The Developmental Validity of Traditional Learn-To-Swim Progressions for Children with Physical Disabilities

by

Joanna E. Gelinas

Department of Physical Education
Faculty of Education
McGill University
Montreal, Quebec, Canada

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ABSTRACT

Girls' participation in physical education, sport and other physical activity was examined relative to their levels of Perceived Sport Competence, Body Attractiveness, Physical Self Worth and Social Physique Anxiety. Two hundred and thirteen grade 11 girls from two co-educational and two single sex Toronto high schools completed questionnaires designed to assess physical activity participation and these psychological attributes. T-tests verified that there were no differences on the psychological measures between the two types of schools. On the basis of the girls' reponses, they were divided into non, low, medium and high participant groups. The relationships between physical activity participation and the selected psychological measures were analyzed by Pearson correlations. Analysis of Variance's (participant groups x psychological construct) determined where differences existed among participant groups. The results revealed that high level participants had greater Perceived Sport Competence, Body Attractiveness, Physical Self Worth levels than the participants at the lower levels. Social Physique Anxiety was unrelated to physical activity participation. Perceived Sport Competence was the best predictor of participation.

RESUME

Le but de cette étude était de déterminer si les progressions traditionelles. pour apprendre à nager sur le ventre et sur le dos. étaient valables au point de vue du développement pour les enfants ayants des handicaps physiques.

Quarante enfants entre 5 et 12 ans ont participé à l'étude. Les enfants ont été décrits en utilisant cinq caractéristiques: le handicap. la catégorie du handicap. la classification d'habilité sportive fonctionelle. la méthode ambulatoire. et le besoin d'un flotteur. Une exigence était que chaque enfant soit à l'aise dans l'eau et recommendé par l'instructeur aquatique. De plus. chaque enfant a passé l'examen d'orientation et ajustement à l'eau.

La validité au point de vue du développement des progressions a été déterminée en évaluant les enfants sur sept habiletés: respiration rythmique. planche sur le ventre. glisse sur le ventre. nage sur le ventre. planche sur le dos. glisse sur le dos. et nage sur le dos Si tous les critères d'une habileté étaient présents. l'enfant a réussi cette habileté particulière. Les données ont été analysées afin de déterminer le nombre d'enfants qui ont suivi une progression typique ou atypique

Les résultats ont indiqués que les progressions suggérées pour apprendre à nager sur le ventre et le dos n'étaient pas valables au point de vue du développement pour la plupart des enfants ayants des handicaps physiques.

Ces résultats rejoignent les concepts de la théorie écologique et suggèrent que tous les enfants ayant des handicaps physiques n'atteindront pas tous le but final d'une habileté par les mêmes moyens. Par conséquent. les instructeurs aquatiques auront besoin d'adapter leurs méthodes d'instruction en fonction des capacités de leurs étudiants.

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CHAPTER 1

Introduction

1.1 Adapted Aquatics and the Ecological Theory of Motor Control

"Physical education for students with profound disabilities should comprise activities that are chronological age appropriate and functional, yet specially designed to be beneficial and to meet students' unique abilities.... Whenever possible, these activities should be based on a student's preferences and taught in natural environments, including community based settings, where the student ultimately will use these skills and where there are opportunities to interact with nondisabled peers" (Block, 1992, p 204). Swimming is one such functional activity and therefore is appropriate to teach to students with disabilities.

The Canada Fitness Survey (1986), which described the nature of, and attitudes towards physical activity of over two million individuals with a disability, found that approximately 50% of Canadians with a disability were physically active. Twenty-two percent of both sexes with a disability reported swimming at a pool, the fourth most popular activity after walking, gardening, and bicycling (CFSR, 1986). Approximately 597,000 of those surveyed reported taking part in this activity at least once in the 12 months preceding the survey. Also, swimming at a pool was rated as the most appealing activity to begin, according to approximately 139,000 persons with a disability. This would represent a 23% increase in participation (CFSR, 1986).

