY

GRADUATE DIVISION OF EDUCATIONAL RESEARCH

CALGARY, ALBERTA

NOVEMBER, 2000

0-612-64828-1

ABSTRACT

The purpose of this dissertation was to examine the internet as a means for enhancing skill acquisition, knowledge and attitudes in school based physical education. In study one, modeling delivered through progressive still photographs over a simulated internet site was found to contribute to significant improvements in front crawl technique. No significant improvements were found for swimming knowledge, front crawl speed, back crawl speed or back crawl technique that could be attributed to the internet based model delivery. Based on the results of this study a number of modifications were made to the experimental design of the research as well as to the instructional design of the simulated internet site and a second study was conducted.

The second study examined video and photographic modeling of front crawl and back crawl delivered using a simulated internet site, compared to traditional swimming instruction. Significant pre-post-transfer improvements were found for front crawl and back crawl stroke technique for the two internet enhanced groups, but not for the control group. No significant improvements were found for swimming speed or written knowledge. The use of video modeling was expected to lead to a higher frequency of self-instruction, analysis and correction, resulting in better swimming performance, however no significant differences were found between the two internet enhanced modeling groups. This indicates that both photographic models and video models were equally useful in enhancing front crawl and

back crawl technique acquisition. In terms of student attitudes, the Likert questions given in the post test found that all the students in the internet enhanced groups enjoyed the swimming lessons compared to only three out of four in the control group. The qualitative interviews showed that, if given the choice, the majority of students in the two internet enhanced groups would choose internet enhanced instruction over traditional instruction. Overall, the research showed that the use of models delivered via the internet provided a rich source of information that increased cognitive effort that lead to higher levels of performance. This was accomplished without any loss of physical activity time, indeed, the data suggests that physical activity was increased for those in the internet enhanced groups.

ACKNOWLEDGEMENTS

I would like to thank all of the following for their support and assistance in the completion of this thesis:

Dr. Joan Vickers, my supervisor, for her considerable support over the past four years, for her time and advice with my research and for editing this thesis.

Drs. Caird and Sandals, members of my supervisory committee, for their advice and suggestions with my research and the writing of this thesis.

The Faculties of Kinesiology and Education, specifically the Neuro-Motor Laboratory and the Human Performance Laboratory, and the Lindsay Park Sports Centre for their support and for supplying the equipment and facilities for the collection of the research data.

Sue Chambers for her insight, support and facilitation, Barry Morton for his assistance in the collection of my data and Teresa Michalak for her time, suggestions and constant support.

Peter and Valerie Morey, my parents, for their endless and multiple support.

Last, but by no means least to Dino Sorrentino, my husband, for his commitment, faith in me, understanding and never ending support.

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CHAPTER ONE

INTRODUCTION

A number of recent studies have examined the role of technology within physical education, kinesiology and related fields (Bailey, 1998; Beashel & Sibson, 2000; Dorman, 1998; Ellery, 1999, 1997; Finkenberg, 1998, 1997; Friesen & Bender, 1997; Grosse, 1997; Haggerty, 1997; Kuhrasch, 1998; LaMaster, 1998; LaMaster, Williams, & Knopp, 1998; Martens, 1997; Mohnsen, 1999, 1995; Mohnsen, Chestnut & Burke, 1997; Morely & LaMaster, 1999; Neal, 2000; Sharpe & Hawkins, 1998; Silverman, 1997; Ulrich, 1997; Wittenburg & McBride, 1998). These studies universally encourage the use of computing technology within physical activity, sport and exercise environments and highlight the emerging uses of computing technology within physical education.

Physical Education and Computing Technology

Silverman (1997), noted that the utilisation of word processing and database managers was probably the most common computer technology used by physical education teachers to aid them in being more productive. LaMaster (1998), when she surveyed physical education teachers and their uses of computer technology, confirmed that word processing was the number one use of computer technology with the use of email being the second most common. A number of studies have also noted the administrative power of databases for creating student records (Beashel & Sibson, 2000), and creating lesson content databases that provide them with the ability to store and compile lesson plans in just a couple of mouse clicks (Kuhrasch, 1998). With regard to e-mail, student teachers are now able to be constantly linked to resources, peers and mentors while conducting practica away from their teacher training institutions (Wittenburg & McBride, 1998). Web pages and list-servers enable teachers to globally share lesson plans, ideas, resources and provide each other with support (Neal, 2000). Haggerty (1997) and others (e.g., Finkenberg, 1998; Ulrich, 1997) have also noted how research within kinesiology and physical education is being enhanced through the use of computer technology and the internet.

Specialised Physical Education Software

Another element of innovation within computer technology, is the emerging prevalence of specialised physical education software. Dorman (1998) and others (e.g., Mohnsen, 1995; Mohnsen, Chestnut & Burke, 1997; Silverman, 1997; Wilkinson, 1997) have promoted the use of the many software developed for physical education. These software can be used for testing knowledge, assessment and instruction; which is the primary focus of this dissertation. However, Bailey (1998) cautions, that it is necessary to acknowledge "that not everything so far produced is of good quality or educationally relevant" (p. 27). In fact, few studies have actually examined the effectiveness of technology based interventions, such as instructional software, CD ROM's or internet sites, in terms of showing that they lead to improvements in skill acquisition, knowledge, changes in attitude or motivation to participate in sport and physical activity. The results of the studies done have been mixed and only a small number of the studies have been published in international professional journals. This has resulted in researcher's calling for the empirical testing of the technology currently available, before we jump further into the technology revolution (Sharpe & Hawkins, 1998).

Research on Computing Technology to Enhance Instruction

Research on technology effectiveness has been more forthcoming within other areas of education. Results from a meta-analysis by Cliff Liao (1998) of hypermedia instruction versus traditional instruction in academic instruction, found that the use of hypermedia in teaching produced more positive outcomes than traditional teaching methods. Throughout education as a whole, there is a growing move towards the integration of different technologies into the curriculum. One such project is the British Colombia initiative TESSI (Technology Enhanced Secondary Science Instruction) (Woodrow, Mayer-Smith & Pedretti, 1997), out of which the TEI (Technology Enhanced Instruction) professional development program was developed (Woodrow & Spann, 1997). The development of a software designed to aid teachers in the production of effective computer assisted learning materials (Moir & Batty, 1997) has increased as well as the use of dynamic overheads, electronic overheads that change dynamically on a key press, to illustrate key points during statistics instruction (Sandals, Connop-Scollard & Henningsmoen, 1997).

Although low levels of research appear to have been conducted within the field of physical education, academia have been vocal in supporting the integration of technology into kinesiology and physical education. A number of key professional journals have introduced "technology" sections and the number of special issues and articles devoted to the issue of technology in physical education and kinesiology has dramatically increased. In terms of the internet though, it seems to be predominantly thought of as a means of communication and dissemination of resources and ideas. Martens (1997) noted that "the computer and telecommunications networks, especially the internet, are revolutionizing education" (p. 251). In the same issue of Quest, Finkenburg (1997) identified the tremendous growth that the internet has experienced and highlighted that the internet will become the primary means of communication in the 21st Century. Ellery (1999; 1997) and others (e.g., Friesen & Bender, 1997; Grosse, 1997; LaMaster, Williams, & Knopp, 1998; Morely & LaMaster, 1999) have also been advocates of using the internet to share ideas and information and also to promote the subject area as a whole as well as individual school programs.

Modeling and Motor Skill Instruction

Modeling, providing students with a demonstration of the skill to be learned, is a necessity in physical education (Jambor, 1996). Darden and Shimon (2000) note that at some point the majority of physical education teachers have tried to use video taped models within their instruction. However, they generally tend to demonstrate the skills themselves (Beashel & Sibson, 2000), or use a skilled student to provide the class with a demonstration. Jambour (1996) states that "demonstration is vital in swimming instruction" (p. 34), however the swimming pool and most other environments in sport, can be a challenging place to provide students' with clear demonstrations. Traditionally demonstrations in swimming tend to be more abstract than concrete, with the instructor attempting to demonstrate, on pool side, a skill that is performed in the water. Internet enhanced instruction does not replace the swimming instructor, but enables the instructor to enhance their instruction with realistic expert models which can be viewed from different angles above and below the water.

Through integrating technology, such as an internet site, it should be possible to extend the application of modeling research to an increased number of learners, in a wider variety of contexts. For an internet site to be effective in enhancing instruction, it is important that the site be designed following standards derived from research on the effectiveness of internet based learning.

Purpose

In this dissertation, the internet will be examined as a means of enhancing skill acquisition, knowledge and attitudes in school based physical education. Two studies were conducted to compare traditional swimming instruction with internet enhanced swimming instruction. Study one, examined modeling through progressive static photographs, delivered over a simulated internet site projected in a room to the side of the pool, compared to non-internet enhanced instruction where the modeling was provided through black and white drawings projected with an overhead projector on pool side. Study two compared traditional swimming instruction without any visual aids with two different forms of internet enhanced instruction where one group was presented with video models and the other photographic models delivered via different simulated internet sites projected on pool side.

Overview

This thesis combined theory from both educational technology and motor learning and applied it to the practical setting of swimming instruction. The following two chapters will review and examine the current use of computers and software developed for physical education, instructional design for internet based instruction, research on instructional methods in motor learning and swimming instruction and how these can be integrated to create an effective instructional aid for swimming. The design of the research will also be elaborated upon in terms of advances in experimental design in motor learning research.

CHAPTER TWO

PHYSICAL EDUCATION,

TECHNOLOGY AND INSTRUCTIONAL DESIGN

Physical Education and Technology

Within many institutions specializing in sports science and human performance, modern technologies such as SIMM Biomechanics Software Suite: CAD Tools for Musculoskeletal Modeling (Musculographics, Inc., 1992), Cardiovascular Fitness Microlab (HRM Software, 1985), corneal reflection and eye movement recording systems, are becoming common. The use of computer technology for administrative purposes is also now becoming very common (Beashel & Sibson, 2000). However, technology within the gymnasium instructional setting is still rare (Brodie & Skinsley, 1992). Englehorn (1983) stated that "the development of the relatively inexpensive yet sophisticated microcomputer has opened new horizons in many areas of movement science" (p. 30). Although computers are used in many ways to examine movement science, in terms of instruction many of these horizons have not yet been examined, let alone utilized to their full potential.

Physical Education Specialty Software

Wilkinson (1997) notes that there are a number of different software programs available that claim to help students improve learning in physical education. Called physical educational utility software (Mohnsen, 1995), these programs can be categorized as either drill and practice, tutorials, educational games or simulations. Although these programs claim to save time, provide instruction, enhance problem-solving activities and simulate activities otherwise not available, their effectiveness has not been empirically confirmed.

One use of this type of software within physical education is for the measurement of physical fitness. Some programs help you calculate the percentage of body fat, others measure cardiovascular fitness in conjunction with apparatus such as heart rate monitors and other more scientific measures calculate VO2 maximum measures of fitness (Deal & Deal, 1995; Mohnsen, 1995; Strand & Mathesius, 1995; Strand, Mauch & Terbizan, 1997). Unfortunately, many of the software require specialized hardware, site licenses and enough computers for the whole class. Supporting the use of these software can be expensive and consequently few, if any, physical education departments are able to utilize them on a regular basis. The ability to provide sophisticated software programs through an internet site would reduce costs for physical education departments, and make computer assisted instruction a more viable teaching tool.

A second area in which computer technology is more commonly used is for the collation of data such as times, distances, weights, and grades (Mohnsen, 1995). Fitness Reporter™ is an example of such software. "Fitness Reporter is a physical education software program for compiling and reporting results from fitness tests" (R. K. Solutions, 1996). However, in these instances it is generally the teacher or one or two non-participating students who use the technology and not the student body as a whole.

A third area is for sport specific instruction. For example, "Bonnies Fitware" produced by California Physical Education, which is directed by Bonnie Mohnsen, has a number of sport specific software's, such as MacSoftball Game 1.1, MacSoftball Basic Strategy Tutorial 1.1, PC Softball Basic Strategy Tutorial, MacBowling Scoring Tutorial 1.1, PC Bowling Scoring Tutorial, and MacFootball Rules Game 1.3, which are advertised as being designed for both teachers and students. Again, physical education teachers need to have easy access to these as well as being assured of their effectiveness in enhancing skill acquisition, but only a handful of studies have examined the effectiveness of computer-assisted instruction.

Empirical Effectiveness of Physical Education Specialty Software

The first study to examine the effectiveness of computer aided instruction in motor skill instruction was conducted in 1987 and examined traditional bowling instruction compared to computer-assisted bowling instruction (Steffen & Hansen, 1987). Ninety university students (51 males, 39 females) enrolled in elementary bowling courses were split into four groups. Two groups received traditional bowling instruction consistent with instruction normally employed in university settings, where handouts were given, lectures were given, instructor demonstrations were given, practice time was given and students bowled in mini tournaments. The other two groups received computer-assisted instruction (CAI) in bowling from a program entitled "The Bowling Series". One major draw back of this study was that the CAI groups were given more time to interact with the software than the traditional groups spent receiving lectures, and the computer-assisted groups received more time to practice the skills. This resulted in the CAI groups receiving 135 minutes more time in the course, that present questions as to the validity of the results. The results indicated that those who received instruction through computer assisted means performed significantly better, as measured by bowling scores, than the participants who received traditional instruction.

Although a promising indication of the effectiveness of CAI, due to the discrepancy in the time given to learn and practice, no categorical conclusions can be formed. What is known, is that this topic warrants much further study. As yet however, there have been few other empirical studies that have examined the instructional effectiveness of different computer based technologies within physical education or motor learning. A small number of physical education studies have been published (Adams, Kandt, Throgmartin & Waldrop, 1991; Adams, Waldrop & Justed III, 1989; Kerns, 1989), and a number of abstracts in the field of athletic training education

(Buxton, Speitel, & Holgen, 1995; Chen, Buxton, Holgen & Speitel, 1995; Deere, Wright, Solomon & Whitehill, 1995), but these provide us with mixed results as to the effectiveness of CAI and generally tend to examine knowledge acquisition rather than skill acquisition. They also tend to compare traditional methods of instruction with instruction delivered 100% by a computer. No studies were found that examined traditional methods compared to methods where the physical education teacher used computer technology to enhance their instruction. Some articles have documented physical education teachers' use of other software (Mohnsen, 1995; Mohnsen, Chestnut & Burke, 1997), however, these have not empirically tested the effectiveness of the software use.

Video Technology

Film and video technology, specifically that used in video modeling and video feedback, has a long history within teaching and coaching (Martens, Burwitz, & Zuckerman, 1976; Paulat, 1969: Rothstein, 1981). Darden and Shimon (2000) recently referred to videotape and its use in motor learning, as an old technology. Video modeling is defined as a practice procedure where another person demonstrates the skill or skills to be learned (Schmidt, 1991). The modeled performance may be performed by an expert in the skill, a peer at the same level of expertise as the learner or by a teacher or coach (Carroll & Bandura 1982, 1990; Hand & Sidaway, 1992; McCullagh & Caird, 1990;

McCullagh & Meyer, 1997; McCullagh, Weiss & Ross, 1989; Sidaway & Hand, 1993). Video feedback is the process of analysing one's own performance as presented on film, photograph, or videotape, assisted by others or alone in a self-analytical mode (Schmidt, 1991; Schmidt & Lee, 1999). This media is most commonly seen within the coaching field, where video is used to provide feedback to the athlete and to provide athletes with peer and expert model performances (Boyce, Markos, Jenkins & Loftus, 1996; Hand & Sidaway, 1992; Mohnsen, 1995; Mohnsen & Thompson, 1997; Rothstein & Arnold, 1976; Schmidt, 1991; Schmidt & Lee, 1999; Selder & Del Rolen, 1979). Mohnsen and Thompson (1997) note how video technology in the area of physical education instruction can also be used to "show model performances, demonstrate concepts, provide scenarios and provide students with the opportunity for self analysis" (p. 8). Laser discs and CD ROM's have increased the potential to use video modeling within physical education (Katz & Green, 1989), although it seems that we have not utilized this potential. This study will determine the effectiveness of video modeling through an alternative medium, the internet.

Physical Education and The Internet

The internet is a relatively new technology, emerging on a global scale within the last five years. Each day an increasing number of resources for physical educators and their students are posted on the internet. Ellery (1997) notes that "more and more physical education teachers are recognizing the value of the world wide web and the importance of being on-line, or connected to it" (p. 5). He also describes how the world wide web, or the internet, can provide interactive tasks related to physical education and can help us to teach our classes more effectively. He names the Nutritional Profile Web Page (http://www.mirical.com/site/Mirical/form3.html) and the Body Composition Web Page (http://www.fctpa.coedu.usf.edu/ellery/bodycomp/ bodycomp.p1) and notes that it is quite possible to create your own, or to even work on creating an interdepartmental site, to support ones classes. The use of the internet also increases opportunities for cross-curricular activities with other subject areas such as information technology (Brodie & Skinsley, 1992; Fox, 1992; Snailham, 1992; Sparkes & Owen, 1994).

The advantage of the internet over specialty software is that instead of incurring the expense of buying licenses and maintaining expensive hardware, the internet is a viable alternative that enables the delivery of high quality programs at a greatly reduced cost. Increasing numbers of similar sites are already running on the internet, such as How to Play Better Baseball (http://member.aol.com/HowToPlay/), ballet instruction (http://www.geocities.com/vienna/choir/6862/class.2.html), Judo Lessons (http://www.jundoinfo.com/menu.shtml) and Jeff Pill's On-line Soccer Drills (http://www.eteamz.com/soccer/pills).

Other academics in the pedagogy field have also commented on the importance of physical educators being on-line (Friesen & Bender, 1997; Grosse, 1997). Grosse gives the URLs (Uniform Resource Locator) for fifteen sites now available to physical educators, such as GolfWeb (http://www.golfweb.com), Tennis On-Line (http://www.duke.edu/~tarobins/tennis/), Tap Dance (http://www.hahnemann.edu/tap/) and Swim 2000 (http://www.swim2000.com). He also states that students are enthralled by the internet and will be motivated to find information about rules, techniques and skill practices. As yet however, no instructional web sites, specifically designed for physical educators to use with their classes, have been empirically tested.

Internet Based Instructional Design

The use of the internet and specifically the world wide web (WWW) for the delivery of instruction in both the distance learning environments and in site based learning environments has received considerable attention in recent years (Campbell, Hurley, Jones & Stephens, 1995; Doherty, 1998; Dwyer, Barbieri & Doerr, 1995; Galbreath, 1997; Just, 1997; Kahn, 1997-98; LaRoe, 1995; Locatis & Weisburg, 1997; McKenna & Agogino, 1998; Powers, 1997; Reinhardt, 1995; Risinger, 1998; Shotsberger, 1996; Sunal, Smith, Sunal & Britt, 1998). Dwyer et al. (1995) stated that "the web provides significant new functionality in transmitting information to the student and providing forums for exchange"(p. 897) which can increase students involvement levels in their learning.

The use of the internet provides enormous versatility in providing students with access to material that they might not otherwise have. Class materials that were once available only during class time or for restricted periods of time from the library, are now available twenty-four hours per day. In addition, there would only be a few copies of these materials, meaning that only a few of the class members would be able to view the materials at any one time. Using the internet to present such materials means that the information can be easily posted on the internet giving students virtually unlimited access (Shotsberger, 1996). Consequently, this makes it possible to provide supplementary information and examples to students, which would not be covered in class, due to lack of time.

Risinger (1998) highlights that it is not necessary to have one computer for every single student and teacher to make effective use of the internet. He describes how a single computer, used only by the teacher, can provide students with "primary sources, photographs, and student projects that can be more effective than the collection of ancillary resources that come with textbook programs" (p. 110). He goes on to say that one or two computers situated at the back of the classroom can provide students with leads to links with other students around the world, in addition to a wealth of other information and resources. Risinger, also notes how more and more institutions and community centres are being connected to the internet, such as local libraries. He proposes that within 10 to 15 years all teachers and students will be teaching and learning with the aid of computers and the internet. This suggests that the internet is not a technology that will disappear; it is here to stay. However, for an internet site to be effective in delivering instruction, it is important that the site be designed following guidelines derived from research on the effectiveness of internet based learning.

Internet Site Design Decisions

The following review outlines literature pertaining to the design of internet based instruction. Although most of the software available were written with small, monitor based viewing environments in mind, a few have provided guidelines for larger open space settings (Connop-Scollard et al. 1997; Just, 1997; Loosemore, 1993; Vetter, Ward and Shapiro 1995). Given the nature of swimming instruction, this review will focus on design issues related to projecting information in large open areas of instruction, such as a swimming pool, as well as for individual use of the site viewed through a monitor. The review has been subdivided into the areas of screen design, consistency, written content, multi-media, file size, navigation, hyperlinks, interactivity and inherent functions of the web.

Screen Design

Hannafin and Hooper (1989) state that the purpose of the screen's design is to aid learners in focusing their attention on the important aspects of the content, while maintaining motivation and interest in the content. Consequently, the overall design should be visually clear, legible, easy to use (Faiola & DeBloois, 1988) and motivating. Three main elements of a screen design are layout, text formats and use of colour. Other elements that are contained within a screen, such as navigation controls, written content, and multi-media go beyond just their placement within the screen and will be discussed separately.

Layout. There is a consensus that the screen layout should be consistent for all screens within an application (Faiola & DeBloois, 1988; Hazen, 1985; Milheim & Lavix, 1992). Hazen notes that there should be consistent functional screen areas for headlines, titles, navigation and instructional information. Faiola and DeBloois state that there should be consistent relationships on the layout between the placement of titles, headings, captions, instructional information, visual cues, touch points and frequently occurring information. For internet sites specifically, experts recommend that pertinent information and navigational controls should be at the top of the page so that they will appear at the top of the screen (Emery, 1997). This allows users to make a quick exit if they select the wrong link

On the internet it is possible to subdivide the screen through the use of frames, which are similar to having different windows open. Nielson (1996a, 1996c, 2000b) has been adamantly opposed to the use of frames because they break the "fundamental user model of the web page" (Nielson, 1996c, p. 1). When frames are used, the user is unable to use functions which are inherent to the internet, such as; book marking a page, using the back and forward buttons, using hyperlinks and printing the whole screen or printing elements of the screen with ease (Nielson, 1996c, 2000b). In addition it should be noted that not all browsers support frames, resulting is only some of the internet community being able to view the site.

Text Format. Hathaway (1996) found that text should optimally be double-spaced, upper and lowercase, with 80 characters per line, for optimal reading on a computer screen. Faiola (1990) has recommended that all of the text used should be of a consistent size, colour and font. When changes are made to the texts format, the user will look for meaning in why the change was made. Nielson (1996b, 2000b) recommends that on the internet text should be all one size and that the designer should not stipulate the size. Most browsers allow users to set the text size to their preferred size, if the designer then stipulates a size it will only be optimal for the designer and not for the user. Also on the internet, specific text formats are known to identify hypertext, consequently using any formatting the same or similar to this should only be used when the text really is hypertext, or users will be very confused (Nielson, 1996b, 2000b). Vetter et al. (1995) described the difference that font type and size and weight of text can have on the presentation of information. They recommend using a sans serif font like Helvetica, and a heavy weighting for dark coloured text on light backgrounds and a lighter weight text for light coloured text on a dark background. They also recommend using text between 14 and 24 points which when projected will be approximately 1/5 to 3/5 of an inch high.

Colour. Loosemore (1993) recommends that colour should only be used when it serves a purpose, such as highlighting key points and links, and for aiding understanding of the content. Loosemore recommends the number of colours used per page should be kept to a minimum; no more than 7 for a graphical display or 4 for a text only display. Loosemore also states that one should use colours that are a contrast of light and dark, such as a dark blue background with either light yellow or white text. As previously mentioned, internet browsers use different text formatting, including the use of colour to denote hypertext (Nielson, 1996a, 2000b). Consequently, one should never use a colour that also denotes a specific function such as blue, red or purple, which often denote hyperlinks.

Consistency

Consistency relates to the appearance, physical characteristics, procedural usage, screen design, writing style, navigation and multi-media inclusion. It is generally agreed that consistency should be evident throughout an application (Cates, 1992; Faiola & DeBloois, 1988; Heines, 1984; Marshall, Nelson & Gardiner, 1987; McKenna &

Agogino, 1998). Only when changing topics or where there are distinct separate sections of a site, is it recommended that an element be manipulated, such as background colour (Loosemore, 1993). A change in design should aid the user in knowing that they have moved from one part of an application to another, and should not be used for aesthetic or other reasons.

Maddux (1998) recommends that on every page within a site there should be a title and contact information. Nielson (1996d, 2000b) reiterates that there should be a direct link at the top of every page to the home page or main menu page. This helps users who enter a site from a location other than the menu, or home page, to then find the origin of the site that they have entered.

Written Content

Nielson (1997c, 2000b) found that people rarely read on the internet, they skim over the information, so consequently it is beneficial to write content that is scan-able. Scanning is enhanced when: key words are highlighted; meaningful sub-headings are used; bulleted lists are used; ideas are limited to one per paragraph; important information is placed first such as the conclusion; and 50% of the words that you would have used in conventional writing are used (Nielson, 1997a, 1998a, 2000b). As previously mentioned, it is advisable to place the most important information at the top of the page. Hyperlinks, links that add a new dimension to the content, can also be used to provide more information for users who require it and also to provide examples to further clarify the content. These are most commonly used in the form of either hypertext, text that is linked to additional content, or hypergraphics, where a graphic (diagram, picture or photo) is linked to additional content.

Multi-media

Multi-media is the term used to describe a computer based system that incorporates a number of different media, such as text, graphics, video and audio (Hofstetter, 1995; Roblyer, Edwards & Havriluk, 1997). Due to memory, bandwidth, and time delay limitations, it has been recommended that multimedia should only be included on the internet when it is absolutely necessary for aiding instruction (Nielson, 1997a, 2000b). Where it is desirable to use graphics on the internet the user should be given the option to download the full graphic (photograph, diagram or video clip) only if they wish. Nielson (1996b, 2000b) recommends using 'relevance-enhanced image reduction' in the form of thumbnails of graphics. This way the user can view the key elements of the graphic without necessarily downloading it. Although Nielson does not discuss links to video clips, is seems that it could also be possible to use relevance-enhanced thumbnails as links to video clips. Nielson (1995) notes that video is particularly suited to demonstrating things that move. He also recommends that animation is valuable for showing continuity in transitions when something has more than one state. King et al.

(1996) in relation to navigational icons, note that it is important to use icons that are intuitive so that people will be able to perceive them correctly and utilise the navigational controls provided correctly. They found that where it is not possible to use an easy to perceive icon the combination of an icon and one or two words, worked well.

File Size

One of the first rules that web site designers learn is that "size equals time" (Procknow, 1998, p. 88). A web site should take only a few seconds to load, otherwise the users attention will be lost. This is especially important if users will be viewing the site over a modem where download speeds are greatly increased (McKenna & Agogino, 1998). File sizes can be kept small by incorporating a number of the guidelines noted above: use a minimal amount of multi-media; provide hyperlinks to full sized graphics; keep pages between one and three screen's in length; summarize key points and using hyperlinks, to expand on the content and provide pertinent examples.

Navigation

It is also recommended that a site map is incorporated into the home or menu page, so that the user can quickly see where the information they require is located on the site and also directly link to this information (McKenna & Agogino, 1998; McMurdo, 1998; Nielson, 1996a; Procknow, 1998). Navigating web sites is accomplished using commands established through research (Maddux, 1998; Milheim & Lavix, 1992) and include home, menu, quit, help, next/forward, previous/back, and glossary. This enables the user to have control of where they want to go and how to get there. On-screen instructions can also be used to aid this navigation (Cates, 1992). The use of a consistent page design can also aid navigation as users know automatically if they have selected a link leaving the site, due to the change in design (McKenna & Agogino). Navigation can also be aided through the use of link titles or onscreen messages informing the user of where they will go if they use the link (Cates; Maddux & Johnson, 1998; Nielson, 1998b, 2000b).

Hyperlinks

Use of hyperlinks has already been discussed in relation to written content and also to reducing file sizes. Shotsberger (1996) notes that although this is a useful tool and one well worth using, hyperlinks should be used sparingly. It is difficult to read text, if every other word is underlined and requires you to click on it. Hyperlinks, however, do not have to be in the form of hypertext. Icons can also be used as hyperlinks, but they will only be effective if the icon is easy to perceive (King et al. 1996).

Interactivity

Interactivity, is one of the most important features of computer-based instruction (Milheim, 1995; Milheim, 1995-96; Milheim & Lavix, 1988). Cates (1992) states that interactivity should be used in meaningful ways, not just to turn a page. Interactivity should allow the user to choose where they go within the site, and how far they go into the site. For example, rather than overwhelm the user with vast amounts of information, they can be offered an overview with the option to go to supplementary information. The design should draw them into the content, rather than allow them to sit back and be passive observers watching the material appear on their screen (Heines, 1984). This can be done easily on the internet through the incorporation of hyperlinks, more commonly referred to as links, which allow the user to chose where they go within the site. Hyperlinks can also enhance interactivity by giving the user the option of linking to additional pages containing highly specific information, examples, activities, or provide tasks that require the user to type in an answer or select an appropriate hyperlink in response.

Inherent Functions of the Web

Nielson (2000a) describes his "law of the internet user experience". This is that web users spend most of their time on other sites, which means that they want your site to work in the same way as the all the other sites. For example, there are a number of inherent functions of the web, that users take for granted, such as links being underlined or the ability to print a copy of the web page by clicking on the print button within the browser. However, specific design choices, such as the use of frames or changing the color of links can interfere with these inherent functions (Maddux, 1998; McMurdo, 1998; Nielson, 1996a). Nielson (1996a) explains that the inappropriate use of frames prevents the user from being able to bookmark pages and can make printing specific pages complicated and frustrating, because you have to ensure that you have clicked your mouse somewhere with the frame that you want to print. McMurdo, (1998) describes how specific colours on the web have specific meanings, such as the colours used to denote hypertext, and should not be used indiscriminately.

CHAPTER THREE

MOTOR LEARNING MODELING

RESEARCH APPLIED TO INTERNET SITE DESIGN

It is critical that insights gained from research on the effectiveness of models be used in the design of the internet site. The following chapter will review one of the major models of motor learning, motor learning research on modeling and provide a brief outline of the experimental design used to test the effectiveness of using models.

Models of Motor Learning

There are a number of different models of motor learning, that is, how we learn to perform different motor skills such as swimming front crawl or riding a bicycle. Fitts and Posner (1967) describe learning as a "relatively permanent change in performance that can be shown to be the result of experience" (p.8). Fitts and Posner identified three phases that appear to be involved in the acquisition of skills. They note that these are not individual stages that have definite transitions from one to another, but more that as learning progresses one phase merges into another.

The first stage, known as the early or cognitive stage, is where the learner tries to understand the nature and requirements of the skill. Fitts and Posner (1967) note that whether given instruction or left to ones own devices most adults will automatically try to understand the basics of the skill before they try to perform it. They also note that any good instructor aids initial learning by pointing out important cues and characteristics of a skill. This helps the learner to link elements of previously learned skills together, to create new patterns. Fitts and Posner note that "one of the most promising devices for use in skill training is the television recording, which enables a students to see and hear himself immediately after attempting some portion of a new activity" (p.12). They further note that during the initial stage of learning, demonstrations and instructions are most effective.

Fitts and Posner (1967) named the second stage of learning as the intermediate or associative phase. This is where the learner practices the routines or elements of previously learned skills identified during the cognitive phase and new patterns of fluid movement begin to emerge. During this phase learners tend to make gross errors, however these errors diminish as a result of practice. This stage of learning can last for a variable amount of time dependent on the complexity of the skill and the amount and nature of practice. Since Fitts and Posner first published this model, many studies have been conducted on the optimal scheduling of practice and how specific skills should be practiced (Hall, Dominiques & Cavazos, 1994; Lee & Magill, 1983; Ota & Vickers, 1999; Shea & Morgan, 1979; Shea &

Wright, 1991). As learners move into the third stage of learning, called the final or autonomous stage, the skill becomes increasingly autonomous. At this stage the skill requires little cognitive control and performance is maintained even when there is interference from other activities or distractions. Ideally the goal of instruction is for all learners to reach the autonomous stage of learning. Although Fitts and Posner note that demonstrations are most effective during the first stage of learning, more recent studies on the use of demonstrations have found that they can enhance acquisition beyond the cognitive stage.

Motor Learning Research on Modeling

Research in motor learning has found that there are a number of interventions that facilitate the acquisition of motor skills, one being the use of modeling (Carroll & Bandura 1982, 1990; Hand & Sidaway, 1992; McCullagh & Caird, 1990; McCullagh & Meyer, 1997; McCullagh, Weiss & Ross, 1989; Sidaway & Hand, 1993). Modeling has been found to increase learning compared to not using a model (Hand & Sidaway, 1992; McCullagh & Meyer, 1997; McCullagh, Weiss & Ross, 1989; Sidaway & Hand, 1993). Carroll and Bandura (1990, 1982) state that only the observation of a skilled action will provide an effective means of improving skill acquisition. However, it is not widely accepted that it is beneficial to only use expert (skilled) models.

Correct and Learning Models

A study by McCullagh and Caird (1990) suggested that the observation of a learning model was more beneficial to the learner than a skilled model. However, a more recent study by McCullagh and Meyer (1997) found contradictory results indicating that the observation of either a skilled or learning model was equally effective, essentially retracting the earlier findings.

McCullagh and Meyer (1997) tested the influence of model type on the learning of a free weight squat lift. Forty female undergraduate students, who had never performed a free-weight squat before, were randomly assigned to one of four experimental groups: Correct Model and Feedback (C+F), Learning Model and Feedback (LM+F), Physical Practice and Feedback (PP+F) and Learning Model no Feedback (LM-F). The task was to perform fourteen free-weight squats within 30s. Each group performed five 30 second trials with a two minute rest period between each trial. The PP+F group received feedback regarding their performance. Their performance was video taped and used as the learning model for the LM+F and the LM-F group. The LM+F group viewed the tape of the learning model prior to their first trial and also during each of the two minute rest periods, but received no feedback, however they did receive information about the learning model's performance. The LM-F group also viewed the video prior to the first trial and during each two minute break. They did not receive any information about the model's performance. The CM+F viewed a tape of a correct model prior to their first trial and also during every two minute rest break. They received information about the correct model's performance.

The effect of the different models on the acquisition of the squat was measured through a retention trial given two days after the acquisition trials. All participants were required to perform three 30 second trials, with a two minute rest between each trial. There was no feedback given or any models viewed during any of the two minute rest breaks. During both the acquisition and retention trials all of the participants were filmed from the side, front and back which was used for evaluation purposes.

Video tapes of the participants were evaluated by two weight lifting instructors, who were unaware of the purpose of the experiment. Each participant was given a form score and an accuracy score, based on the number of squats that were performed during each trial. Participants were aiming to perform a total of 14 squats per trial. The accuracy scores did not produce significant results. Only the form score produced any significant results. The results showed that both the LM+F and the CM+F conditions resulted in far better form scores than either the LM-F or the PP+F conditions. It was concluded that both a correct model, and learning model, when coupled with feedback about the models' performance, can have a significant effect on motor skill acquisition.

Other studies have also examined possible differences in learning between a learner observing a skilled model (correct model) and a learning model. Pollock and Lee (1992) found that there were no differences in performance due to observing a skilled or learning model. They concluded that either model produced better performance than not observing a model at all. These results agreed with earlier research by Lirgg and Feltz (1991) which found that performance increased for all learners observing a model, skilled or learning, compared to learners without a model. In this study they also examined if the status of the model had any effect on the learners performance. For example, a teacher model compared to a peer model, or a known model compared to an unknown model. Their results suggested that it does not matter which type of model is observed. Consequently, one could conclude that providing students with both types of models would be advantageous (Darden, 1997).

Knowledge of Results or Knowledge of Performance and Modeling

The majority of the studies reviewed above use knowledge of results (KR), external feedback related to the result of the performance in terms of the desired goal, in order to assess performance. McCullagh, Steihl and Weiss (1990) examined knowledge of performance (KP); external feedback related to the actual movement produced during performance. They found that participants "who observed a model...had significantly higher form or quality scores than no model groups" (p.348). This supported their hypothesis that groups who viewed a model produce better qualitative performances than groups who did not view a model.

Frequency of Modeling

Although the research has shown that the use of a model is beneficial, it was still unknown how often models should be used. Sidaway and Hand (1993) examined the frequency of video modeling on a golf chip shot. During both instruction and practice of a golf chip, learners viewed a video of an expert model. Their study utilized three experimental groups and one control group. The experimental group A viewed the model before every attempt at the chip, group B, before every fifth attempt at the chip, and group C before every tenth attempt at the chip. The control group D did not view the video at all.

Their results found that during practice there was no significant difference between the four groups. However during a retention test, which was performed the day after completing the acquisition trials, the participants performed 50 trials of a chip identical to the one practiced during acquisition. Group A had a significantly more accurate chip than any of the other groups. This was also seen during the transfer test that was performed after the retention test. Unlike the retention test the length of the chip performed was different, and only 30 trials were performed. Sidaway and Hand (1993) concluded that increasing the availability of an expert video model during both instruction and practice resulted in improved long-term performance.

Holistic Models

Vickers, Livingston, Umeris-Bohnert and Holden (1999) utilised holistic video modeling to improve hitting in baseball, in combination with video feedback and bandwidth feedback. Bandwidth feedback being the allocation of a tolerance level of error, where minor errors are not identified but larger errors are identified to the learner as an error (Sherwood, 1988). A holistic model presents the complete skill, without any breakdown into component parts. Participants who were skilled in baseball produced significantly better performance scores (% of hits) during a transfer test performed at the conclusion of a seven week instructional unit. A similar result was found in a study in golf (Vickers, 2000). In both studies, performance improvements were initially delayed compared to control groups who also viewed a model, but without a bandwidth.

Visual Discrimination and Modeling

The studies presented above identify the importance of visual discrimination skills required by modeling, such as those used in observational learning. Doane, Alderton, Sohn and Pellegrino (1996) examined how the difficulty of initial learning, influences acquisition, through examining if visual discrimination skills are stimulus specific. Participants, in two groups, were required to discriminate between similar, 'easy' to discriminate and 'hard' to discriminate, polygons. One group was taught under an 'easy-first' condition where simple tasks were taught first, tasks where they had to discriminate between very dissimilar shapes, followed by more complex tasks, tasks where they had to discriminate between very similar shapes. The other group was taught under a 'hard-first' condition, where complex discrimination tasks were taught first, followed by more simple tasks.

As can be seen in Figure 3.1 on the next page, during acquisition those in the easy first group performed better than those is the hard first group. However, the retention results found that those taught under the hard first condition achieved better results than those participants taught under the easy first condition. This effect was still found even when the easy first condition was given more practice time than those in the hard first condition. Doane et al. argued that it was the use of hard first instruction and not the amount of practice, which aided the participants' retention of the discrimination skills.

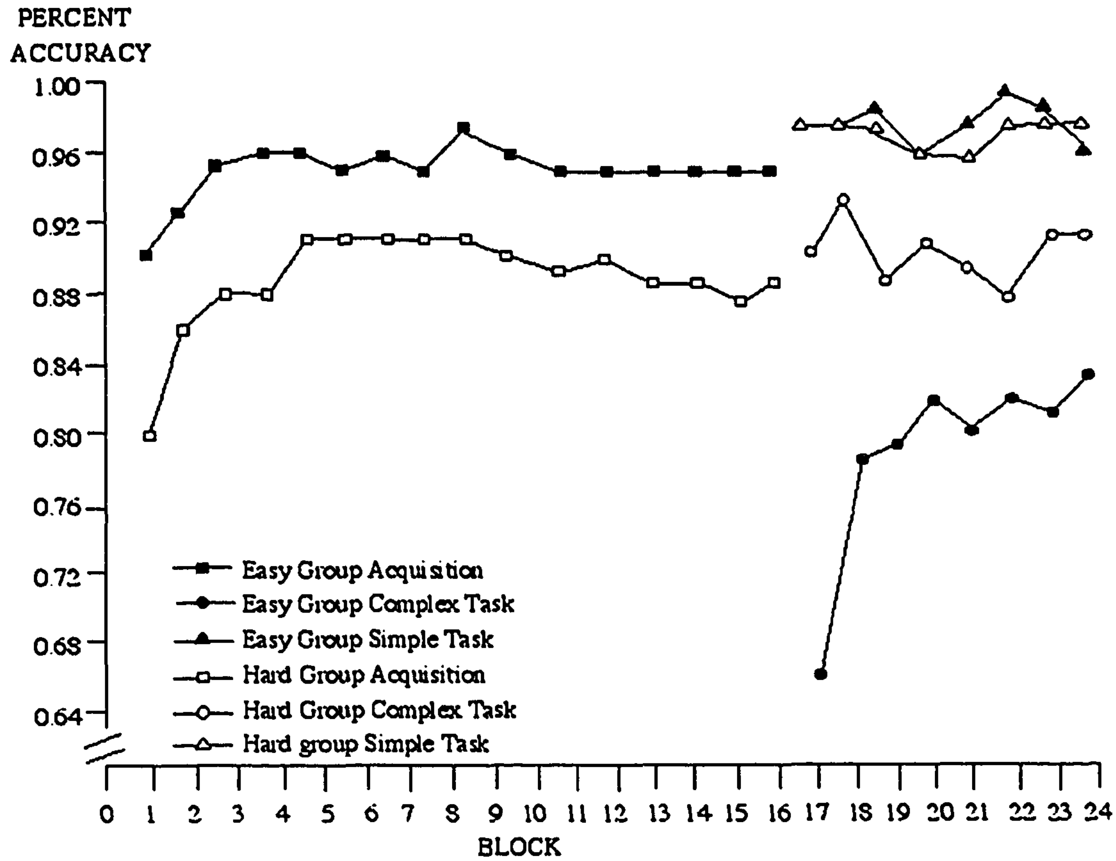

Figure 3.1. Mean accuracy of the hard first and easy first group during acquisition and retention of discrimination tasks (Adapted from Doane et al., 1996).

The authors concluded that the hard first condition facilitated learning because the learner acquired stimulus-driven strategic processes while learning to discriminate between the shapes. The nature of these strategies then influenced the learner's ability to transfer these to novel discrimination tasks. The strategies acquired by those in the hard first group were more complex due to the degree of difficulty presented by the harder discrimination tasks. Consequently these strategies could be used on a wider number of novel tasks than the strategies developed by the simple first group who had not developed such sophisticated strategies. This was the case even after tasks requiring more specific strategies where administered to those in the easy first condition. This demonstrates that the strategy adopted during initial learning can affect the transfer of skills to another task, supporting the findings from motor learning studies, that difficulties introduced at the beginning of learning can significantly improve skill acquisition (Schmidt, Young, Swinnen & Shapiro, 1989; Shea & Morgan, 1979; Vickers et al., 1999).

It is thought that "hard first" visual discrimination conditions, such as providing the whole skill first (Vickers, 1994), causes the learner to elicit higher levels of cognitive processing (Lee, Swinnen & Serrian, 1994). Introducing small easy sections of a task does not require the same degree of processing and consequently the learner is not as engaged in the learning process.

Summary

The above studies show that providing learners with a visual model, either skilled or learning, can enhance acquisition in terms of qualitative performance and the desired goal or result of performance (Carroll & Bandura 1982, 1990; McCullagh & Caird, 1990; McCullagh & Meyer, 1997; McCullagh, Weiss & Ross, 1989). They also show that providing models frequently is more beneficial than only showing models at sporadic intervals (Hand &

Sidaway, 1992; Sidaway & Hand, 1993). Studies in visual discrimination support why providing a model is so important (Doane et al., 1996). Providing a model challenges the learner to focus on the model and discriminate between the different elements of a skill and engages the learner in their skill acquisition which increases cognitive effort and consequently improves their resulting performance (Lee, Swinnen & Serrian, 1994).

Although none of the studies above specifically examined using models in swimming instruction, they promote the use of models when providing instruction and provide a theoretical foundation for integrating modeling on a regular basis into a program of instruction. The following section identifies modeling literature specific to swimming instruction.