Aquatics for individuals with disabilities has changed over the decades. Adapted aquatics developed in the 1940s when water was used as a therapeutic approach in the rehabilitation of persons with war related injuries or polio (Grosse, 1985). People continued to participate in these programs for the therapeutic benefits of water, but it became evident that an important educational aspect was inherent as well (Grosse, 1985, 1996). In the 1950s special classes were started for individuals who were deaf or blind, and increasingly became available to those with other disabling conditions. In the 1970s and 80s "swimming for the handicapped" became Adapted Aquatics (Grosse, 1985, 1996), encompassing many more aquatic activities than simply swimming, such as canoeing, SCUBA diving, water-skiing and synchronized swimming (Grosse, 1985; Reid & O'Neill, 1989; Sherrill, 1993).

Since most adapted physical activity textbooks include aquatics as a specific skill area and often devote an entire chapter to it (Chanias & Reid, 1996) it is plausible to conclude that aquatics is an important area in adapted physical activity. As well, aquatics is specifically highlighted as a main teaching domain of the American law PL 94-142 which defines physical education for all children with disabilities: "Physical education services, specially designed if necessary, must be made available to *every* handicapped child...and include physical and motor fitness; fundamental motor skills and patterns; and skills in aquatics, dance and individual and group games and sports (including intramural and lifetime sports)" (*Federal Register*, August 23, 1977, p. 42480). Although aquatics appears to be very important and there have been many views and methods on how to teach or use aquatics for those with disabilities, there is still a paucity of research in the area (Langendorfer, 1989).

There are several aquatic programs designed for children with and without disabilities which generally follow the same learn-to-swim progressions, although they may have different teaching philosophies and stem from different educational models. These progressions are termed water orientation/entry and exit, breath control, buoyancy, gliding (with push-off), arm and leg actions, and combined limb aquatic locomotion (Canadian Red Cross Society, 1983, 1996a, 1996b; Langendorfer & Bruya, 1995; Sherrill, 1993; YMCA, 1993a). These programs all propose basic aquatic skills that are necessary in order to learn how to swim. This seems to work for nondisabled children with typical development and intellectual functioning. However, are all of these skills absolutely necessary prerequisites to swimming? Are the proposed sequences useful for the child who has either intellectual difficulties or physical limitations? Does a child who has an intellectual disability and may learn at a slower rate than his or her nondisabled peers follow every one of these prerequisite skills in learning how to propel him/herself forward in the water? Langendorfer and Bruya (1995) point out that neither the Red Cross nor the YMCA have considered the developmental validity of their progressive programs. Although the Red Cross (1983, 1996a) and YMCA (1993b) instructor manuals indicate that the sequence of progressions is not a rigid one, and teaching beginner skills in any order is permitted, the program structure and certification for each level are designed so that only the suggested progressions seem appropriate. These progressions might be described as "bottom-up" programming (Block, 1994; Kelly, 1989) whereby the lower end of the scale is the focus of instruction until these skills are learned and the child can progress to the next step. In other words, instructors tend to teach each skill in the offered progression, assuming that each and every skill is a prerequisite of the next, regardless of whether or not that skill is necessary or useful for the child at that time.

A "top-down" model (Block, 1994; Kelly, 1989) would question the validity of the standard swimming progressions, such as those suggested by the Red Cross (1983, 1996a, 1996b) or YMCA(1993a), and more importantly, would challenge the strict adherence to them. A top-down model is appropriate to use when teaching children with disabilities because educational programs can be designed by identifying functional skills the student needs in physical activity environments, as well as present skills. Once these are established, only the essential motor skills needed by the student to be successful now and in the future will be presented (Kelly, 1989). "The top-down approach forces the teacher to focus on critical skills a student needs to be successful in current and future recreational environments while eliminating less functional items" (Block, 1994, p95). In the present context of swimming, are some of the beginner swimming skills nonfunctional to independent swimming?