Swimming Instruction and Modeling

Modeling is a key element of swimming instruction. Swimming instruction has traditionally been delivered by a swimming instructor who models the strokes as they describe them on pool side. Swimming instructors are taught how to model the strokes to their students from the pool side, and where possible, to use a student from their class as an example to the other students when teaching specific skills. Rutt Leas (1992) emphasized this point, noting that, with novice swimmers it is especially important to provide them with clear "demonstrations, film or video" (p. 182).

Mathias, Adams, Stearns and Mayo (1993) investigated the effects of an interactive videodisc application on the skill acquisition of front crawl and butterfly swimming strokes. The videodisc was created by Mathias, Smith, Steffen, Heinrich and Carlisle (1991) and contained six modules that provided oral, visual and written instructions on the stroke mechanics of both front crawl and butterfly. To test the effectiveness of the videodisc, Mathias and Adams took 36 male and female college students enrolled in intermediate swimming lessons, and divided them into two groups. Both groups received the same instruction from the same instructor during class time. The difference between the groups was that during five mandatory additional hours of swimming practice, the treatment group practiced using the videodisc while the control group practiced on their own. Pre and post test videos were taken of the swimmers at the second and last swimming class. The videos were rated on a fifteen (15) point scale by the researchers. The results found that those in the videodisc group showed greater increases in their butterfly stroke technique, but not in the front crawl stroke technique, when compared to the control group. This was also found by Mathias (1990) in an earlier study on the effectiveness of interactive video in teaching the ability to analyse butterfly and front crawl stroke technique. Mathias (1990) attributed this result to the greater familiarity of the learners with the front crawl stroke. He noted that front crawl tends to be the first stroke taught to learners and the primary stroke used by many swimmers. He also postulated that the learners may have been less intent on improving their ability to analyse front crawl technique compared to butterfly.

Experimental Design

Due to the lack of empirical studies that have specifically examined the effectiveness of computerized technological interventions on motor skill acquisition, it was necessary to draw on the methodology from a number of studies in the fields of educational technology as well as motor learning and physical education. The following section will examine appropriate experimental design and methods of data collection for assessing the effectiveness of an instructional program.

Retention and Transfer

The experimental design of research studies in motor learning has changed over the last 15 years to now include retention and transfer tests (Christina, & Bjork, 1991). Schmidt and Lee (1999) describe a retention test as a performance test administered after the end of original learning. This test involves performing the same skill as originally learned. A transfer test is a test also administered after the end of original learning but where either the skills to be performed or the conditions under which the skills are to be performed, is different from that originally learned. Schmidt and Lee note that a retention test can be conducted after a retention interval of one minute to one or more years. The longer the retention period the greater the test of learning. They also note that the level of performance at the beginning of a retention test is not always the key identifier of learning. Often the time it takes for the learners' performance to improve is the key to long term learning. If the learner, during retention, can demonstrate large increases in performance over a short period of time, at a faster frequency to that of the original learning, this is indicative that long-term learning has taken place.

Schmidt and Lee (1999) also note that transfer tests are good predictors of long term learning, especially when this learning has a positive effect on other skills and on other performance conditions. The only way to assess if long-term learning has occurred is to administer a retention test and also a transfer test to see if the learning can be transferred to either a different skill or skills or to a different performance condition, such as a competition. Studies that utilise both a retention and transfer test have shown that performance during acquisition is not necessarily a good predictor of permanent learning. Indeed, the opposite has been found (Schmidt & Lee).

Purpose and Hypotheses

The objective of study one was to examine the proposed methodology and to obtain preliminary results for the empirical effectiveness of internet enhanced instruction (IE) compared to non-internet enhanced instruction (NIE), for teaching the motor skills of front crawl and back crawl. Study two had two main objectives, to quantitatively and qualitatively assess the effectiveness of two different forms of internet enhanced instruction, compared to a control condition. The Internet Enhanced Video Model group (IEVM) viewed a simulated internet site, projected on poolside, that contained video clips of expert models. The Internet Enhanced Photographic Model group (IEPM) viewed an identical simulated internet site projected on pool side, that contained progressive photographs of the expert models rather than video clips. The Control group (C) received traditional swimming instruction. Stroke technique, swimming speed and written knowledge were assessed quantitatively and the participants' attitudes were assessed through the use of qualitative techniques, plus one objective questionnaire.

Hypotheses Study One

It was hypothesised that internet enhanced instruction (IE) would lead to significant improvements in both front crawl and back crawl stroke technique, front crawl and back crawl swimming time and written knowledge, compared to non-internet enhanced instruction.

Hypotheses Study Two

It was hypothesised that internet enhanced swimming instruction (IEVM and IEPM) compared to a Control group (C), would result in significant improvements in:

- front crawl and back crawl stroke technique.
- front crawl and back crawl swimming time.
- written knowledge of front crawl and back crawl technique.
- more positive attitudes of the learners towards the swimming instruction.
- more positive attitudes of the learners and instructor towards swimming (Ellery, 1997; Grosse, 1997; Cliff Liao, 1998).

It was also expected that the Internet Enhanced Video Modeling (IEVM), compared to the Internet Enhanced Photographic Modeling (IEPM), would lead to significant improvements in:

- front crawl and back crawl stroke technique.
- front crawl and back crawl swimming time.
- written knowledge of front crawl and back crawl technique.
- more positive attitudes of the learners towards the swimming instruction.
- more positive attitudes of the learners and instructor towards swimming (Ellery, 1997; Grosse, 1997; Cliff Liao, 1998).

Figure 3.2 presents a flow chart demonstrating the chronological order of the internet site development and the two studies.

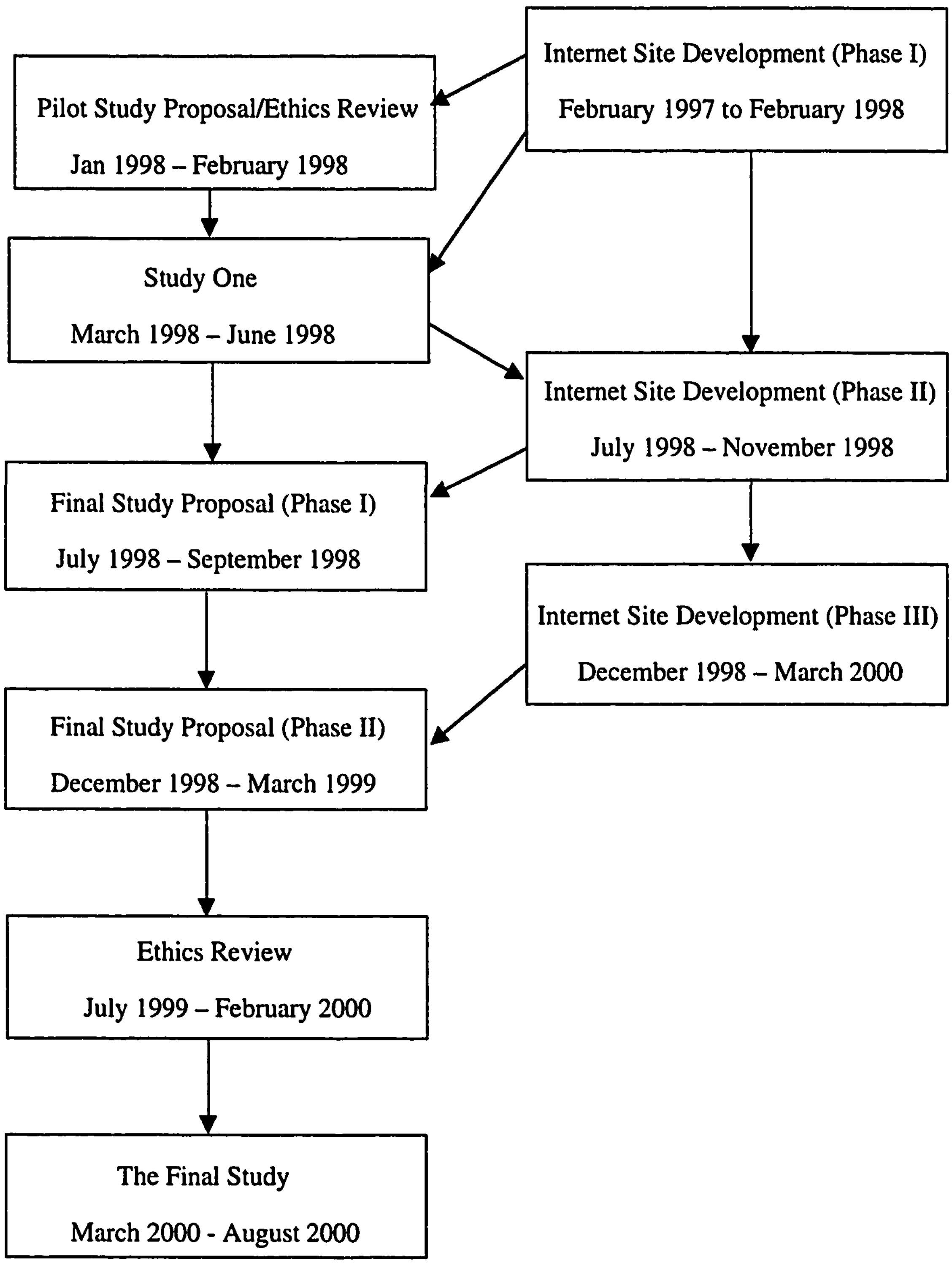

Figure 3.2. A flowchart demonstrating the chronological order of study one and the internet site development preceding the final study.

Chapter four will describe the method, results, conclusions of study one and the implications for study two. Chapter five will describe the method of study one, chapter six and seven the quantitative and qualitative results of study two, followed by the conclusions and implications of both studies in chapter eight.

CHAPTER FOUR

STUDY ONE

Study one (Morey & Vickers, 1998), was conducted using the first generation of the internet site "Swimming" which contained only progressive photographs of expert swimmers as models of the strokes. At the time it was not feasible from a technical perspective to use video clips on the internet, as they were too large to be delivered using the small bandwidth available to users.

Method

Participants

Participants were 34, grade nine high school students, enrolled in required physical education. The class was transported to the swimming pool by bus. Prior to the start of the study all participants and their guardian signed a participant informed consent form.

Instruction

It was important to ensure that all participants received equitable instruction to eliminate methodological biases in the experimental design, consequently, instructional minutes were kept equal for all groups over four sessions each lasting 50 minutes.

Internet Enhanced (IE)

IE were taught with the aid of a simulated internet site containing progressive photographs of an expert model. By projecting the internet site up onto a screen, in a room to the side of the pool, the site was used as a dynamic overhead to aid instruction. Modeling was provided through the use of the photographs on the site, printed handouts of these photographs and by the instructor who modeled the strokes during instruction. Supplementary resources made available to the internet group in their resource centre was the internet site used to aid instruction.

Non-Internet Enhanced (NIE)

The NIE were taught with the aid of overheard transparencies. By projecting these transparencies onto a screen on pool side they were used to aid instruction. Modeling was achieved through the use of the transparencies, printed handouts of the transparencies and by the instructor who modeled the strokes during instruction. The supplementary resources made available to the traditional group in their resource centre, were a number of books on swimming and related aquatic activities.

Experimental Design

A pre-post-transfer design was used with four instructional sessions given between the pre and the post test. The pre test was given three days prior to starting the instructional sessions. Instructional sessions were one week apart, except for the second and third sessions, where there was an interval of two weeks due to bad weather. A one week retention period was given between the last instructional session and the post test, with a further two week period between the post test and the transfer test. Five dependent variables were measured at both pre and post test: Written knowledge (WK), back crawl time (BCT), front crawl time (FCT), back crawl stroke technique (BCST) and front crawl stroke technique (FCST). Only the latter four were measured during the transfer test.

Session one: Pre test

The pre test consisted of a written knowledge test, a quantitative stroke analysis completed by the researcher and a timed swim (18 meters) for both the front crawl and the back crawl. Results from the pre test were used to create two heterogeneous groups (IE and NIE) based on both their combined times (BCT & FCT) as seen in Figure 4.1 $F(1,30) = 4.40$,

$p = .9834$) and their combined stroke technique scores (BCST & FCST) as seen in Figure 4.2, $F(1,30) = 2.03$, $p = .9877$.

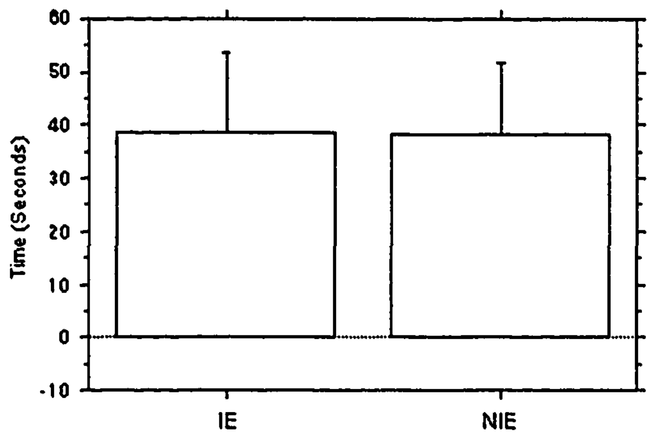

Figure 4.1. Total time (Front Crawl and Back Crawl times combined) for the pre test.

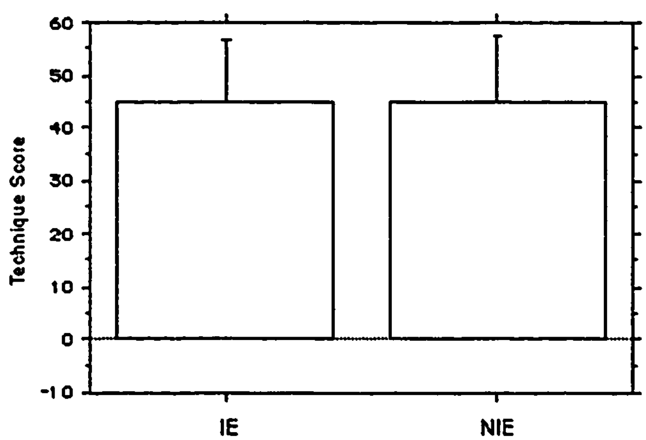

Figure 4.2. Total stroke technique scores (Front Crawl and Back Crawl technique scores combined) for the pre test.

Mean time (sec) of the groups for total time were: x = 38.66 sec (SD = 15.05) for IE and x = 38.55 sec (SD = 13.03) for NIE, with a $p = .9834$. The final means for the two groups for total score in the stroke analysis were: x = 44.88 sec (SD = 12.13) for IE and x = 44.94 sec (SD = 12.70) for NIE with a $p = .9887$.

Sessions two to five: Instructional sessions

Each class started with a warm-up in the water. This was followed by an instructional period, following either the internet or traditional instructional strategy. Sessions two and three focused on front crawl while sessions four and five focussed on back crawl. The following table depicts the instructional minutes devoted to the warm-up, instruction, practice, the contrasting activity and free time.

Table 4.1.

Instructional minutes for each of the four sessions.

Session	Warm Up	Primary Instruction	Practice	Secondary Instruction	Practice	Contrasting Activity	Free Time
2	5 mins	5 mins	10 mins	3 mins	12 mins	8 mins	7 mins
3	5 mins	4 Mins	10 mins	13 mins	10 mins	8 mins	
4	5 mins	5 Mins	10 mins	3 mins	12 mins	8 mins	7 mins
5	5 mins	4 Mins	10 mins	13 mins	10 mins	8 mins	

Session six: Post test

The post test was given one week after the swimming instruction had ended. The post test was the same as the pre test, with the addition of a Likert question, asking the students about how they liked the visual aids used by their instructors.

Session seven: Transfer test

To determine if the participants could transfer their learning to a new situation, all participants competed in a transfer test, which was in the form of a 'fun gala'. If the participants technique scores and times remained similar to the post test, this would suggest that learning that had occurred during instruction and had been retained. The transfer test was given during the last class, after a transfer interval of two weeks after the post test. The gala consisted of four races which were video taped for later technical analysis. These races were two 25 meter front crawl squadron relays and two 25 meter back crawl squadron relays. The 25 meter times were scaled to 18 meters using the following equation:

$$25 \text{ meter time}/25 * 18 = \text{Scaled } 18 \text{ meter time}$$

This was calculated in order to enable comparison with the pre test and post test times recorded over 18 meters. These relays were interspersed with different fun races.

Data Analysis

To assess the effects of the two methods of instruction on motor learning, written knowledge (WK), back crawl time (BCT), front crawl time (FCT), back crawl stroke technique (BCST) and front crawl stroke technique (FCST) were analysed separately using a 2 (Group: NIE or IE) x 3 (Test: Pre test, post test and transfer test) repeated measures analysis of variance (ANOVA). An alpha level of .05 for statistical significance was set for all tests.

Results

The results showed that there was a main effect for WK, FCT, BCST, FCST in addition to a group by test interaction effect for the FCST. The means and standard deviations for all of the tests are presented in Table 4.2.

Table 4.2.

Means and standard deviations for the variables WK, BCT, FCT, BCST, and FCST by group across all experimental stages.

	Pre test		Post test		Transfer Test	
Variable	IE	NIE	IE	NIE	IE	NIE
Written Knowledge	9.19 (1.94)	9.44 (2.19)	11.86 (2.71)	13.18 (2.48)	N/A	N/A
Back crawl Time	21.37 (9.69)	20.36 (6.44)	18.93 (4.39)	20.41 (5.53)	21.90 (4.42)	20.08 (3.97)
Front crawl time	17.28 (5.57)	18.19 (6.93)	15.71 (2.42)	16.25 (2.99)	17.19 (2.77)	17.58 (5.29)
Back crawl stroke technique	24.06 (6.28)	23.06 (6.34)	30.33 (4.12)	29.50 (2.88)	29.44 (4.10)	29.21 (2.83)
Front crawl stroke technique	20.81 (6.73)	21.88 (7.56)	30.53 (4.16)	25.58 (6.52)	28.78 (3.60)	27.07 (6.31)

Significant main effects were found for WK, $F(2,45) = 51.57, p = .0001$; FCT, $F(2,45) = 4.24, p = .0206$; BCST, $F(2,45) = 41.28, p = .0001$; and FCST, $F(2,45) = 56.52, p = .0001$, indicating that both the IE and NIE methods of instruction were effective in improving swimming knowledge, swimming time for front crawl and swimming technique for both front crawl and back crawl. As predicted there was also an interaction effect for type of instruction by test for FCST, $F(2,45) = 4.84$, $p = .0125$. Figure 4.3 shows that IE improved significantly in front crawl stroke technique during the post and transfer tests.

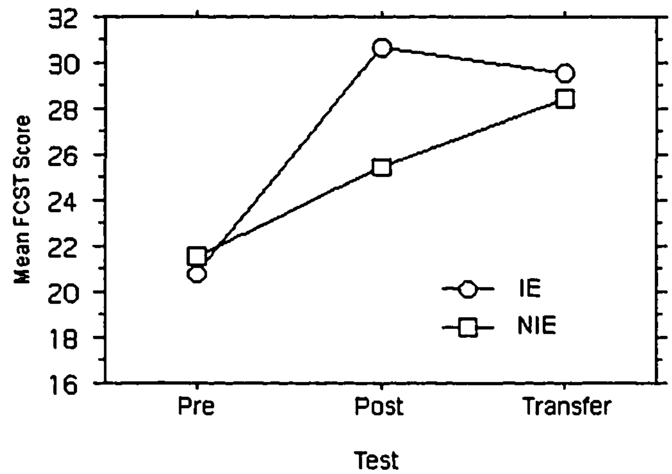

Figure 4.3. Front crawl stroke technique group interaction effect during pre test, post test and transfer swim competition.

Discussion

Use of the internet enhanced swimming instruction resulted in students attaining higher levels of front crawl stroke technique than traditional swimming teaching methods. Back crawl technique did not show a significant improvement. This could be attributed to the shorter interval period between the back crawl instruction and the post and transfer tests. The interval was only one week and three weeks respectively compared to four weeks and six weeks since the front crawl instruction. This result indicates that students need enough time to effectively change their technique, with five weeks being sufficient for front crawl but two weeks being insufficient for the back crawl. Previous research has shown that three to seven weeks are needed to permit motor skill improvement (Rothstein & Arnold, 1979; Vickers et al. 1999). This is also supported by the fact that a significant main effect was found for both front crawl time and front crawl stroke technique, which as it has been already mentioned was taught four weeks before post test and six weeks prior to the transfer test, giving a longer retention and transfer interval. A main effect for both groups was found for written knowledge. This indicates that both methods of instruction yielded improvements in participants swimming knowledge.

Both groups were significantly improved in front crawl time. Over the instruction period, the speed at which the participants were able to swim front crawl increased. A significant group interaction group was not found, which could indicate again that time is not a good predictor of initial improvement. As noted in the review of literature, McCullagh et al. (1990) found results that support the hypothesis that form or quality based indicators of improved performance tend to show better increases in performance after learners have observed a model, compared to this who did not observe a model. This could be why, not only was a significant main effect found for front crawl stroke technique, but also a significant group interaction effect. This could be attributed to the importance of visual modeling in conveying relative motion information compared to outcome based information, such as time,

In addition to the quantitative measures recorded, each student was given four qualitative written questions prior to writing the post test written test. The responses to these questions were measured on a 5 part Likert scale. The results found that 85% of IE said that they found the visual aids used by their instructor to be very useful, compared to only 75% of NIE.

Other factors that may also have influenced the results might be the related experience of the teachers. Both teachers had approximately 10 years of swimming teaching experience and alternated instructional roles equally, however one instructor had limited experience with the internet and how to use the internet as an instructional aid compared to the other who was very experienced. Differences in experience with the internet may have affected results, in the future it is recommended that all teachers have equitable backgrounds in both swimming teaching experience and in use of the internet, so that the effect of the teacher can be ruled out as having affected the results.

Conclusions and Implications for Study Two

In this preliminary study the use of a simulated internet site, containing progressive photographic models, to enhance swimming instruction resulted in students attaining higher levels of front crawl stroke technique then a non-internet enhanced swimming teaching method where students viewed black and white drawings of models projected through an overhead projector. Although an encouraging preliminary study the study is limited by the small sample size, the length of instruction and the internet site design.

Based on the results of study one, a number of modifications were made to the design for study two. First, a longer period of instruction was scheduled to allow for a minimum of seven weeks between the pre and post tests. Previous studies (Rothstein & Arnold, 1976; Vickers, et al., 1999) have suggested that a time interval of three to seven weeks may be needed before effective changes is motor skill technique and performance can be realised. The results of study one support the previous research as it indicates that participants needed sufficient time to effectively change their technique, with five weeks being sufficient for front crawl but two weeks being insufficient for the back crawl, a result similar to Mathias (1990).

Second, only one instructor was used to reduce instructor differences in experience and/or technology use. Third, video clips were added to the internet site (one group with video, one with progressive photos). The inclusion of video clips should produce more realistic models in that the timing of each skill will also be presented. Fourth, a control group was added in order to isolate the effects of using the internet more effectively. Fifth, participants were selected from three different schools to minimise contact and discussion.

This will reduce the chance of the participants in the three groups from comparing their classes and instruction. Sixth, study one was conducted at a university swimming pool, which was not very representative of a typical pool space where the majority of school swimming lessons take place. The final study was conducted at a public pool setting regularly used by school swimming groups. Seventh, qualitative data was collected in addition to quantitative data, in order to assess changes in students attitudes towards the instruction. The addition of this data allowed the researcher to gain an insight into the class environment and the attitudes of both the students and the instructors towards the method of instruction throughout the study. Finally, since both experimental groups received instruction enhanced by the internet they were more appropriately labeled Internet Enhanced Video Model group (IEVM) and Internet Enhanced Photographic Model group (IEPM).

CHAPTER FIVE

STUDY TWO

Method

Participants

Three junior high schools, from similar areas within a large Western Canadian city, took part in the study. All participants were enrolled in physical education and volunteered to take part in the study after reading and signing a participant consent form with their parent or guardian. Each school was randomly assigned to one of three groups: Internet Enhanced Video Model group (IEVM), Internet Enhanced Photographic Model group (IEPM) or Control group (C). The IEVM group comprised of 15 students (8 females, 7 males) with a mean age of 13 years and 10 months at a mean grade level of 7.93. The IEPM group comprised of 16 students (8 females, 8 males) with a mean age of 13 years and 10 months at a mean grade level of 8. The C group comprised of 16 students (8 females, 8 males) with a mean age of 13 years and 7 months at a mean grade level of 7.75. Four students from each group were randomly selected to be interviewed to gain an understanding of their perceptions and attitudes towards the swimming lessons.

Equipment for IEVM

IEVM received eight instructional sessions, enhanced by a simulated internet site "Swimming" developed by the author (Morey Sorrentino, 1997-2000). All lesson content on the internet site was consistent with the I CAN SWIM™ program of swimming instruction from Swimming Canada. A Compac Amada M700 Pentium II laptop computer connected to a Toshiba TLP 450 Multi-Media projector, was set up on pool side to project the site onto a screen, 180 cm by 180 cm in size as shown in Figure 5.1, which resulted in the computer screen projected being 169cm wide by 126cm tall and the video clip being 52cm wide by 39cm tall.

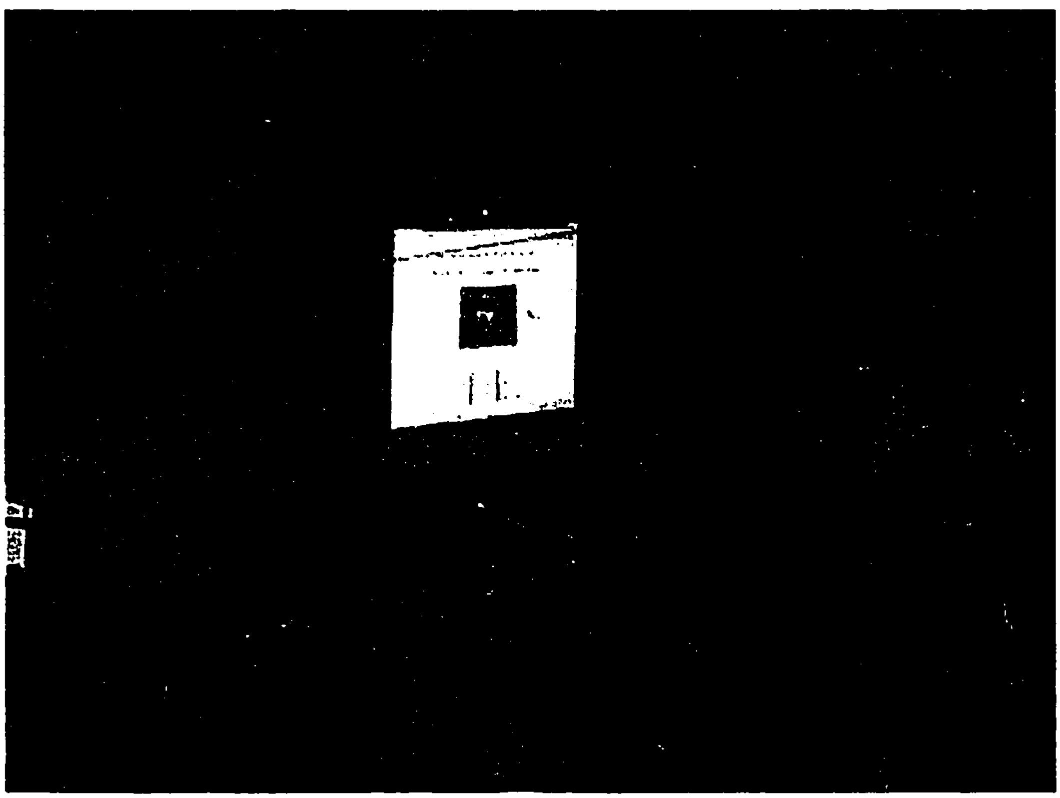

Figure 5.1 Pool side set up for the Internet Enhanced Video Model group (IEVM).

The internet site "swimming" was stored on the lap top's hard drive. The decision to simulate the internet by having the site stored on the hard drive was made because the pool site did not have an internet connection on pool side. It was considered a true simulation of the internet as the site loaded and ran and the same speed on the hard drive as it did from the offices, with internet connections, at the pool site.

The internet site contained digitized video clips of two strokes front crawl and back crawl. Each stroke was modeled by male and female expert swimmers, from an elite city swim team, viewed in the frontal and sagital plane, both from under the water and above. An overview of the site's content can be seen in Figure 5.2.

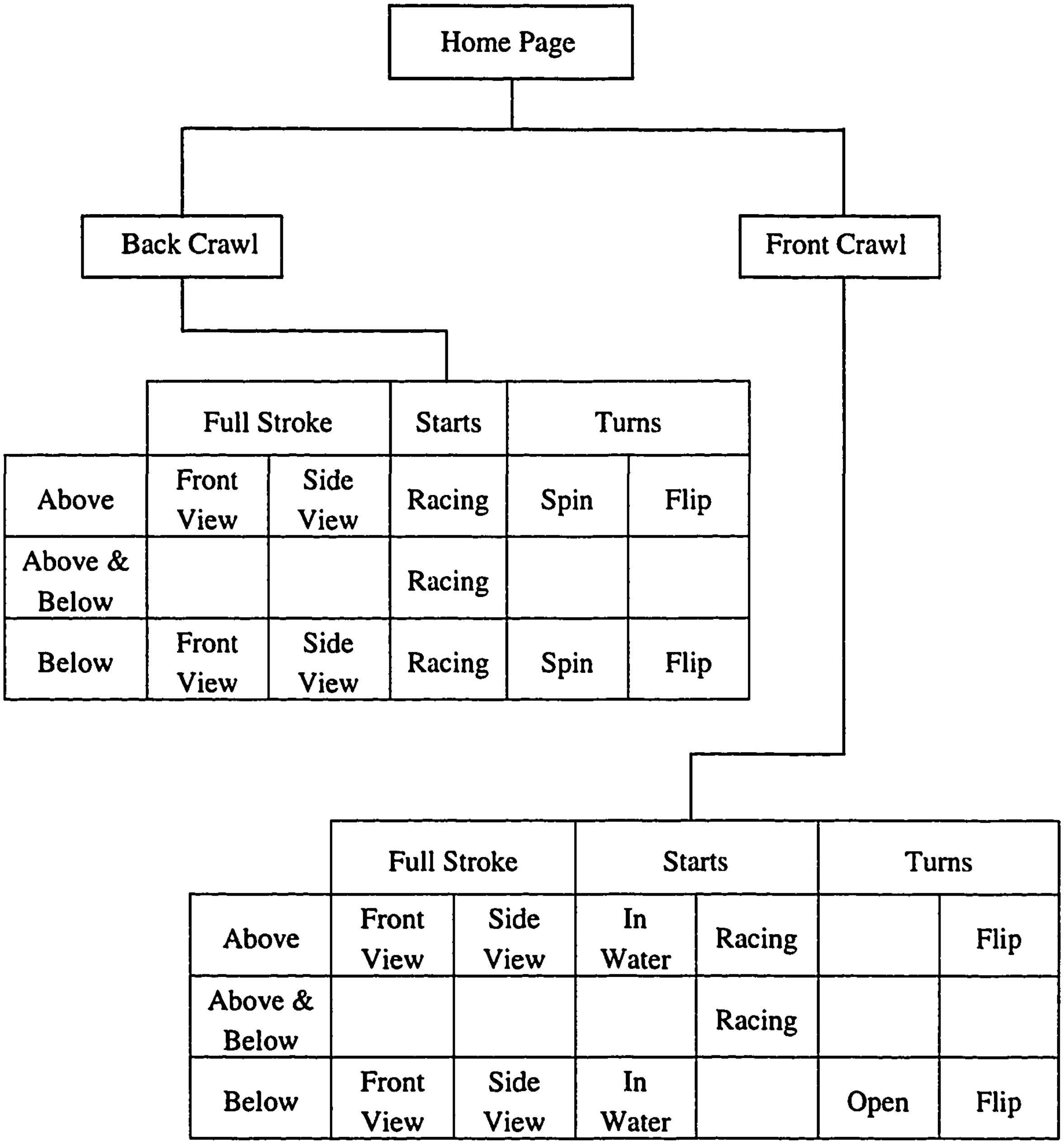

Figure 5.2. The content of the two internet sites as viewed by IEVM and IEPM.

During instruction, the instructor used the video to emphasize the critical technical requirements of the front and back crawl. Figure 5.3, on the next page, shows the screen design of the internet site viewed by IEVM. The design employed a simple layout where the video clip was placed centrally to draw the attention of the learners. The other controls on the screen for interacting with the site were designed to be easy to use. The main menu bar across the top lists the other main sections of the web site while the sub-menu bar along the bottom shows through graphics and text all the other video clips available for that specific stroke. This screen design was used consistently throughout the site to aid navigation.

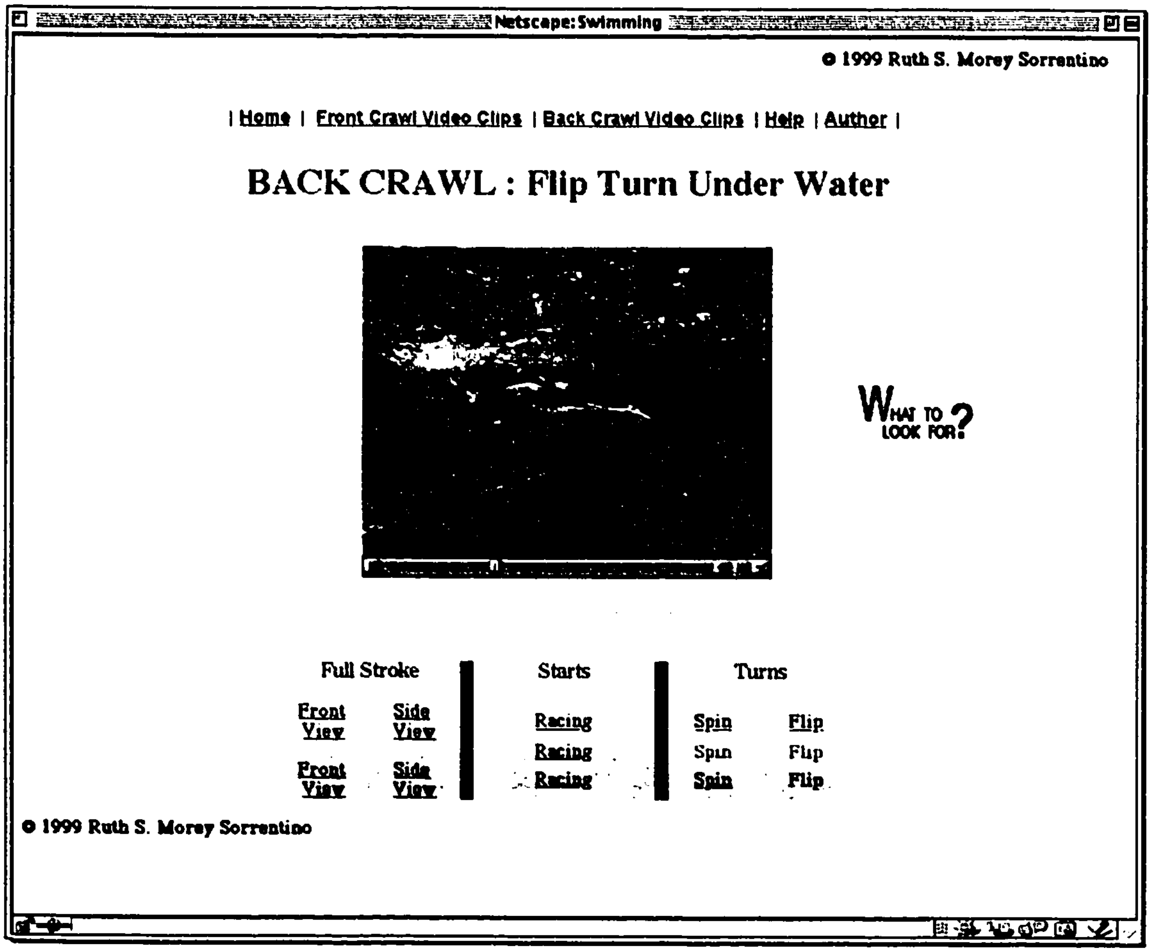

Figure 5.3. The screen layout for the simulated internet site "Swimming" viewed by the Internet Enhanced Video Model group (IEVM).

Each of the video clips on the internet site was controlled by the instructor using a hand held remote controlled mouse. This allowed the instructor to play the clips in real time but to also pause the clip and go through it frame by frame while giving instruction and highlighting specific cues.

Equipment for IEPM

The IEPM group received eight instructional sessions consistent with I CAN SWIM™ enhanced by a simulated internet site which contained the same digitized images as IEVM, except they were presented as eight progressive photographs rather than a video clip. The site was projected using the same computer and multi-media projector as for IEVM. The pool side set up was also identical to that of IEVM. Figure 5.4, contains the progressive still photographs for the back crawl full stroke from the side view, from under the water. Each photograph was selected based on the criteria of illustrating a critical cue or transition point within the stroke cycle. In order to ensure that the photographs were the same size as the images in the video clip, the photographs were displayed on two screens.

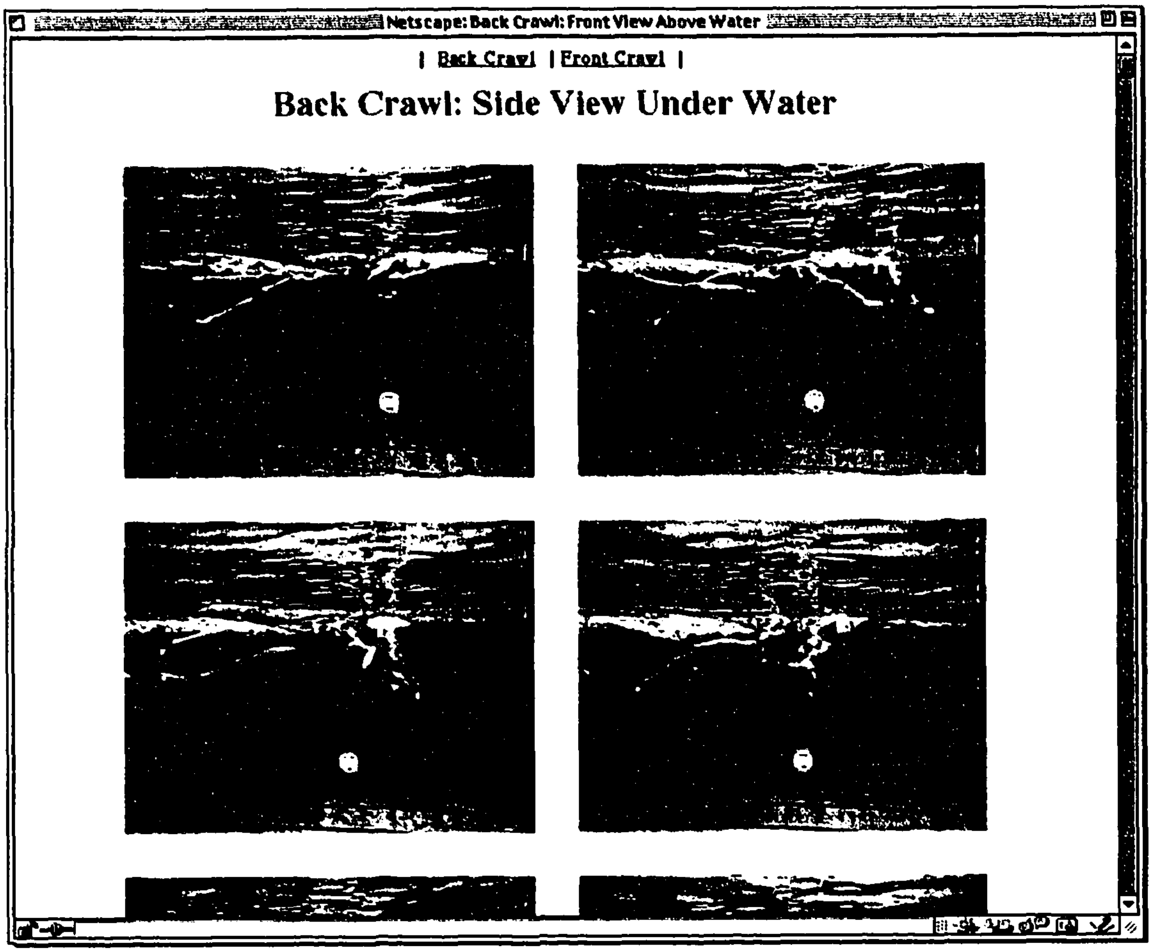

Figure 5.4a. Screen 1 of the progressive still photographs of the back crawl full stroke (side view under water) as viewed by the Internet Enhanced Photographic Model group (IEPM).

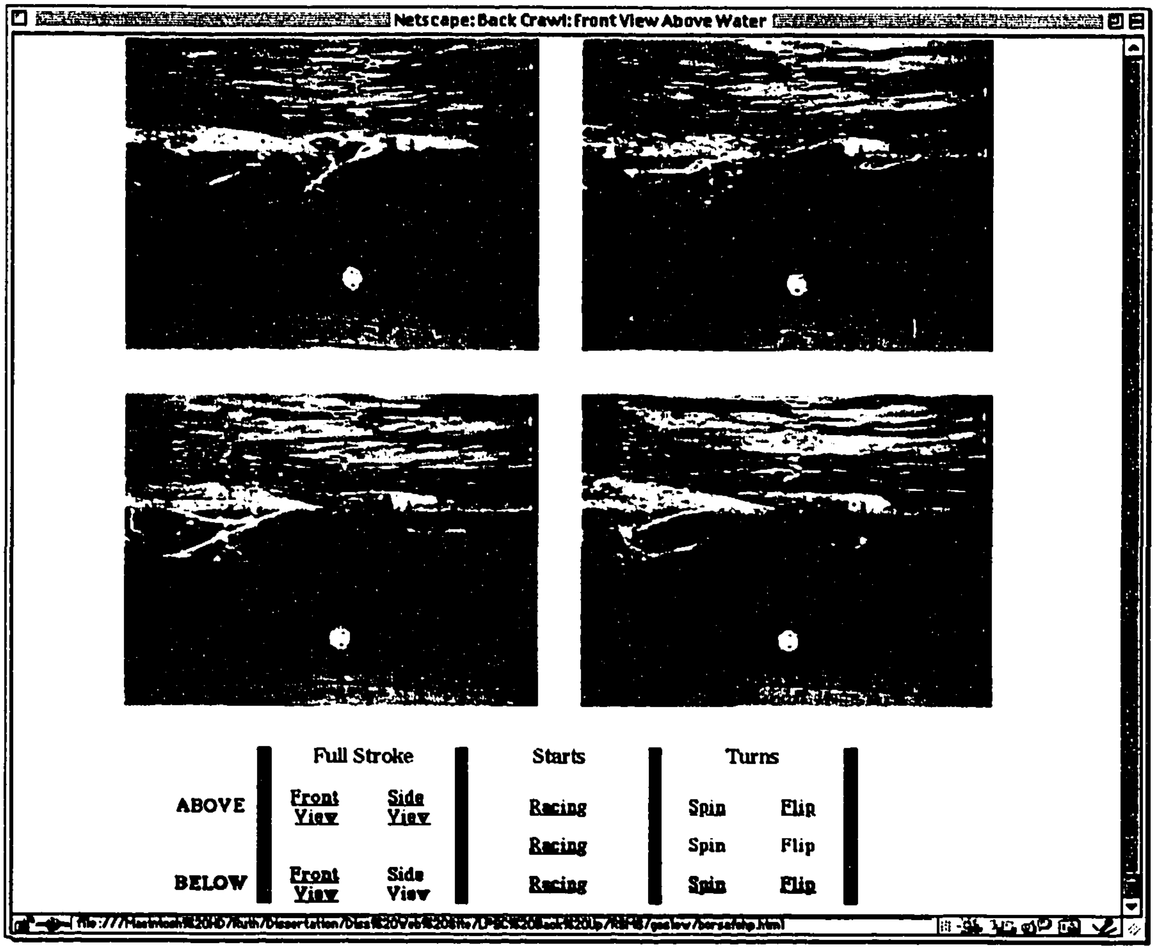

Figure 5.4b. Screen 2 of the progressive still photographs of the back crawl full stroke (side view under water) as viewed by the Internet Enhanced Photographic Model group (IEPM).