Davis (1984) challenged some of the basic assumptions of the assessment of people with disabilities. One criticism was that criterion-referenced tests assume there is a single biomechanically optimal movement for all persons performing the skill. He also challenged the assumption that motor development proceeds in an ordered sequence of steps that are followed by everyone, although on different time scales. Davis felt that criterion-referenced tests such as those used when evaluating students within the Red Cross or YMCA aquatic programs, did not sufficiently take into account the complex relationship between the performer, task, and environmental constraints.

The "ecological view" of motor control (Block, 1994; Davis, 1984; Davis & Burton, 1991) addresses this criticism, arguing that behavior emerges as a function of many interacting systems. In other words, a movement outcome is dependent upon the interactions between the person, task, and environment. Also, changes in behavior can be linked to changes in the systems and their interactions with one another. Therefore, one must not assume that each performer will perform skills in the same fashion and follow the same developmental sequence. Rather, individuals may reach the same skill goal through the use of different movements and will acquire the ability to perform that same skill through different means, depending on the characteristics of the performer, the demands of the task, and the environment in which the task is being performed.

In terms of instruction, the ecological view stresses the importance of the final or "end-goal" of a skill to be taught. Ecological task analysis, the process of changing task dimensions when teaching a skill through a series of observations of a student's choices to elicit successful performance, emphasizes that the end-goal of any skill must be maintained for each task goal during the application of the task analysis. It is argued that by altering the task goal from the end-goal of the skill, the movement outcome will be disrupted (Davis & Burton, 1991). In other words, the goal of any task used to facilitate the teaching of a skill must be essentially the same as the end-goal of that skill. For example, the end-goal of the front float is different from that of the front swim and may therefore not be a true prerequisite of the front swim. The ecological view supports the notion that not all prerequisite skills or progressions may be necessary, and using the above example, the front float may not be an appropriate skill to use when teaching the front swim.

In addition, the ecological model encompasses philosophies such as chronological age appropriateness and functionality of skills learned, and community based instruction for these skills (Block, 1992), thus supporting the use of aquatics as appropriate skills to teach to people with disabilities. Some aquatic programs (Reid & O'Neill, 1989; Sherrill, 1993) have recognized that swimming progressions need to be flexible in order to accommodate the various needs of participants, so that swimming can be fostered and encouraged through the provision of a variety of learn-to-swim progressions.

Thus, based on the lack of evidence of developmental validity of traditional learn-to-swim programs, the appropriateness of using a top-down versus bottom-up teaching approach, and the ecological model's challenge of set sequences in instruction, the purpose of this study was to explore the developmental validity of typical learn-to-swim progressions for children with physical disabilities. In particular, the skills assessed were breath control, prone floatation, and forward glide for the acquisition of the functional end-goal of forward propulsion, as well as the skills of supine floatation and backward glide for the acquisition of the functional end-goal of backward propulsion. These are progressions in the new Red Cross Aqua Quest water safety program (1996a, 1996b), although they are typical of other learn-to-swim programs. Other proposed prerequisite skills of water orientation-adjustment, entry and exit, and arm/leg action were not included in this study because it is accepted that these skills are directly related to a person being able to perform subsequent skills in the water (Langendorfer & Bruya, 1995). That is, if you are not in the water or are not comfortable in the water, or are not moving your arms or legs, you can not possibly go under water or propel yourself forward.

1.2 Research Question

Are the proposed progressive skills of traditional learn-to-swim progressions true prerequisites of subsequent skills for the learner with a physical disability?

1.3 Delimitations

1. The participants ranged in age from 5 - 12 years old.
2. The participants were identified through school records as having either moderate or severe physical disabilities.
3. The participants were identified by their aquatic instructor as being comfortable in the water, independently, or with limited floatation devices. The importance of this water orientation and adjustment lies in the fact that no other aquatic skill can be learned if the student does not possess an advanced level of comfort in the water (Langendorfer & Bruya, 1995).