The screen design employed for the simulated internet site was kept as simple as possible with just the necessary controls to be able to move within the web site, while keeping the progressive photographs as the main focus of the design. The same main menu and sub-menu were provided and located in the same place on the screen as with the internet site for IEVM.

Equipment for C

C also received eight swimming lessons with the lesson content consistent with the I CAN SWIM™ program of swimming instruction from Swimming Canada, but without the enhancement of a simulated internet site or any form of overhead visual aids. Instead they received verbal instruction illustrated by live modeling, on pool side, from the instructor.

Instructors

All three groups received instruction from the same instructor. The instructor was a full time employee of the pool site and had 10 years of experience teaching swimming. He was also a certified I Can Swim master teacher, teacher trainer and assessor. The instructor took part in four training sessions prior to teaching the classes. During this time he practiced using the laptop, the remote control mouse and the projector to aid his teaching. Instructional sessions were continued until the instructor and the researcher felt that the instructor had reached a level of comfort and ease of use with the system. This level was maintained throughout the instructional sessions with the exception of one of the eight sessions for each group, where due to unforeseen circumstances the researcher, who is also a certified instructor, gave the instruction.

Protocol for Instructional Procedures

Instructional procedures were similar for all three groups as shown in Table 5.1. Each of the instructional sessions for IEVM, IEPM and C began with a three minute warm up. The warm up consisted of a review of what was taught in the previous lessons. During each instructional session there was a primary and secondary focus. The number of minutes allocated to each part of the class in addition to the main and secondary focuses of each class is shown in Table 5.1 below.

Table 5.1.

Instructional minutes and main and secondary focus's of each class.

Wk	Primary Focus	Secondary Focus	Primary Instruction	Primary Focus Practice	Secondary Instruction	Secondary Focus Practice	Contrast -ing Activity
1	Pre test: Written Test and Video Analysis.						
2	FC	FC Times	5 mins	12 mins	13 mins		7 mins
3	BC	BC Times	5 mins	12 mins	13 mins		7 mins
4	FC	BS	5 mins	12 mins	4 mins	9 mins	7 mins
5	BC	BF	5 mins	12 mins	4 mins	9 mins	7 mins
6	FC	BS	5 mins	12 mins	4 mins	9 mins	7 mins
7	BC	BF	5 mins	12 mins	4 mins	9 mins	7 mins
8	FC	FC Starts	5 mins	12 mins	4 mins	9 mins	7 mins
9	BC	BC Starts	5 mins	12 mins	4 mins	9 mins	7 mins
10	Post test: Written Test, Timed Swims and Video Analysis.				Synchronized Swimming		
11	FC & BC Timed Swims				Diving		
12	Transfer Test: Fun Gala including FC & BC Squadron Relays for Video Analysis						

Front crawl and back crawl were both introduced during the first two weeks of instruction. This provided a retention period of 9 weeks and 8 weeks respectively between the onset of instruction and the post test. This gave a retention period of 11 and 10 weeks respectively between the onset of instruction and the transfer test.

During practice times, the model of the stroke that the IEVM and IEPM participants were practicing was left projected onto the screen. The instructor cued the learners to look at the model while they were recovering between lengths. On some occasions the instructor assigned tasks whereby the participants would have to look at a specific element of the stroke during the break between lengths. Figure 5.5 shows a group of participants from IEPM viewing the screen showing four progressive photographs of back crawl full stroke; side view under water.

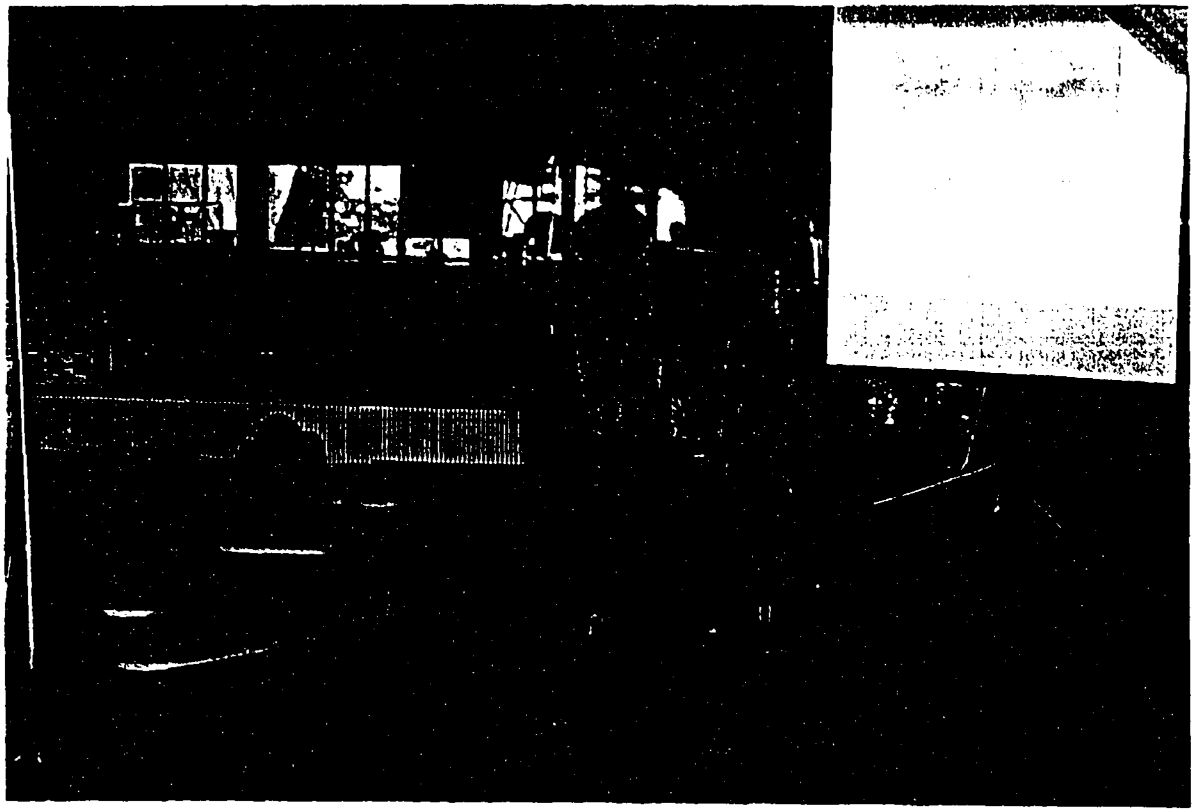

Figure 5.5. The IEPM students viewing the photographic models on the screen, while recovering from a length of back crawl legs only.

Quantitative Data Collection

Five pre-post dependent variables were measured: written knowledge of swimming (WK), back crawl speed (seconds) (BCT), front crawl speed (seconds) (FCT), back crawl stroke technique (BCST) and front crawl stroke technique (FCST). Only the latter four were tested during the transfer test.

The pre test was given one week prior to the first instructional session. The first test each participant took was the pre test written knowledge test (Appendix B), which was taken on the bleachers beside the pool. The test consisted of 10 multiple choice questions on front crawl and 10 multiple choice questions on back crawl. In addition to the multiple choice swimming knowledge questions, at pre test all participants were asked if they had had school swimming lessons before, if they had had private swimming lesson before outside of school and if they 'Strongly Agreed', 'Agreed', 'Neutral', 'Disagreed', or 'Strongly Disagreed' with the following question 'Do you enjoy going swimming?'. As each participant completed the test they came to the pool side to take the first of the swimming competency tests.

Each participant was asked to swim 25 meters of front crawl using their best technique possible. They swam in a lane adjacent to the pool side so that if they needed to hold onto the side they could. Each participant had time to rest before repeating the test swimming back crawl. Each time a participant swam they were video taped. The tapes were used to score the participants stroke technique (the procedure for this will be described later). At the first instructional lesson all participants were given an introductory lesson in swimming front crawl. The secondary focus (as shown in Table 5.1) was to time each of the participants swimming front crawl, as fast as possible, for 25 meters. At the second instructional session an introductory lesson was given in back crawl. Toward the end of the lesson each participant was timed swimming 25 meters of back crawl. No other testing was conducted during the remaining 6 weeks of instruction.

The post test was administered one week after the last instructional session and took a similar format to that of the pre test. All participants started by taking the post test written knowledge test. Like the pre test, the post test comprised of 10 different multiple choice questions on each stroke: front crawl and back crawl. In addition the post test asked each participant a number of likert questions. All participants were asked if they 'Strongly Disagreed', 'Disagreed', 'Did not Know', 'Agreed', or 'Strongly Agreed' with the following statements: 'I really enjoyed the swimming course', 'I think that my knowledge of swimming has really improved', and 'I do not think that my swimming has improved over this course'. Participants in the IEVM and IEPM were also asked to respond the statement 'I found the visual aids used by my instructor very useful'.

When each participant had completed the written test they came to the pool side to be video taped swimming their 'technically best' attempt at 25 meters of front crawl. After resting they swam 25 meters of back crawl. As with the pre test, the post test video tapes were later analysed and scored. Once each participant had completed the lengths which were video taped, they then went to a different lane where they were timed in pairs swimming 25 meters as fast as they could of front crawl. This was then repeated for back crawl. During week eleven all participants repeated the timed tests to see if they could improve on their swimming time.

The transfer test in week twelve, given two weeks after the post test, took the format of a 'Fun Gala'. Participants competed in a minimum of four races that included one front crawl squadron relay and one back crawl squadron relay. Each of the squadron relays were video taped in order to take the time of each swimmer and conduct the transfer stroke analysis. The stroke analyses was carried out by the researcher and an experienced swimming instructor and coach from the swimming pool site (a different swimming instructor to the one who taught the three groups IEVM, C and IEPM). The analysis was performed from viewing a video of each of the swimmers swimming 25 meters of front crawl and 25 meters of back crawl. The swimming instructor received training prior to the start of the study in how to use the analysis sheets (see Appendix C and D) to analyse swimming video. Both the research and the instructor practiced using the stroke analysis system to ensure their inter-analyser reliability.

Qualitative Data Collection

Data analysis of the qualitative data began on the first day and continued throughout the study and beyond (Bogden & Biklen, 1992; Creswell, 1998; Locke, 1989; Lincoln & Guba, 1985; Merriam, 1988, 1998; Rovegno, 1994). From the moment data was collected it was analysed in relation to the hypothesis, to assess qualitatively if the video group compared to the photograph group and the control group, resulted in significant improvements in the attitudes of learners and instructor towards swimming and the swimming instruction.

A sample of four participants from both experimental groups were interviewed prior to the start of the study. The same participants were then interviewed after 5 weeks and again after the last instructional session, before the post test. Participants in C were interviewed only once, after the last instructional session, before the post test. These interviews were audio taped and conducted following procedures similar to Morey (1995) and Morey and Karp (1998), in order to gain the instructor and participants perspectives on their previous experiences and attitudes towards swimming and its instruction and their experiences during the study (McBride, 1989). The interviews were semi-structured using the following open-ended questions: 1. How are you enjoying the swimming lessons? 2. Do you think the swimming lessons are helping you to improve your swimming? 3. Have you found the visuals used by your instructor to be useful in helping you improve your stroke technique? 4. What would you do to improve the swimming lessons so that you would find them more enjoyable?

Each of the instructional session were also observed by the researcher from the bleachers at the side of the pool, a location which permitted the researcher to hear the participant to participant and instructor to participant interaction, yet far enough away to not intrude on the class. Each session was also video taped to aid in the interpretation of the observations. The observations were conducted with the following purposes: 1. Did the participants appear enthusiastic about their experience of being part of the swimming class? 2. Were the interactions between the instructor and the participants positive, negative or neutral? 3. To what extent did the participants take an active role in their stroke improvement? 4. What was the nature of the interactions between the participants and the internet site? 5. What was the nature of the interactions between the instructor the internet site and the participants while they were in the water?

The interviews and observations followed procedures outlined by Creswell (1998) and Bogdan and Biklen (1992). All notes and audio tapes were transcribed and read by the researcher and coded according to the themes that evolved during the course of the study (Spradley, 1980) in addition to being analysed using NUD*IST as recommended by Creswell (1998). To ensure the trustworthiness of the themes, a second researcher schooled in qualitative methodologies also read through the transcripts. This was done in order to ensure that themes were not excluded and that the themes noted were not influenced by the researcher (Lincoln & Guba, 1985).

CHAPTER SIX

QUANTITATIVE RESULTS

Five dependent variables were analysed: back crawl stroke technique (BCTech) and front crawl stroke technique (FCTech), back crawl time (seconds) (BCTime), front crawl time (seconds) (FCTime), and written knowledge (WK). The software program SuperANOVA 1.11 (Abacus Concepts Inc., 1991) was used to calculate all statistics. The following steps were carried out in the analysis. First, inter code-recode reliability of two independent coders is reported. Second the analyses for stroke technique. Third the analyses for swimming time. Fourth the analyses for written knowledge. For each of the dependent variables the analyses of variance (ANOVA) of the difference scores are reported followed by the ANOVA for the raw scores. The fifth and final results reported are the percentage of participants in the three groups who had previously taken swimming lessons and their level of enjoyment in swimming at pre test and the percentage of participants of the C, IEPM and IEVM groups who enjoyed the swimming lessons, found the visual aids useful and perceived that their swimming and/or knowledge had improved.

Code-Recode Reliability

The correlation between the technique scores awarded by each of the coders for each test is shown in Table 6.1. The mean inter-coder reliability correlation was $r = .945$. The following table provides the individual inter-coder reliability correlation for each group for each test.

Table 6.1.

Inter-analyser reliability correlation for IEVM, IEPM and C for the front crawl and back crawl stroke technique scores.

	Front Crawl	Back Crawl
Pre Tests Technique Scores (r)		
Control Group	.966	.968
Internet Enhanced Photograph Group	.951	.980
Internet Enhanced Video Group	.958	.952
Post test Technique Scores (r)		
Control Group	.979	.942
Internet Enhanced Photograph Group	.908	.910
Internet Enhanced Video Group	.917	.962
Transfer Test Technique Scores (r)		
Control Group	.926	.909
Internet Enhanced Photograph Group	.969	.984
Internet Enhanced Video Group	.938	.893

Table 6.2 shows the means, standard deviations and significance levels for each of the five dependent variables for IEVM, IEPM and C groups at pre test, post test and transfer

Table 6.2.

The mean pre, post and transfer test scores for Technique, BCTech, FCTech, Time, BCTime, FCTime and WK.

	Group Mean Score (Standard Deviation)			Group Mean Score (Standard Deviation)			Group Mean Score (Standard Deviation)			Mean Scores		D-Scores	
	IEVM			IEPM			C			Significance		Significance	
	Pre	Post	Trans	Pre	Post	Trans	Pre	Post	Trans	F_a	P_b	F_a	P_b
Technique$_c$	126.5 (34.07)	158.71 (20.13)	162.25 (15.73)	103.71 (38.37)	150.47 (22.60)	151.09 (29.95)	146.04 (28.51)	153.67 (25.96)	164.69 (19.14)	6.68	<.0001	8.47	<.002
BCTech$_c$	55.23 (22.73)	78.82 (12.30)	81.54 (9.00)	49.75 (22.21)	76.20 (14.50)	74.27 (19.96)	67.50 (17.14)	74.00 (14.81)	82.08 (8.52)	3.90	<.01	8.49	<.002
FCTech$_c$	71.27 (18.87)	79.89 (12.85)	80.71 (9.57)	53.96 (18.46)	74.27 (13.23)	76.82 (12.67)	78.54 (13.22)	79.94 (13.72)	82.62 (12.75)	4.87	<.002		ns
Time$_d$	78.04 (18.43)	65.22 (11.37)	63.09 (8.99)	85.86 (28.36)	71.32 (16.26)	69.95 (18.64)	61.68 (12.66)	58.48 (12.2)	55.28 (7.27)		ns		ns
BCTime$_d$	42.52 (11.80)	35.07 (6.96)	34.80 (4.60)	46.67 (14.31)	39.59 (9.36)	38.68 (10.50)	33.08 (6.58)	32.85 (8.69)	29.75 (3.92)		ns		ns
FCTime$_d$	35.52 (9.26)	30.15 (6.28)	28.29 (4.88)	37.55 (14.73)	31.73 (8.17)	31.28 (8.89)	27.93 (7.23)	26.67 (6.00)	25.54 (4.20)		ns		ns
Written Knowledge$_e$	8.86 (2.83)	10.39 (2.36)		8.81 (1.76)	8.63 (3.05)		8.33 (2.85)	8.35 (3.04)			ns		ns

a Repeated measures ANOVA
b Significance level set at p<.05
c Scores as determined from video analysis. A high score represents a better technique.
d Time (sec) over 25 metres.
e Multiple choice knowledge tests (Different questions pre to post).

Stroke Technique

Improvements in stroke technique are reported for total stroke technique, back crawl and front crawl. Total stroke technique was calculated by taking the sum of the technique scores for both front crawl and back crawl. Difference scores (d-scores) were then calculated, pre to post test and post to transfer test, for the total technique scores, back crawl technique and front crawl technique. A two way repeated measures ANOVA was performed on the two sets of difference scores.

A significant interaction was found between the three groups $F(2, 40) = 8.474$, $p = .0012$ for total technique. Figure 6.1 illustrates that C improved by a mean score of 7.63 from pre to post compared to IEPM and IEVM who both showed a large improvement in stroke technique 46.76 and 32.21 respectively. During the transfer test C performed better than either IEVM or IEPM who each showed a small improvement on their post test scores.

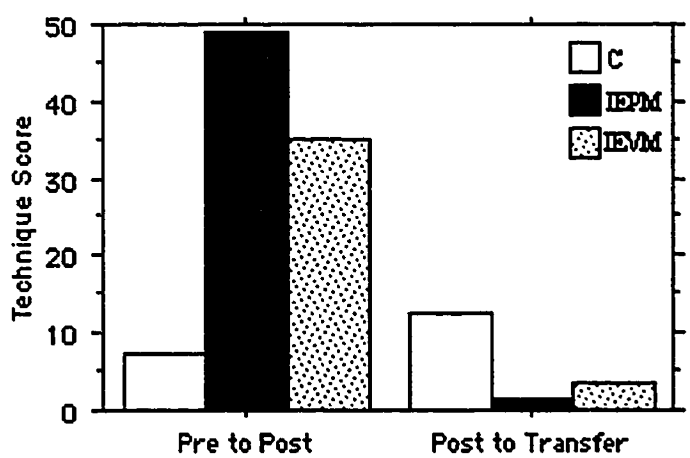

Figure 6.1. Mean difference scores, pre to post and post to transfer for total stroke technique for IEVM, IEPM and C.

A two way repeated measures ANOVA was run on the raw scores for total technique. This too found a significant interaction effect between the three groups $F(2,44) = 6.679, p < .0001$. Figure 6.2 highlights the initial differences between the groups and the large improvement made by IEPM and IEVM who made total gains of 47.38 and 35.75 compared to C who's mean gain was only 18.65.

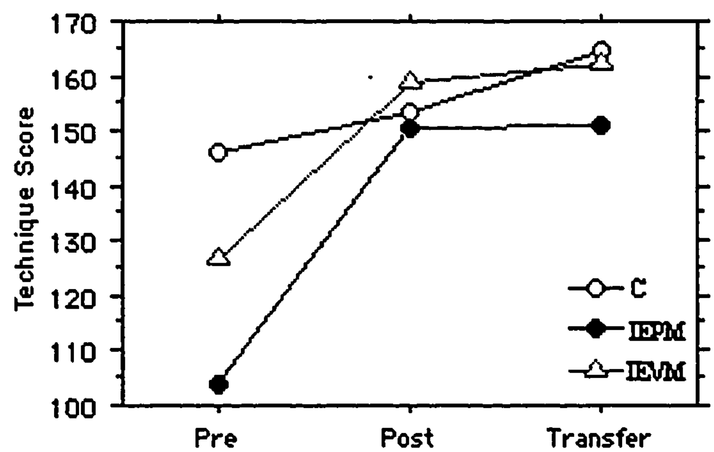

Figure 6.2. Group interaction effect for pre, post and transfer tests for total stroke technique.

In order to control for the initial groups differences found at pre test, although the groups were not found to be significantly different, an analysis of covariance (ANCOVA) was conducted on the pre to post test stroke technique scores and the post to transfer technique scores. However, none of the analyses yielded any significant group interaction effects.

Back Crawl Technique

A two way repeated measures ANOVA performed on the d-scores yielded a significant interaction effect between the three groups $F(2,40) = 8.491, p = .0012$. Figure 6.3 shows that C showed only a small improvement from pre to post of 6.5 compared to IEPM and IEVM that both showed larger improvements of 26.45 and 23.59 respectively.

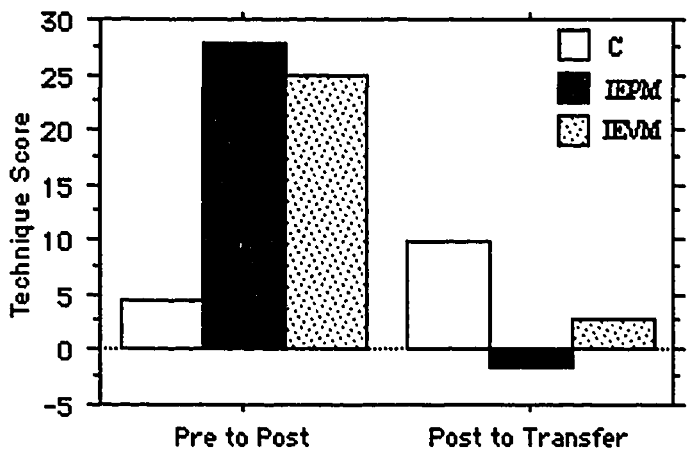

Figure 6.3. Mean difference scores, pre to post and post to transfer for back crawl stroke technique for IEVM, IEPM and C.

A two way repeated measures ANOVA calculated for the raw back crawl technique scores yielded a significant interaction effect between the three groups $F(2,44) = 3.899, p = .0064$. Figure 6.4 highlights the initial differences between the groups and the larger overall improvements made by IEPM and IEVM of 24.52 and 26.31 respectively compared to 14.85 for C.

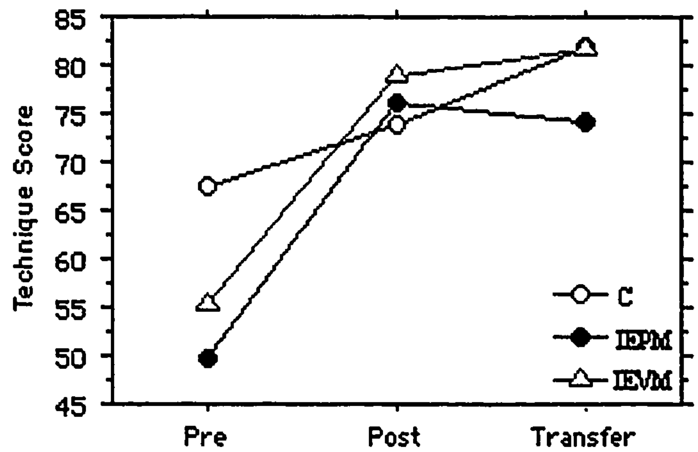

Figure 6.4. Group interaction effect for pre, post and transfer tests for back crawl stroke technique.

Front Crawl Technique

A two way repeated measures ANOVA performed on the difference scores failed to find any significant differences between the three groups for front crawl technique. However, Figure 6.5 shows that a similar pattern was found to back crawl technique and total technique, with the difference being that IEPM had a larger increase in technique score of 20.67 compared to IEVM who gained 8.6 and C who gained the smallest amount of 1.4.

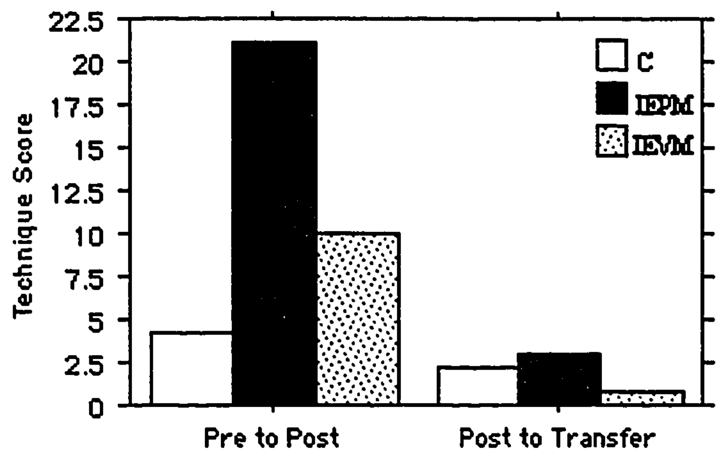

Figure 6.5. Mean difference scores, pre to post and post to transfer for front crawl stroke technique for IEVM, IEPM and C.

As with back crawl technique and total technique a two way repeated measures ANOVA was also run on the raw scores for front crawl technique. Unlike for the difference scores this found a significant interaction effect between the three groups $F(2,44) = 4.868$, $p = .0016$. Figure 6.6 shows the mean group technique scores for all three groups and all three tests.

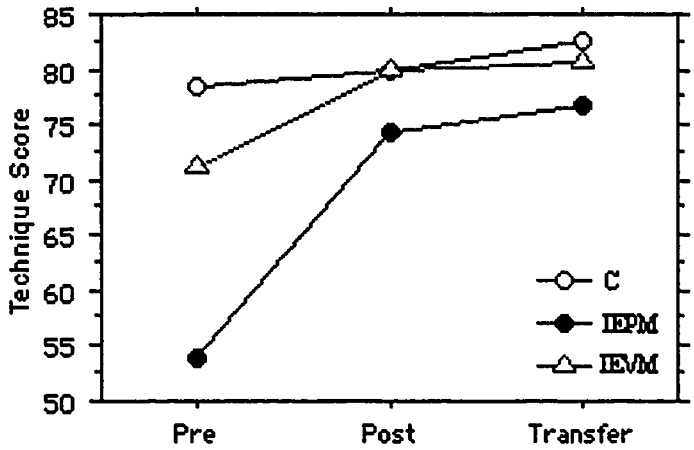

Figure 6.6. Group interaction effect for pre, post and transfer tests for front crawl stroke technique.

The figure shows that from pre test right through to transfer that C only made a small gain in front crawl technique compared to both IEVM and IEPM who demonstrate much larger gains in their front crawl technique. At transfer both IEVM and IEPM continue to show a small improvement, where C showed a slightly better improvement.

Swimming Time

Improvements in swimming time are reported for total time, back crawl and front crawl. Total time was calculated by taking the sum of the time over 25 metres for both front crawl and back crawl. D-scores were then calculated, pre to post test and post to transfer test, for the total time, back crawl time, and front crawl time. A two way repeated measures ANOVA was performed on the two sets of difference scores but failed to indicate any significant interaction between the three groups. However, it can been seen that as with the technique scores that both the IEVM and IEPM showed greater improvements from pre to post compared to C who demonstrated only a small improvement.

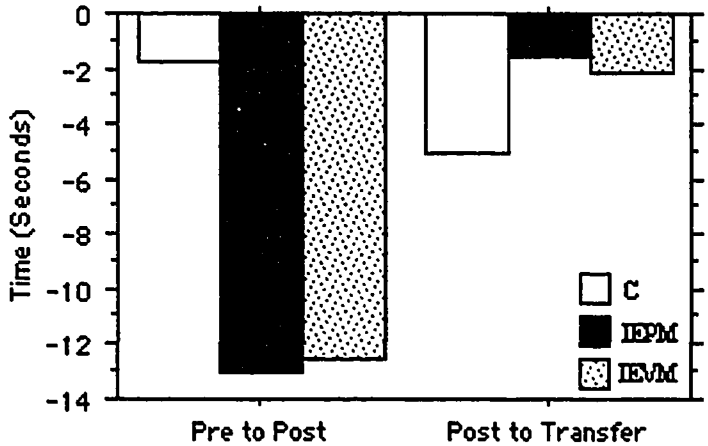

Figure 6.7. Mean difference scores, pre to post and post to transfer for total time for IEVM, IEPM and C.

A two way repeated measures ANOVA of the raw time scores also failed to find any significant interaction between the three groups.

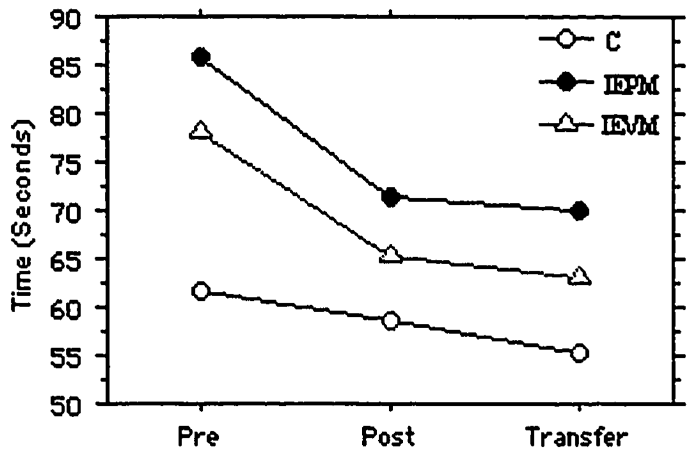

Figure 6.8. Group interaction effect for pre, post and transfer tests for total time (seconds).

Back Crawl Time

As with total time, the two way repeated measures ANOVA of the d-scores did not indicate any significant differences between the groups.

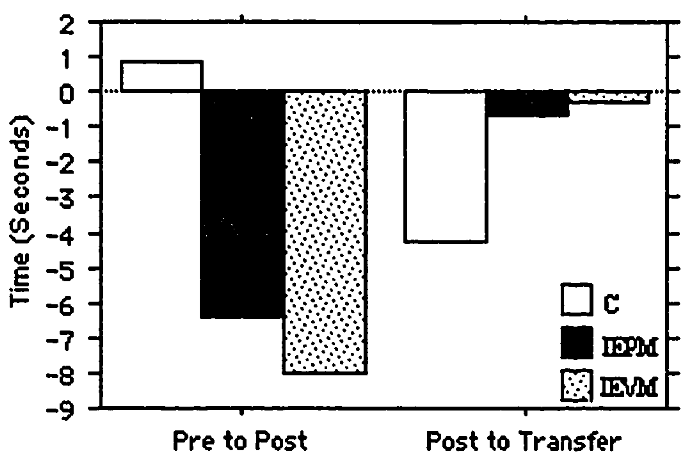

Figure 6.9. Mean difference scores, pre to post and post to transfer for back crawl time for IEVM, IEPM and C.

A significant group interaction was also not found when a two way repeated measure ANOVA was conducted on the raw times for back crawl technique.

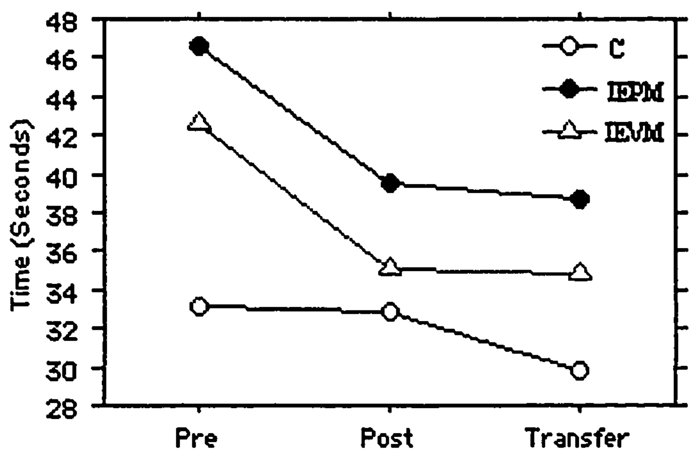

Figure 6.10. Group interaction effect for pre, post and transfer tests for back crawl time (seconds).

Front Crawl Time

As with back crawl time two way repeated measure ANOVA's of the d-scores and the raw times for front crawl time did not yield any significant interaction between the three groups.

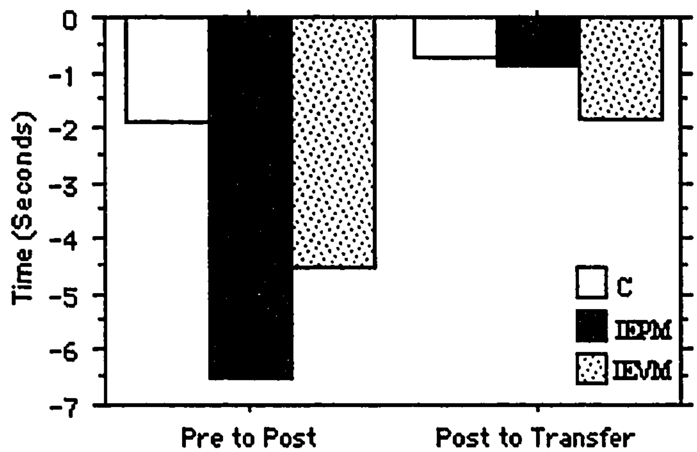

Figure 6.11. Mean difference scores, pre to post and post to transfer for front crawl time for IEVM, IEPM and C.

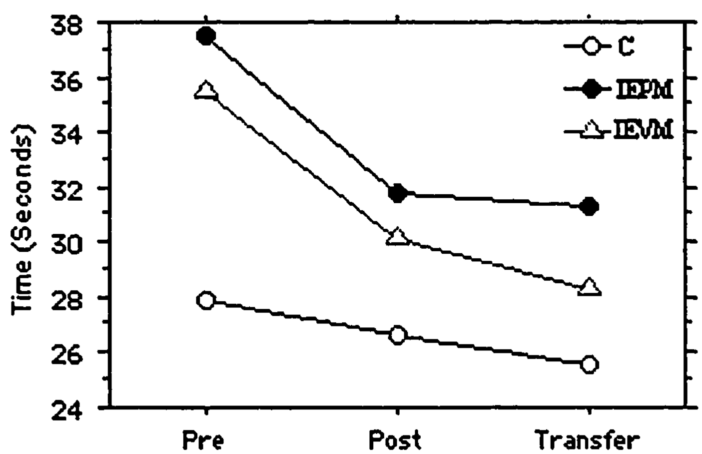

Figure 6.12. Group interaction effect for pre, post and transfer tests for front crawl time (seconds).

<u>Written Knowledge</u>

Figure 6.13 illustrates the pre and post written knowledge test results for each group. The results show that the written knowledge for both C and IEPM remained almost

unchanged. However, although IEVM appears to show an improvement from pre to post on the written knowledge test an analysis of variance conducted between the three groups was not found to be significant.

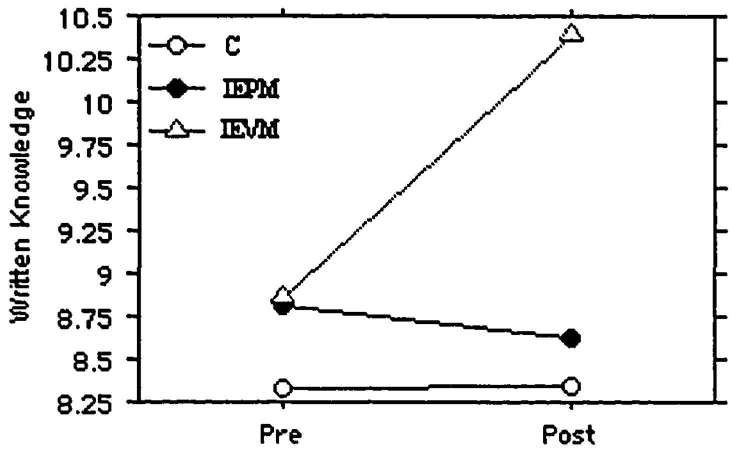

Figure 6.13. Written knowledge group interaction effect from pre to post test for IEVM, IEPM and C.

Written Test: Attitude Questions

In addition to the knowledge questions on the written tests Likert questions pertaining to the participants' attitudes towards swimming and the instruction were given. Table 6.3 provides a summary of the results of the pre test written knowledge test for each group.

Table 6.3.

The percentage of participants of the C, IEPM and IEVM groups who had previously taken swimming lessons and their level of enjoyment in swimming at pre test.

	C			IEPM			IEVM		
	Yes	or	No	Yes	or	No	Yes	or	No
Previous swimming lessons (%)	100		---	93.75		6.25	78.57		21.43
School swimming lessons (%)	100		---	46.67		53.33	42.90		57.10
Other swimming lessons (%)	50		50	81.25		18.75	64.30		35.70
	A	N	D	A	N	D	A	N	D
Enjoy going swimming (%)	94	6	---	85	15	---	86	14	---

A = Agree, N = Neutral, D = Disagree

These results show that at pre test the written knowledge for front crawl and back crawl is very similar across all three groups. The results also show that the majority of each group had received some form of school swimming lessons prior to the start of this study and that almost half of the participants in each group had also received swimming lessons out side of school. When asked if they enjoyed going swimming, the majority of participants answered either Strongly agree or agree, with only a relatively small percentage in each group who were neutral about going swimming. None of the participants stated that they disagreed, and did not like going swimming.

At post test, after each group had received 8 instructional sessions, another written knowledge test was given. Table 6.4 provides a summary of the results for the attitude questions.

Table 6.4.

The percentage of participants of the C, IEPM and IEVM groups who enjoyed the swimming lessons, found the visual aids useful and perceived that their swimming and/or knowledge had improved.

	C			IEPM			IEVM		
	A	N	D	A	N	D	A	N	D
Enjoyed the swimming course (%)	73	9	18	100	---	---	100	---	---
Thought knowledge had improved (%)	64	9	27	75	6	19	92	---	8
Found Visual aids very useful (%)	---	---	---	75	19	6	67	17	17
Did not think swimming had improved (%)	73	9	18	25	25	50	8	25	67

A = Agree, N = Neutral, D = Disagree

In terms of assessing the participants' attitudes towards the visual aids used, slightly more participants in IEPM (75%) found the visual aids useful compared to IEVM (67%). In terms of their enjoyment of the course, all of the participants in both IEVM and IEPM either strongly agreed or agreed that they had enjoyed the course compared to only 73% of C.

In terms of perceived swimming improvement the majority of IEVM (67%) disagreed with the statement that they 'Did not think their swimming has improved', compared to 50% for IEPM and only 18% for C. Almost three-quarters (73%) of C stated that they did not think their swimming had improved. This is in stark contrast to the other two groups where for IEPM 25% thought they had not improved and only 8% of IEVM thought that they had not improved. When asked if they felt their knowledge had improved 92% of the IEVM stated that they thought their swimming knowledge had improved over the instructional period compared to 75% of IEPM and only 64% of C.

Attendance

Attendance was taken at each instructional session. IEVM had the best attendance record with a mean attendance of 14.25 participants per instructional session out of a total of 15. The mean attendance for IEPM was 13.38 participants per instructional session out of a total of 16 and the mean attendance for C was 13.13 participants per instructional session out of 16.

CHAPTER SEVEN

QUALITATIVE RESULTS

The following chapter will present the qualitative data for each of the three groups. Each group (IEVM, IEPM, C) will be presented as an individual case (Creswell, 1998). The case of the instructor will be presented last. All names used in the following presentation of results are pseudonyms and not the real names of the individuals interviewed.

The Internet Enhanced Video Model Group (IEVM)

IEVM were a very friendly and lively group. They had the best attendance of all of the three groups and always seemed enthusiastic about being at the pool site for their swimming lessons. If they arrived early they would always ask "can we get in yet, can we get in yet". The majority of the class once in the water would pay attention and listen to the instruction, but there were a few who were more into playing around and ducking under the water. They seemed to pay more attention when the instructor spoke to them at the end of the pool where the internet site was projected.

Attitude Towards Swimming

Prior to the beginning of the study all of the sample of participants interviewed were looking forward to going swimming. All of them had been swimming before and three (James, Alison, Rodney) had had school swimming lessons with their elementary school. Alison and Rodney had also had private swimming lessons. Only one of the participants, Shelley, said that she had never received any form of swimming instruction, she said she had taught herself. None of the participants said that they went swimming regularly, or had ever been a member of a swimming club. They were recreational swimmers who mostly went swimming while on vacation or during the summer. When asked about the importance of being able to swim, they all agreed that it was important to be able to swim so that if you ever fell into the water you would be able to save yourself and possibly even be able to help someone else.

Attitude Towards the Classes and Instruction

Half way through the eight weeks of instruction when the second interview was conducted all participants stated that they were enjoying the classes. They all commented that they found the lessons hard work, although James, Alison and Rodney, said they did not mind having to work hard, they still found the lessons enjoyable. The other participant Shelley blamed the instructor for working them hard "he's so mean" (Shelley, Second

Interview). Shelley was the only participant of the four interviewed who stated that since starting the lessons she did not enjoy swimming as much as she did before, because of the instructor and because she found it so tiring. She also commented that the instructor yelled at them. None of the other participants seemed to have the same impression of the instructor, although Alison felt that he sometimes expected too much from them, too much perfection. Shelley was the only one of the participants who had not taken any swimming lessons before.

James commented that the lessons were tiring but explained that he just needed to get stronger, "my arms are really weak in swimming, I can't swim that far" (James, Second Interview). Although they were tiring, James felt that he had improved since the beginning of the classes. Rodney felt that he was "getting more used to the water" (Rodney, Second Interview) and that he enjoyed going swimming now, more than before the beginning of the lessons. Alison said that the thing she most liked about the swimming lessons was that she was learning how to do new things.

After the last instructional sessions, each participant was asked to rate the lessons out of ten, with ten being 'awesome' and one being 'really bad'. Rodney gave the lessons the highest rating of an 8, Alison gave them between a 7 or 8, James between a 6 or 7, and Shelley 'around a 6'. Only Shelley spoke negatively of the lessons. She referred to the instructor as "that guy" and commented further that he was mean. Shelley said that the lessons were repetitive, and that they were "always learning the exact same thing. Then we have to practice and then we rest and it's cold" (Shelley, Third Interview). The other three participants all noted that the lessons were still hard work, but that they found the work challenging. When asked about their perceived improvement Rodney responded very enthusiastically "Yes, OOH, Yes" (Rodney, Third Interview). Alison also agreed that she thought she had improved. She said that when she went swimming at a pool near her house she found swimming a lot easier and said "I was doing things that I didn't think I could do" (Alison, Third Interview).

The Internet Site

The overall initial reaction to the internet site used as overheads was "it's cool". Alison in her second interview described how "it looked kind of neat, I don't know, I guess it was different from everything else". Although all of the participants said that they had seen overheads in some classes, they had never really seen anything like the ones from the computer or in a swimming lesson. Alison, James and Shelley said that the underwater views shown on the internet site were not new to them. They had all seen people swimming from under the water before though, either a video tape, physically going under the water to look at friends or from looking through an underwater window during a swimming lesson.

By the end of the instructional sessions, there were mixed reactions as to the usefulness of the internet site. Rodney said that they helped him to understand what to do and if he had a choice between lessons with the internet and lessons without, he would choose the lesson with "because it's easier....because you don't have to have someone explaining it to you, you can see it for yourself" (Rodney, Third Interview). James agreed that he found that the overheads helped him to know what to do, he continued that "the person on the overhead is like a good example" (James, Second Interview) and that it was easy to see what they were doing. He said that he would choose lessons with the internet if he had a choice because "it's better just to be able to see what your going for, what your trying to do" (James, Third Interview). Like Rodney, James also said that he would choose lesson with the internet if he had a choice.

Alison and Shelley however were not as positive about the use of the internet based overheads. Shelley said that the video was too small to see properly. She would have preferred it if the instructor had got into the water, or even if he had just told them what he wanted to do rather than "just pointing at this little thing on the screen and you can't know what to do" (Shelley, Third Interview). Shelley believed that if the instructor had got into the water then it would have been easier to view the skill he was showing them. She felt that she would have been able to see the skill from more angles than from the angles shown to them on the screen. Alison was more positive than Shelley, she stated that "it gives me a demonstration, that way I know what it looks like....you look at it and think, OK, I can try and do it like that" (Alison, Third Interview). However, Alison was not sure that if she had a choice of lesson with the internet and lesson without that she would choose the lesson with the internet. "Even if you do it with the internet you still have to show the kids everything to do anyway, well like sometimes you won't have to, but, so your going to have to show them how to do it" (Alison, Seconds Interview). Alison also explained how she felt that the instructor expected her to be able to do the skill exactly like the people in the video clips. "I mean they can do it a whole lot better than you can because they have been doing it half their life... but when your watching someone else doing it you want to get yourself to go like that, it's really confusing" (Alison Third Interview). She would have preferred it if he had just shown them how to do it instead of using the internet site.