1.4 Limitations

1. A longitudinal design would have been the preferred experimental approach in answering this research question. However, to follow children with physical disabilities from their first encounter with water orientation to independent swimming might require 4 or 5 years (Newman, 1976). There is, however, precedence for determining the validity of learn-to-swim progressions on the basis of a cross-sectional approach. Killian, Arena-Ronde, and Bruno (1987) determined interobserver agreement and validity of two water orientation assessment instruments, the Water Orientation Checklist-Basic and the Water Orientation Checklist-Advanced using a cross-sectional approach.

1.5 Definitions

Physical disability - Moderate to severe physical limitations or impairments which adversely affect the child's performance in sport related motor activities, specifically swimming. The impairments can be caused by disease, congenital disorders, acquired disorders, or from other causes, and include cerebral palsy, spina bifida, traumatic brain injury, muscular dystrophy, etc. (Sherrill, 1993, p. 556).

Rhythmic breathing - The skill of repeatedly submerging below the surface of the water while exhaling and rising above the water surface to inhale in a continuous and rhythmical manner.

Front float - The skill of resting on the surface of the water in a prone position with little or no movement or effort.

Back float - The skill of resting on the surface of the water in a supine position with little or no movement or effort.

Front glide - A smooth sliding motion of the body along the water surface in a prone, streamlined position, having been initiated from a push off the bottom or side of the pool.

Back glide - A smooth sliding motion of the body along the water surface in a supine, streamlined position, having been initiated from a push off the bottom or side of the pool.

Front swim - The action of propelling the body through the water in a prone position using any combination of arm or leg movements.

Back swim - The action of propelling the body through the water in a supine position using any combination of arm or leg movements.

Floatation device - A buoyant device such as a bubble, arm wings, or a styrofoam tube, which offers minimal support to the wearer.

CHAPTER 2

Review of Literature

This study was designed to determine whether the prerequisites for the front swim and the back swim, as described by traditional learn-to-swim progressions and programs, are developmentally valid for teaching aquatics to children with physical disabilities. This chapter reviews the literature pertinent to this research question and will be divided into three main parts: (2.1) Adapted Aquatics; (2.2) The Ecological Model of Motor Development; and (2.3) Learn-to-Swim Programs and Progressions.

2.1 Adapted Aquatics

Water has been used for therapeutic purposes for many years. In the 1930s and 40s hydrogymnastics and hydrotherapy were employed in the process of rehabilitation and recuperation for individuals with various physical impairments (Grosse, 1985, 1996; Lampos, 1947; Lowman & Bright, 1935; Reid & O'Neill, 1989; Sherrill, 1993). Lowman and Bright (1935) indicated that hydrogymnastics became more popular as teachers of aquatics and physical education realized the corrective nature of the exercises. In corrective physical education classes, children who had postural or other physical defects were given exercises and drills in the water to stabilize muscles, increase motor efficiency, and improve posture. Regular physical education teachers felt they could aid this process by including these exercises in their classes (Lowman & Bright, 1935).

The use of water as part of corrective physical education stems from hydrotherapy (or water exercises for therapeutic purposes). Water exercises and activities were prescribed as part of the rehabilitative process of individuals with war-related injuries or poliomyelitis (Grosse, 1985; Lampos, 1947; Reid & O'Neill, 1989). Lampos (1947) wrote of his experiences as a member of the Chicago Polio Swim Club and of an American Red Cross program which introduced war veterans who were paralyzed to swimming and water exercises. Participants felt that the water helped them relax and allowed them to regain some strength and movement. Another important benefit was that the time in the water with other participants was a social experience where they could talk and laugh, and not feel self-conscious, thus increasing morale and confidence.