The Internet Enhanced Photograph Model Group (IEPM)

IEPM was a fairly quiet group of participants. A small group of the participants were very enthusiastic about going swimming and were always out on pool side first, but there were others, mostly girls, who were not so eager and enthusiastic about getting into the water. Once in the water the group was very well behaved. There was the usual horse play but when the instructor spoke to them and gave them instruction they were generally quiet and attentive. The instructor rarely had to stop to wait for students to stop chatting or playing around.

Attitude Towards Swimming

All of the four participants interviewed were positive about going swimming prior to the start of the study and all expressed that they were looking forward to the swimming lessons. Three of the four (Campbell, Jenna, Stewart) had had school swimming lessons before at elementary school, two (Jenna, Campbell) had also had private swimming lesson. Only one of the participants (Cindy) had never had any formal swimming lessons with the school or outside of school but she had been swimming before. None of the participants said that they currently went swimming very often. They were all recreational swimmers who went swimming on vacation or during the summer or occasionally at weekends. In fact Jenna who had only just given up going to private swimming lessons commented that she preferred being around people and found that "swimming is kind of solitary" (Jenna, First Interview). All of the participants' thought that it was important to be able to swim so that you would be able to save yourself if you fell into water and even save someone else.

The participants appeared to maintain their positive attitude towards swimming as the lessons progressed. Only one participant, Jenna, said that she was finding the swimming boring, which was reflected in her attendance. Although she came and watched she did not actually swim for the last four instructional sessions or either of the three weeks of swimming after completion of the instructional sessions.

Attitude Towards the Classes and Instruction

All of the participants stated that they were enjoying the swimming lessons. Campbell said that they were sort of hard work but also fun at the same time. By the end of the eight instructional sessions Campbell felt that they were a little repetitive, he said that that they tended to do a lot of the same drills over and over. When asked how he thought the lessons could be improved, he said that it could have been made a little more fun by adding some competition. Generally though he felt that his strokes had improved over the course, and he stated that he had enjoyed them. Cindy and Stewart, who had not had private swimming lessons before felt that they had improved a lot. Stewart commented that the lessons were very challenging for him and that they were definitely hard rather than easy. Only Jenna felt that she had not improved very much, she contributed this to the fact that she had been taking swimming lessons, until recently, since she was three. Unlike any of the others, as previously mentioned, Jenna had also missed quite a few of the instructional sessions. Although Jenna did not feel she had improved she did state that the lessons were not easy, she felt that she still had to work when she was there. Like Campbell, Jenna felt that some of the drills that they were given were somewhat repetitive.

At the interview conducted after the last instructional session, as with the participants interviewed from IEVM each participant was asked to rate the lessons out of ten, with ten being 'awesome' and one being 'really bad'. The participants as a whole gave the lessons a good rating. Jenna gave the lesson an eight, Stewart an eight and Cindy gave them a nine. Unfortunately Campbell's reply was muffled on the tape. When asked what they would suggest to improve the classes Jenna said that she wouldn't do anything, they were fine as they were, although for her personally it would be better if they could be made more challenging. Cindy said that she would like to see more games, but noted that the instruction part was really enjoyable. As previously mentioned Campbell would have liked to have had more competition whereas Stewart said that he would have liked the instructor to get into the water with them and show them "the technique and stuff" (Stewart, Third Interview).

The Internet Site

In general all of the participants were very positive about the use of the internet site. As with the IEVM their first reaction to the overheads was that they were "pretty cool". Stewart stated "it helps because he shows us like the pictures of how to do it, like underwater how it should be, it makes it easier for us instead of explaining it to us" (Stewart, Second Interview). Cindy said that they did not have too much of an impact on her but that, they did give her "an idea of how to, the position to be in and stuff" (Cindy, Second Interview). Campbell who had had private and school swimming lessons before thought that the use of the internet site was "nice because you can see what they are doing, because normally the instructors don't go into the water, this way you can see what you're supposed to do". He went on to say that seeing the internet site "makes it easier to swim because you know what to do" (Campbell, Second Interview).

Jenna was not as positive about the overheads as the three others. She said that they were sometimes useful but that other times they were not useful because they were hard to see. "They are blurry, well not really blurry, but it's not really clear....well like in back crawl, like he's telling us to bring our shoulder out of the water, and I can't tell the difference between their shoulder and the rest of their body, because it's kind of small" (Jenna, Second Interview).

When asked if they would choose lessons with the internet site or lessons without all of the four participants stated that they would choose the lessons with the internet. Stewart replied" I would say the slides (internet site) because it shows under the pool like the side view and...you then know how to actually do it. (Stewart, Second Interview). Campbell also agreed that he would choose the swimming lessons that had the overheads. He said "normally people just tell you, that way (with the overheads) you see what you're supposed to do not just being told" (Campbell, Third Interview). Although Jenna had expressed finding the pictures hard to see she did say that she would choose the lessons with the slides rather than ones without. When asked why she replied "because they're pretty".

The Control Group (C)

C was a lively group, they always had a lot to say. When they came to class they were always very enthusiastic and were always asking can we get in yet, can we get in yet. Once in the water they were also quite chatty and would play around quite a lot. About half of the group were quite attentive and would listen to the instructor when he gave them instruction, but there were a few who found it harder to pay attention and focus on the instruction. They seemed to be more interested in bobbing up and down in the water and diving than on the instruction. The instructor often had to wait for the students to stop talking and playing around in the water.

Attitude Towards Swimming

All of the participants interviewed had received swimming lessons while at elementary school. One student, Jane, had also had private swimming lessons, she had stopped them about 5 years ago, but she still considered swimming to be her favourite sport. Karen was quite neutral about swimming, to her it was 'OK' but it was not her favourite sport; her favourite was soccer. Both Jared and Todd were very positive about swimming and said that they enjoyed it. Todd said he had not been swimming for quite a while prior to the swimming lessons, but Jared said that went swimming "not too often, maybe twice a month or something" (Jared, First Interview).

Attitude Towards the Classes and Instruction

Three of the students (Karen, Todd, Jared) said that they had enjoyed the swimming lessons. Karen was the least positive about them. She had been very unsure about taking the classes in the first place and often looked uncomfortable and self-conscious while in the lessons. Karen said that she sometimes found the lessons hard and was quite neutral when it came to whether she has enjoyed them. In the interview when asked if she had enjoyed them she replied "Um, I guess so, but um I don't know" (Karen, First Interview). She said she would have preferred to have been playing soccer, which she was quite enthusiastic about.

Jared and Jane both said that the classes were quite easy for them and they felt that they had only improved a little bit. Jane said although they were quite easy she was sometimes challenged by them, but found them more tiring than hard work. She said that the lessons that she had had with her elementary school had been much easier. Compared to other swimming lessons that Jared had had, he said that, "these ones have had more instruction to them, more orderly" (Jared, First Interview). Todd expressed that he was really enjoying the swimming lessons. He thought these lessons were much better than the lessons that he had had before. Todd commented that he would not say they were challenging but was very enthusiastic about them and felt that he had made lots of improvement. "I think I have improved a lot as I never, like knew how to swim backwards I always went down to the bottom, now it is easy for me" (Todd, First Interview). When asked if they would make any changes to the lessons both Todd and Jane said that and that was nothing that they would change to make the lesson any better. When asked to rate the swimming lessons from ten to one. Karen gave them the lowest score of 5, Jane gave them a 9 and Jared gave the swimming lessons "an eight and a half to a nine" (Jared, First Interview). Jared also thought that since he had been going swimming regularly for the swimming classes he would probably continue to go swimming more often.

The Instructor

The instructor, Keith, was very positive about the whole experience of being the instructor for the study. He said that he really enjoyed teaching all of the classes and found the internet sites very easy to use and a very useful teaching aid. He explained "I find that a lot of the stuff that we've been using really useful in teaching, like even though I know some of the kids weren't paying attention to it, for those that were I think it was fairly helpful in like...instead of me having to explain it I could just show it, it is a big help for me.... I think you can show them exactly where the hand position in the water for front crawl and when you talk about rubbing your arms against your ears in the back crawl you can actually show it, instead of having to get into the water, and then you don't get to see your class the entire time" (Keith, Second Interview).

When asked about the two different internet sites that he used Keith responded that he found the two " very comparable....in the video I have tended to play it section by section, you play it overall and then slow it down so that I can pin point the exact moment that I want, with the slides (photographs) it is comparable, but not as good as it does not have every single second of the video so you can't pin point certain areas but it does have very good, you know better than nothing, it definitely has sections that you can use" (Keith, Second Interview).

When asked about the three groups Keith felt that they were a diverse group of participants. Within each group he noted that there were participants that he really liked and participants that he did not like as much, but that he believed he treated them the same. "I have tended to be very patient with them and not discipline a lot because I've been wanting to be consistent" (Keith, Second Interview). At the first interview, Keith had commented that IEVM was probably his favourite group, with IEPM next who tended to be quite quiet and C being last because they did not listen to him as much as the other groups; it was harder to get them to pay attention to what he was teaching them. Elaborating further on C, he said that it was really just a couple of participants though and not the whole group. The researcher felt that the instructor did a very good job at treating all of the three groups the same. He showed a lot of patience with all of the participants especially when they were chatting and playing around.

When asked about differences between the groups and their performance levels he commented "at first I thought they were drastic. I really thought that one group was way better than the others and that was just from the first day...but now as I am teaching them, they are very much the same as far as ability, you have some kids who are you know right on top, some kids who are mediocre and some kids that are just learning the basics…every group has that right now" (Keith, Second Interview).

With regard to the two experimental groups, Keith was asked if he saw any differences in their attitudes towards the use of the internet sites. "It's hard to say because I think that…at first they are like 'Oh, that's cool' and they really looked at it, but then afterwards, I didn't see so much 'Oh lets look at the screen; and you start to see less and less of the kids actually kind of looking at the screen then mimicking the movements" (Keith, Second Interview). Keith was asked if he thought that having a wider variety of video clips might help to prevent this 'dropping off' of enthusiasm in the internet sites. "I actually think it might have made a bit of a difference because they get to see different perspectives of the stroke and it's not just one, if we had more than one person, I know we have two now but if we had four or five, because everyone's technique is going to be different right, even though it's going to be the same overall there's going to be slight modifications just due to their body proportions and all that sort of thing, so maybe by having different people that might have helped out" (Keith, Second Interview).

The researcher noticed that in addition to using the video clips or the progressive photographs the instructor still had to model the drills himself. They asked Keith what he would think about having video clips of different drills incorporated into the internet sites. "It definitely would have helped to explain what you're trying to accomplish by doing the drill, so the kids could see it. I don't know how feasible it would be as an instructor to have to go through and look for the drill and pull it up" (Keith, Second Interview).

CHAPTER EIGHT

DISCUSSION AND CONCLUSIONS

This thesis was conducted to assess the effectiveness of two different forms of internet enhanced instruction compared to traditional swimming instruction. All attempts were made to select three similar schools that were then randomly assigned to the three different groups. Although these measures were taken, non-significant group differences were observed at pre test. Unfortunately, it was not feasible to randomly assign individual students to the three groups, as it was felt necessary to keep the three groups as separate as possible to prevent student comparison of their instruction and a possible Hawthorne effect. The inability to randomly assign individual students to the three groups is a limitation of this study. Had more schools been involved in the study with larger numbers of participants the group differences may not have been as great. However, this study is one of the first to examine the effectiveness of internet enhanced motor skill instruction in an applied setting and although not generalizable to all grade seven, eight and nine students, it does provide a great deal of insight into how the internet can be used to enhance motor skill instruction.

Stroke Technique

Prior to the start of study two it was hypothesised that the two experimental groups, who received internet enhanced instruction, would make significantly greater improvements in stroke technique than the control group. This hypothesis was upheld for swimming technique, for both the front crawl and back crawl. The quantitative results presented for stroke technique each followed a similar pattern, as highlighted in the Figures 6.1 to 6.6. In all cases, from pre to post, IEPM showed the largest improvement between pre test and post test indicating the largest increases in performance. IEVM showed a large improvement in performance although slightly less than IEPM, and C only a relatively small improvement from their pre test score.

From post test to transfer, however, a different pattern emerged. In all cases C showed the greatest gain in performance. This gain was not considerable, but it did indicate that the transfer conditions were more favourable to C compared to the other two groups. Both IEVM and IEPM tended to show only small improvements in their stroke technique under the transfer conditions. In fact, IEPM showed a slight decrease for back crawl technique. The overall pattern at transfer was that all groups maintained their post test performance and in all but one case they actually showed improvement. This was an interesting finding as it was expected that the participants' performance would decline at transfer, due to the added anxiety and pressure of a competitive situation. This indicated that all the participants improvements gained, as a result of the instruction, were relatively permanent (Schmidt & Lee, 1999). If the post test results had not been maintained, then their performance at transfer would have shown a substantial deterioration (Schmidt & Lee).

As noted earlier, the transfer conditions appeared to be more favourable to C. This may have been due to the fact that C were more skilled at the beginning of the study, an unexpected occurrence as described at the beginning of this chapter. This appeared to be coincidental as there was nothing in the background of the C, as identified in this study (see Table 6.3), that accounted for their higher initial skill level. On average C had better stroke technique than the other two groups, although, by the end of the instruction the stroke technique differences were greatly reduced if not eliminated. At the time the transfer test was given, C was at a higher level of swimming performance for a longer period of time than either of the other two groups. As C had maintained their level of performance for a longer period of time these skills were more ingrained into their consciousness. Based on the Fitts and Posner (1967) model of skill acquisition, C were most likely in the third stage of motor learning, the autonomous stage, where the skills have been learnt to a point where they can be performed with little or no attention paid to the actual skill. Consequently, C were not as affected by the added pressure of the competitive situation. In fact, it seems to have enabled them to perform better than when they applied pressure to themselves to perform at their best, during the post test.

Swimming Time

It was hypothesized that the two experimental groups (IEVM, IEPM) would show significantly greater improvements in swimming time than C, however, no significant differences were found. Although none of the hypothesis related to time were upheld, all individual participants showed improvement in their swimming speed from pre test to post test and from pre test to transfer test. These improvements followed the same pattern to the improvements found for stroke technique, however, the group differences were not found to be significant. From pre to post, both IEVM and IEPM showed large improvements compared to C who showed minimal improvements. The pattern found between the post test and transfer test for technique was also noted for time, with the exception of front crawl time where C showed the smallest improvement. As noted above this is especially unusual as research shows us that performance will generally decline slightly at transfer due to the increased pressure of a competitive environment (Schmidt & Lee, 1999).

Video Effects

In addition to the two experimental groups performing significantly better than C, it was hypothesized that IEVM would show more gains in performance (swimming technique and speed) than IEPM. This was based on the hypothesis that the video clips used would produce real motion models and thus would provide better temporal information about each stroke than the static photographs viewed by IEPM. However, the quantitative results showed no significant differences between IEVM and IEPM in terms of stroke technique, time or knowledge, indicating that the two forms of model were equally as effective. However, from the qualitative data, IEPM participants appeared to find the photographic models easier to view, in terms of being able to clearly see what the model was doing at each phase of the stroke. Although not explicitly noted, as the students did not see both model types and were thus not able to compare the two, one possible reason for this might have been that unlike the video, the photographs were static; they were always in view. This meant that IEPM were constantly presented with the cues, critical for swimming the specific stroke or element of the stroke that was being practiced. Although the pictures were the same size as the video, it appears that it was easier for the participants in IEPM to focus on each of the cues because they were static and they were able to compare them with the previous and next photographs. IEVM on the other hand watched the video playing continuously, consequently the pictures shown moved constantly, so the students may not have had the opportunity to focus on any of the cues highlighted by the instructor during instruction. Only during instruction, did the instructor stop the video and point out a specific cue or position, such as the kinematics of the arm as the hand entered the water after the recovery in front crawl. Other than during this instruction time, there was no opportunity for a IEVM participant to view the cue for an 'extended period of time' when they could observe information critical to develop technique. The participants in IEVM were not able to go back to a specific cue while recovering, they could only see the video playing in real time. The participants in IEPM, however, could review cues that the instructor had pointed out to them and study the body and limb positions and try to replicate them. This may highlight the importance of the cognitive component required to learn complex motor skills like swimming.

The use of still photographs of movement cues is an interesting finding especially when we consider how many currently teach motor skills. Initially the skill is shown in its entirety, at full speed. Generally the skill is then demonstrated from a variety of angles. Once these modeling techniques, which take a small percentage of instructional time, have been completed the instructor tends to break down the skill into smaller parts each with key points or cues that are emphasized to help the learner piece the skill together; which was done by the instructor for each of the groups. However, each group was left with different stimuli to enable them to remember the cues. For C, the instructor would model the skill for them on pool side and describe the key points, but they were not left with anything permanent which they could refer back to, other than their memory. For IEVM, the instructor paused the video clip to describe the same key points, but again the group was not left with a permanent record of these points, as the instructor would play the video again, consequently not giving IEVM participants the opportunity to study each of the cues. IEPM on the other hand viewed each of the cues all the time as their model was created through the use of individual progressive photographs. This enabled them to keep coming back to the cue identified by the instructor as often as they needed. Allowing them time to discriminate between the different photographs and different phases of the skill. A solution to this problem, for IEVM, would be to develop a waterproof hand held remote control for the mouse. This would allow the students to pause the video from the water and go through the video clip frame by frame if they so desired.

Visual Discrimination

The literature on motor learning and modeling shows us the importance of visual discrimination in the effectiveness of modeling (Doane et al, 1996). Two of the four participants interviewed from the IEVM group noted that the video clip on the screen was hard to see, they found that they were not able to see what they were supposed to do by simply looking at the screen. This may have been because they were unable to slow down the skill and visually discriminate between the different phases of the skill. IEPM were given a break down of the skill due to the nature of the progressive photographs. This may have actually enabled them to visually discriminate between the previous and the next picture in the progression; they could see where the body had moved from and where it was moving to.

This may have enabled the participant to create a mental image of the movements that their body needed to re-create in order to successfully perform the skill. This would also result in greater cognitive effort on the part of the student, which research has found increases learning (Lee et al, 1994).

Internet Use Effects

All of the individual participants in both IEVM and IEPM either strongly agreed or agreed that they had enjoyed the course compared to less than three quarters of the students in C. It can be assumed that having the internet to enhance their instruction increased the participants' enjoyment in the course, as the only difference between the three groups was the use of the visual aids provided through the internet. However, the interview data did not indicate any real group differences between the students' feelings towards the swimming classes or the instruction.

Attitude Changes

Use of the internet may have initially heightened the participants in the IEVM and IEPM groups positive attitude towards the lessons. However, it was unclear whether the use of the internet had any long term effects on the participants' attitude towards swimming. During the study, none of the students interviewed indicated they voluntarily went swimming any more than they had before. This would suggest that the internet affected their attitude towards swimming within the context within which the internet was used, i.e. the actual swimming lessons. A caution should be given here though. It is not merely the use of the internet that seems to enhance the learners' attitudes. It is also the content of the internet site.

As noted in the qualitative results two participants, one from IEVM and one from IEPM, found the graphics on the internet site difficult to see due to their size. This highlights the importance of the site design, where images are used, that can be easily seen by all participants. As Nielson (1997a) stated, graphics should not be used for the sake of using them, they should only be used where they have value. Fortunately, the issue of the size of the graphics was an issue noted by only a small percentage of the participants and not the majority. The majority of the other participants did not see this as a problem that negatively affected their perception of the visual aids or the lessons. In terms of the instructor, he had a positive attitude towards using the internet to enhance his teaching, noting how useful it was to be able to show the students what he wanted them to do rather than having to try and describe the movements.

Initial Skill Differences in Swimming Ability

As described earlier, although measures were taken to select three similar schools, non-significant group differences were found at pre test. Due to these differences it could be argued that the significant results found for stroke technique were only found because the two experimental groups (IEVM, IEPM) were less skilled and had more room for improvement than C. Three factors suggest this was not the case. First, when comparing the swimming times of C to that of the provincial standards, the mean times for C were far below the provincial standards. The mean provincial age group standards (long course and short course) for 13 year olds for 50 meters front crawl is 31 seconds for females and 29.7 seconds for males, and for back crawl 35.65 seconds for females and 34.85 seconds for males. Unfortunately, there are no published standards for 25 meters however, one would assume that half of the time for 50 meters would be a conservative estimate for 25 meters. For front crawl the fastest time recorded was 19 seconds, 4 seconds slower than the provincial standard, which over 25 meters is quite considerable. For back crawl the fastest time recorded was 24:16 over 6 seconds slower than the provincial standards. From this it is clear that none of the participants in the study swam close to that of the provincial standards.

Second, the maximum technique score that could have been awarded for perfect stroke technique was 119 points. No participants were awarded the maximum stroke technique score by either of the two analysers (Range [107 to 17]). Mean technique scores at transfer were IEPM = 75.6, IEVM = 81.1, and C = 82.4. This highlights that all three groups had room for improvement even at the conclusion of the study, which is certainly what one would expect after one eight week unit of swimming instruction.

Last, when the instructor was asked if he felt that the two experimental groups had room for improvement where C did not, he stated that "everyone had great room for improvement, especially from the first day looking at them, as they swam for the video, they definitely all had small things that they could work on immediately that would improve drastically....I think that all of the groups have improved quite a bit overall" (Instructor, Second Interview).

Implications and Recommendations

In terms of creating other programs for enhancing the acquisition of motor skill this study highlights the need to provide learners with effective models. The internet delivered models enhanced the learners understanding of the motor skills of front crawl and back crawl, supporting the recommendations of previous studies that have found that providing learners with models increases skill acquisition (Carroll & Bandura 1982, 1990; Hand & Sidaway, 1992; McCullagh & Caird, 1990; McCullagh & Meyer, 1997; McCullagh, Weiss & Ross, 1989; Sidaway & Hand, 1993). In addition to providing a model, it is recommended that both video models and photographic models are included in instruction.