As more and more individuals participated in corrective physical education and hydrogymnastics, it became evident that, in addition to the valuable therapeutic benefits of water, there was also an important educational aspect inherent in these programs (Grosse, 1985, 1996; Reid & O'Neill, 1989; Sherrill, 1993). This shifted the emphasis of some programs from a medical focus to an educational focus.

In the 1950s, growing emphasis was placed on abilities rather than limitations, with programs being developed to teach children with disabilities to swim (Grosse, 1985; Reid & O'Neill, 1989; Sherrill, 1993). Special classes were initially provided for individuals who were deaf or blind. It was felt that swimming was a particularly valuable activity for individuals with visual impairments because they were able to move more freely and confidently in the water than on land, and they could swim with nondisabled individuals without being at a disadvantage (Hunt, 1955). Also, Meyer (1955) argued that swimming included a rhythmical element which was fundamental in the teaching of swimming to individuals who were deaf. Swimming was praised as an activity which developed every muscle in the body, was challenging, and helped to develop both group spirit and individual confidence, all of which had potential carry-over effects into adult life (Meyer, 1955).

As the success of swimming programs for children who were deaf or blind became known, more and more programs became available to children with physical disabilities (Brown, 1953; Kelly, 1954). The programs' main goal was to teach them how to swim. As well as providing the therapeutic benefits of water, learning to swim helped to improve morale by building or maintaining strength and by offering freedom of movement which was unequaled in other recreational activities (Brown, 1953; Hunt, 1955; Kelly, 1954).

An increase in the number of articles published related to teaching swimming to individuals with disabilities was evident in the 1960s, as instructors began to share their ideas, successes, and experiences (Grosse, 1985; Newman, 1970; Sherrill, 1993). Several books were written which dealt with teaching techniques, values and benefits of programs, equipment needed, administration of programs, instructor training and qualifications (American Association for Health, Physical Education, and Recreation, 1969; Anderson, 1968; Grosse, 1985). As well, information was included in adapted physical education textbooks which covered swimming (Clarke & Clarke, 1963; Daniels & Davies, 1965; Fait, 1966; Grosse, 1985).

The 1970s brought about a change in focus once again. Swimming was no longer the only activity for individuals with disabilities. They began to participate in various recreational aquatic activities such as sailing, canoeing, and kayaking (Grosse, 1974,1985; Mielzarek & Mielzarek, 1975; Muhl, 1976; Roeren, 1985; Thomas, 1976). Aquatic sports such as SCUBA and skin diving, water-skiing, synchronized swimming, and surfing began to attract participants with disabilities as they sought new and exciting opportunities and challenges (Daniels & Davies, 1975; Grosse, 1985; Karman, 1975; Muhl, 1976; Thomas, 1976; Turner, 1988). Articles were written to aid participants and instructors in organizing programs, gathering and adapting necessary equipment, and learning the techniques of the various sports (Bond, 1975; Grosse, 1985; Meister, Villareal, & Villareal, 1976; Roeren, 1985; Turner, 1988). As well, swimming competitions became more popular for individuals with disabilities (Allen, 1981). Events were often adapted through the use of shorter distances, special equipment, or adapted strokes, so that everyone could participate with an element of challenge and success (Newman, 1971).

As learning disabilities with attentional disorders and physical awkwardness became recognized, swimming programs were developed for the specific needs of these children. Programs included perceptual-motor activities, academic and language activities, water play, and movement exploration (Grosse, 1985; Hackett & Lawrence, 1976; Smith, 1985). They were designed to enhance fine motor and gross motor skills, language development, confidence and self-esteem, and, of course, to teach participants to swim (Campbell, 1993; Hackett & Lawrence, 1976; Smith, 1985).