It appears that progressive photos provided the learner with a break down of the skill, a step by step walk though the entire movement. Video clips however provide the learner with the coordination and timing of the specific elements that make up the skill. Based on the Fitts and Posner (1967) model of motor learning it appears that each model type might play a different role in the different stages of learning. During the initial stages of learning, learners need to see the whole skill. At this stage the video model can provide a clear picture of the skill. During the second stage of learning where the learner is trying to master the skill the use of the photographic models show the skill point by point. Once these points have been mastered the temporal elements of the whole skill become important and thus the use of the video model also becomes essential so that the learner can see how the individual elements of the skill link together and gain an understanding of the timing of the skill.

In terms of instructional design it is recommended that the interface used be simple and easy to use and that the models provided be large enough so that the learner can clearly see the limb and body positions of the model. It is also important that the instructor can easily move between screens with short download times, so that the instruction is not interrupted while waiting for the next model to load.

Based on the results of this study, future studies conducted to examine the effectiveness of different instructional methods should pay close attention to how subjects are selected. In educational settings, it can be challenging to find a number of similar motor ability groups who can be instructed and tested independent of one another. If random selection procedures are used, it would be almost impossible, logistically, to randomly select individuals from different schools. It is unlikely that a number of schools would be able to time table all the different times. Consequently, if randomly selecting students, it would probably be necessary for all the subjects to come from one school. Using subjects from just one school, results in it being difficult to ensure that the different groups would not compare their instruction with each other. When each group of subjects is from a different school, it is possible to minimize the interaction between the groups, however, this then increases the possibility of ability differences between the groups, as in this study.

One solution would be to include a greater number of school groups to reduce the effect of individual differences upon the entire group. Another solution would be to obtain from each student, at a number of schools, the approximate number of hours of previous experience in the skill being measured. Then select the schools with a similar number of hours of prior experience and then randomly assign to the different experimental and control groups. The challenge here would be to find enough schools willing to take part in the study.

Another solution would be to pre test students, from one school, prior to randomly assigning the students to groups and then ensuring all groups are equal. Then to minimise inter group comparisons you could asking each student to make a verbal contract, or sign a written contract, that they will not discuss their swimming instruction with any other students, not in their group.

Summary and Conclusion

To my knowledge this study was the first to investigate the effect of simulated internet enhanced instruction in the area of motor learning and or physical education. This study combines theory from both educational technology and motor learning and applies it to the practical setting of swimming instruction, using three modes of delivery (IEVM, IEPM, C). The results showed that internet technology has the potential of making available quality instruction within physical education and kinesiology currently only available in more privileged settings. The different uses of the internet has been apparent for some time and the degree to which technology can be used within coaching science is increasing. However, the use of technology within motor skill instruction is still minimal even though there has been some discussion around the subject for over a decade (Cicciarella, 1983; Englehorn, 1983; Katz & Green, 1989; Londeree, 1983; Mayhew & Rankin, 1983). More specifically, the use of the internet within physical education instruction has received little discussion with the commentaries published to date focusing on other uses of the internet within physical education (Ellery, 1999, 1997; Friesen, & Bender, 1997; Grosse, 1997).

Through this thesis research a number of key factors have been identified and lessons learned. I shall conclude the thesis with a summary of recommendations.

1) The results have shown that both photographic models and a real-time video models of swimming skills are effective in modeling for learners the key elements of a skill. Both were found to lead to significant gains in swimming technique.

2) It is important for the learner to be able to view the models for an extended period of time, from a number of different perspectives. This appeared to be one of the main advantages of the photographic and video models over a traditional live model, because, live models are viewed for a brief duration and from only one perspective at a time. The internet sites allowed the students to view the model from above and below the water while receiving additional information from the instructor. This was not possible with the live model.

3) In terms of internet site design, it is recommended that the models provided should be large enough and clear enough that all students can easily see the body position and the pattern of movement of all the limbs and the body.

4) From the instructors perspective, when designing the site interface, it is important that the buttons provided to move from one model to another, be clear and easy to click on so that instruction time is not lost while looking for the correct button. Instruction time is also maximised when each page is kept to a minimum file size. This means that when a new model is selected by the instructor it will appear in seconds and not delay instruction.

5) When designing an internet site specifically for motor skill instruction, this research has highlighted the importance of identifying the environment in which the site will be used and designing the site accordingly. For example, in this thesis the teaching environment was a swimming pool, located in a large open space with a lot of white light. The final internet site for study two was purposefully designed with a white background and dark text so that it could be seen clearly within this environment. During development of the design, the site was frequently tested within the swimming pool environment to ensure that all elements of the screen could be easily seen from a distance of at least 15 meters.
6) Providing students with models encourages them to view the model and discriminate between the different technical phases of the skill. The results suggested that the use of photographic models facilitated this more than the video models and made it easier to compare the body and limb positions from one phase of the skill to the next. Through the instructor prompting the student to look at the changes in the body and limb positions this encourages them to become involved in understanding the temporal requirements of the skill as well as increasing cognitive effort.
7) This research has highlighted the importance of collecting both quantitative and qualitative data when evaluating an instructional method. The quantitative data is imperative for highlighting changes in skill acquisition and the learners' ability to maintain this level of performance over time. However, the qualitative data provided the

researcher with critical additional information that they would not have been able to find out otherwise. For example, the students' comments on how they actually used the models, what they thought of them, and how they viewed this instruction over previous more traditional instruction. Their verbal comments on the instruction provided a greater insight into why the instruction resulted in the increased long term learning.

8) This research has shown that computing technology, specifically the internet, can be used to enhance the instruction of a motor skill without any loss of physical activity, a common concern among physical education professionals. In fact, the data suggests that physical activity levels may have been increased due to the integration of the internet.

9) It is very important that instructors are given the time to practice using a new instruction aid. They should have reached a level of comfort and expertise using the aid prior to using it with students.

10) It is recommended that great care be taken with subject selection. Specifically, all subjects should take a pre test prior to the allocation to treatment groups. This is needed to create heterogeneous matched motor ability groups.

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Appendix A

UC
THE UNIVERSITY OF
CALGARY
Faculty of Kinesiology

Participant Informed Consent
Internet Enhanced Swimming Instruction

This consent form, a copy of which has been given to you, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more details about the project, or information not included here, you should feel free to ask. Please take the time to read this form carefully.

Purpose
The purpose of this study is to examine, through the use of a pre and post-test transfer design, if using the Internet to assist swimming instruction increases students learning and performance in swimming.

Explanation of Participants Involvement
Participants will receive up to 10 (ten) swimming classes at the Lindsay Park Sports Centre. Through these classes participants will be given swimming instruction on both front crawl, back crawl, breaststroke and butterfly by a qualified swimming instructor. Instruction may include instruction enhanced by the Internet, instruction enhanced by overhead transparencies, as well as traditional instruction such as that normally given by the Lindsay Park Sports Centre. The final session will conclude with a fun swim meet in which all students will be invited to take part. During a pre-test in week one, a post–test in week 10 and the fun swim meet, participants will be videoed while swimming the front crawl and back crawl, in order to assess their swimming technique and speed. This video will only be viewed by the research team, and at no time will participants be identified by name.

Risks
There are no additional risks to the participants, other than those normally associated with swimming. Lindsay Park Sports Centre and your school may also require their normal consent and release forms to be signed, consistent with the school board's policy. All participants will receive quality swimming instruction from a certified instructor, with certified lifeguards in attendance. Provided all participants follow the instructions given to them by both their instructor and the lifeguards, the inherent risks associated with swimming will be kept to a minimum.

2500 University Drive N.W., Calgary, Alberta T2N 1N4
Telephone:(403) 220-2802 Fax:(403) 284 3553 Email: rsmorey@ucalgary.ca

Benefits to be expected
All students should experience increased swimming ability and water confidence. Upon completion of the study, all students will be given the address (URL) of the Internet site so that they can access it if they wish.

Use of Personal Information
Participant information obtained during this research project is confidential. It will not be released without your written consent. The information however, may be used for statistical analysis for scientific purposes with your right to privacy retained. All information collected including video tapes, audio tape and notes will be destroyed on completion of the study.

Freedom of Consent
Your agreement to participate in this investigation is voluntary and you are free to withdraw from the study whenever you choose.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal right nor release the investigator, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time without jeopardizing your grade. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. If you have further questions concerning matters related to this research, please contact:

Ruth Morey Sorrentino M.Sc.	220-2802
Joan Vickers Ed.D.	220-3420

If you have questions concerning your rights as possible participants in this research, please contact the office of the Vice-President (Research), University of Calgary, 220-3381, and also the Chair of the Education Joint Research Ethics Committee, 220-5626.

I have read this form and I understand the procedures required of me to participate in the study. A duplicate copy of the signed consent form is being provided for my records. I consent to participate in this research project.

Participant	Date
Parent/Guardian	Date
Researcher	Date

Appendix B

Pre test for Swimming Knowledge

SWIMMING: WHAT DO YOU KNOW?

Name ....

Have you had school swimming lesson before? Yes / No

Have you ever taken any swimming lessons outside school? Yes / No

Do you enjoy going swimming? Strongly Agree / Agree / Neutral / Disagree / Strongly Disagree

Circle the letter A, B, C or D, which best answers the given question. Try and answer ALL questions.

Back Crawl

Arm Action

1) When do the arms enter the water in the back crawl?
A: Together
B: One, then the other
C: Alternately, in an uneven rhythm
D: After the glide

2) Where should the arms pull in the back crawl?
A: Directly above the body above the water
B: Close to the side of the body above the water
C: Directly under the body under the water
D: To the side of the body under the water

3) A back crawl swimmer pulls with one arm while the other rests at the side. Is this good technique and why?
A: No, the swimmer cannot bend the arm and push
B: No, the swimmer sacrifices continuous power.
C: Yes, the swimmer can relax the arm momentarily
D: Yes, the swimmer can give a more efficient push with the opposite arm.

4) What is a fault in back crawl?
A: Allowing the arms to be slightly flexed
B: Rotating the arms in opposition
C: Letting the elbows enter the water before the hands
D: Reaching back with the small finger leading

Leg Action

5) Which kick is used in the back crawl?
A: Breaststroke kick
B: Dolphin kick
C: Regular scissor kick
D: Inverted flutter kick

6) Which action is most important when executing the leg kick in back crawl?
A: Legs are kept straight
B: Upbeat of the kick is emphasized
C: Ankles are flexed
D: The kick comes from the knees

7) Which statement best describes the joint action of the leg kick?
A: Flexibility at the ankle, knee and hip joint.
B: Flexibility at the ankles and knees but not the hips
C: Flexibility at the ankles and hips but not the knees
D: Flexibility at the knees but not the ankles and hips

8) What is a fault in the back crawl leg kick?
A: The big toes exits the water
B: The legs bend only slightly at the knees
C: The leg action is initiated by the knees
D: The ankles are flexible

Head Position

9) What is the best head position for the back crawl?
A: Head titled slightly toward the chest
B: Head in normal line with the body
C: Head titled back slightly
D: Head tilted back as far as possible

Body Position

10) Where should the hips be in relation to the surface on the water when swimming the back crawl?
A: About 30 cm below the surface of the water
B: Above the surface of the water
C: Level with the surface of the water
D: About 15 cm below the surface of the water

Front Crawl

Arm Action

11) How do the arms move in the front crawl?
- A: They move continuously
- B: They pause at the finish of each arm drive
- C: The pause before entering the water
- D: They work faster on the recovery than on the drive

12) Which part of the arm leads the recovery in front crawl?
- A: Palm of the hand
- B: Forearm
- C: Elbow
- D: Fingertips

13) Which statement is correct concerning the recovery phase of the front crawl arm stroke?
- A: Elbow swings upward and forward while the other hand and arm rest.
- B: Elbow swings slightly upward and forward, and the hand swings forward before the elbow reaches the shoulder.
- C: Elbow swings forward in an extended position with the hand leading.
- D: Elbow swings upward and forward with the hand trailing behind it.

14) Which part of the arm stroke for the front crawl is *incorrectly* stated?
- A: Fingers lead in entering the water in front of the shoulder
- B: Hand presses backward near the centerline of the body as the elbow bends.
- C: Elbow draws close to the trunk and comes out of the water first.
- D: Hands and arms reach forward in front of the head

Leg Action

15) Where does the action of the flutter kick originate?
- A: The ankle joint
- B: The hip joint
- C: The lower back
- D: The knee joint

16) What is the position of the legs for the thrust phase of the flutter kick?
- A: Knees bent, ankles stiff
- B: Knees stiff, ankles stiff
- C: Knees straight, ankles relaxed
- D: Knees straight, ankles bent

17) Which statement describes the front crawl leg action?
- A: Knees are flexed and the lower leg supplies most of the power
- B: Legs are fairly straight and the power is supplied from the hips.
- C: Legs are fairly straight and the ankles flex to supply the power
- D: Ankles, knees and hips are flexed and all three supply power.

18) How high are the legs lifted in the flutter kick?
- A: The legs are lifted out of the water to the knees
- B: The heels only break the surface of the water
- C: The feet are raised above the surface
- D: The feet and legs stay several inches below the surface of the water

Breathing

19) Which statement describes the position of the head during breathing for the front crawl?
- A: Head is lifted out of the water
- B: Head is kept forward
- C: Head is submerged
- D: Head is turned to the side

20) When does the intake phase of breathing occur in the front crawl?
- A: As the arm on the breathing side just enters the water from the recovery
- B: As the arm on the breathing side leaves the water on the recovery
- C: As the arm on the breathing side has just finished the pull in the water
- D: As the arm on the breathing side has just started the pull underwater

Head Position

21) Which statement describes where the eyes should look during the front crawl?
- A: Just below the water level
- B: Above the water
- C: At the bottom of the pool
- D: At your feet

Miscellaneous

22) Which of these terms is not a stroke in swimming?
- A: Butterfly
- B: Free Stroke
- C: Breaststroke
- D: Side Stroke

The above written knowledge questions have been adapted from Mc Gee & Farrow (1987)

Appendix C

Front Crawl : Stroke Analysis

Name:

	1	2	3	4	5	6	7	Points
Body Position								
Head in line with body	N	AN	O	S	M	AA	A	
Hips just below the water	N	AN	O	S	M	AA	A	
Leg Action								
From hips	N	AN	O	S	M	AA	A	
From knees	A	AA	M	S	O	AN	N	
Efficient	N	AN	O	S	M	AA	A	
Arm Action								
Strong	N	AN	O	S	M	AA	A	
Efficient	N	AN	O	S	M	AA	A	
Continuous	N	AN	O	S	M	AA	A	
Entry								
In line with shoulder	N	AN	O	S	M	AA	A	
Ahead of the head	N	AN	O	S	M	AA	A	
Recovery								
High elbow	N	AN	O	S	M	AA	A	
Direct	N	AN	O	S	M	AA	A	
Breathing								
To both sides	N	AN	O	S	M	AA	A	
Head is rotated	N	AN	O	S	M	AA	A	
General Impression								
Efficient	N	AN	O	S	M	AA	A	
Smooth	N	AN	O	S	M	AA	A	
Continuous	N	AN	O	S	M	AA	A	

Key

N	=	Never	(0%)
NA	=	Almost Never	(15%)
O	=	Occasionally	(35%)
S	=	Sometimes	(50%)
M	=	Mostly	(65%)
AA	=	Almost Always	(85%)
A	=	Always	(100%)

(Adapted from ASA Coaches Manual, 1996)

Appendix D

Back Crawl : Stroke Analysis

Name:

	1	2	3	4	5	6	7	Points
Body Position								
Head in line with body	N	AN	O	S	M	AA	A	
Hips just below the water	N	AN	O	S	M	AA	A	
Slight roll with arm pull	N	AN	O	S	M	AA	A	
Leg Action								
From hips	N	AN	O	S	M	AA	A	
From knees	A	AA	M	S	O	AN	N	
Efficient	N	AN	O	S	M	AA	A	
Arm Action								
Strong	N	AN	O	S	M	AA	A	
Efficient	N	AN	O	S	M	AA	A	
Continuous	N	AN	O	S	M	AA	A	
Entry								
At 11.00	N	AN	O	S	M	AA	A	
Little finger first	N	AN	O	S	M	AA	A	
Recovery								
Initiated thumb first	N	AN	O	S	M	AA	A	
Straight arm	N	AN	O	S	M	AA	A	
Direct	N	AN	O	S	M	AA	A	
General Impression								
Efficient	N	AN	O	S	M	AA	A	
Smooth	N	AN	O	S	M	AA	A	
Continuous	N	AN	O	S	M	AA	A	

Key

N	=	Never	(0%)
NA	=	Almost Never	(15%)
O	=	Occasionally	(35%)
S	=	Sometimes	(50%)
M	=	Mostly	(65%)
AA	=	Almost Always	(85%)
A	=	Always	(100%)

(Adapted from ASA Coaches Manual, 1996)

Appendix E

Post test Swimming Knowledge

SWIMMING: WHAT DO YOU KNOW?

Name .... Age .... (Years) .... (Months)

Circle the letters that best matches your agreement/disagreement with the given statements

SD=Strongly Disagree D=Disagree N=Don't know A=Agree SA=Strongly Agree

I really enjoyed the swimming course	**SD D N A SA**
I think that my knowledge of swimming has really improved	**SD D N A SA**
I found the visual aids used by my instructor very useful	**SD D N A SA**
I do not think that my swimming has improved over this course	**SD D N A SA**

Circle the letter A, B, C or D, which best answers the given question. Try and answer ALL questions.

Back Crawl

Arm Action

1) Which part of the arm enters the water first in the back crawl?
- **A:** The Wrist
- **B:** The little finger
- **C:** The forearm
- **D:** The elbow

2) Where should the arms recover in the back crawl?
- **A:** Directly under the body in the water
- **B:** Close to the side of the body under water
- **C:** Close to the body out of the water
- **D:** Directly over the side of the body out of the water

3) In which direction should the hands and arms push and maintain force in the power phase of the back crawl?
- **A:** Toward the head, close to the body
- **B:** Toward the feet, close to the body
- **C:** Toward the head, directly under the body
- **D:** Toward the feet, directly under the body

4) What is a fault in back crawl?
- **A:** Bending the arm slightly during the pull phase
- **B:** Exiting the water with the small finger leading
- **C:** Keeping the fingers together during the pull phase
- **D:** Rotating the arms in opposition

Leg Action

5) Which type of kick is used in the back crawl?
- **A:** Flutter kick
- **B:** Dolphin kick
- **C:** Scissor kick
- **D:** Leg kick

6) *How much of the foot should exit the water during back crawl?*
- **A:** The whole foot
- **B:** The heal
- **C:** The big toe
- **D:** All the toes

7) When is most of the force applied in the back crawl leg kick?
- **A:** On the upward movement of the legs
- **B:** As the legs push downward
- **C:** Equally on the upward and downward movements of the leg
- **D:** Alternatively on the upward and downward movements of the leg

8) What leg movement would most likely keep the swimmer from moving well when swimming the back crawl?
- **A:** Legs are moving from the knees only
- **B:** Legs are bicycling
- **C:** Legs are moving too slowly
- **D:** Legs are moving from the hips

Head Position

9) Where should the water line cut across the head in back crawl?
- **A:** Around the face, the hair and ears submerged
- **B:** The head is completely submerged
- **C:** Along the side of the face, cutting across the ear
- **D:** Around the neck, the head is completely above the water

Body Position

10) How high should the waist be in the water when swimming the back crawl?
- **A:** About 30 cm below the surface of the water
- **B:** Above the surface of the water
- **C:** Level with the surface of the water
- **D:** About 15 cm below the surface of the water

Front Crawl

Arm Action

11) Where should each hand enter the water following the recovery in the front crawl?
A: In front of the face
B: In front of the opposite shoulder
C: In front of the same shoulder
D: Out to the side of the shoulder

12) Which technique is an *error* in the recovery phase of the front crawl?
A: Wrist below elbow
B: Wrist above elbow
C: Elbow out of water first
D: Fingers in the water first

13) What is the correct recovery arm position for the front crawl?
A: Fully extended
B: Fully flexed
C: Partially extended
D: Partially flexed

14) Which statement describes the power phase of the arm stroke in the front crawl?
A: Alternating, pull with one arm followed by a pull with the other arm
B: Simultaneous, both arms press against the water at the same time
C: As the arm enters the water, fingers first
D: As the elbows are raised from the water

Leg Action

15) How much of the foot in front crawl should come out of the water during the leg kick?
A: The big toe
B: The whole foot
C: None of the foot
D: The heal

16) Which statement best describes the joint action of the flutter kick?
A: Flexibility at the ankle, knee and hip joint.
B: Flexibility at the ankles and knees but not the hips
C: Flexibility at the ankles and hips but not the knees
D: Flexibility at the knees but not the ankles and hips

17) What is the most important contribution the kick makes to the crawl stoke?
A: Aids in forward progress of the body
B: Makes the stroke easier to perform
C: Increases the aesthetic quality of the stroke
D: Maintains balance and stability of the body

18) Why is the emphasis on the upbeat of the flutter kick?
A: To keep the feet from going too far under the water
B: To keep the knees from bending too much
C: To provide an efficient thrust for moving forward in the water
D: To help keep the toes pointed, giving a better thrust

Breathing

19) What is the correct breathing movement in the front crawl?
A: Lift the head and inhale, face to the front
B: Lift the head and inhale, face to the side
C: Roll the head inhale, face to the side
D: Roll the head to both sides and inhale on each side

20) When does inhalation occur in the front crawl?
A: As the arm on the breathing side enters the water
B: As the arm on the breathing side leaves the water
C: As the arm opposite the breathing side recovers
D: As the elbow opposite the breathing side leaves the water

Head Position

21) Which statement describes the proper head position for the front crawl?
A: Water Level is just at the hairline
B: Water level is just at the nose level
C: Water level is above the head
D: Water level is just above the ears

Miscellaneous

22) What is another name for front crawl?
A: Butterfly
B: Dolphin
C: Breaststroke
D: Freestyle

The above written knowledge questions have been adapted from Mc Gee & Farrow (1987)