Once instructors became more experienced in teaching individuals with a mild disability, they began to include individuals who had multiple or more severe disabilities in their aquatic programs (Allen, 1981; Case & Bearman-Bucher, 1987; Christie, 1985; Grosse, 1985; Grosse & McGill, 1979; Lahay & al, 1976; Newman, 1971). Aquatics was viewed as an excellent activity, because other recreational and physical activities were often not possible or available due to the severity of the participants' disabilities (Christie, 1985; Grosse & McGill, 1979; Lahay & al, 1976).

In the late 1970s and 80s, as more individuals with severe disabilities were beginning to participate in adapted aquatic programs, there was an increase in the number of individuals with a disability who left special programs for mainstreamed programs (Grosse, 1985; Johannsen, 1985). Since the medium of water often reduces the effects of an impairment, and makes a disability less obvious, swimming was an area where individuals with a disability could participate easily and successfully alongside nondisabled peers (Christie, 1985; Grosse, 1985). Although there was some concern over whether the instructors of these "regular" programs would have the knowledge and support needed to teach the integrated individuals (Priest, 1979, 1983), it was felt that the additional social and emotional values of mainstreaming far outweighed the problems (Christie, 1985; Priest, 1979).

Four main areas of growth in adapted aquatics are reflected in the 1990s. First, adapted aquatics continues a significant focus on various recreational and leisure activities for individuals with disabilities. Mayse (1991) described an aquacise and aquafit program for adolescents with intellectual and physical disabilities. In addition to the physical fitness benefits accrued during water aerobic workouts, the programs proposed to help develop skills needed for workout exercises, to provide a sense of accomplishment and self-confidence as they became less fearful of the water, and to offer a source of enjoyment. Burgess and Davis (1993) also discussed the benefits of water exercise for individuals with a disability. Medical considerations were addressed and disability specific exercises and tips were given to individualize the workout to suit the needs of each participant.

Recently, Petrofsky (1994a) discussed SCUBA diving for individuals with spinal cord injuries and included general information on the sport, certification, risks and their affect on individuals with spinal cord injuries, diving locations, and accessibility considerations. Subsequent articles dealt with equipment needed for SCUBA diving and the modifications that can be made for individuals with special needs. Wetsuits can be modified with zippers on the arms or legs and air tanks should be appropriately sized according to a person's body size and oxygen use (Petrofsky, 1994b, 1995). Also addressed are how to overcome problems faced during training and diving (Petrofsky, 1995).

Grosse (1993) described how to facilitate the participation of individuals with disabilities in aquatic adventure recreation activities such as river running (canoeing, rafting, sailing), skin and SCUBA diving, water-skiing, and surfing, as well as triathlons and other competitive sports. Each activity is depicted, equipment needed and possible modifications are included, and common problems with some solutions are offered. Tips, progressions, and equipment for water-skiing for individuals with a disability are also discussed by Ryan (1997). Gaon (1997) outlined several programs designed to provide sailing opportunities for individuals with various disabilities. Another avenue which allows individuals with physical disabilities to participate more easily in aquatic sports is the development and improvement of equipment. King (1997) described new prosthetics that are available to individuals with amputations for use in aquatic sports and activities.

A second area that has gained much attention in the 1990s is elite aquatic sport. For example, Albright (1995) described the techniques used to coach swimmers with spinal cord injuries and other physical disabilities. Also explained were stretching techniques to increase range of motion in joints, how to help a swimmer with a disability find proper body alignment for a more streamlined position, and how to find the best stroke, start, turn, and finish techniques for the individual's particular abilities. As well, Albright addressed precautions related to drastic change in core body temperature, bladder and bowel capabilities, and the increase in susceptibility to sores and abrasions.

Athletes are also beginning to demand to be recognized as athletes. Although there seems to be an increase in the support and information given to coaches of athletes with disabilities, frequently the athletes themselves are not given enough consideration. Hoffer (1995) wrote that athletes with disabilities feel they deserve the same recognition from fans and the sports world as able bodied athletes, as well as the same level of coaching, support, and sponsorship.

A third area that is continuing to develop in the 1990s is the integration of individuals with disabilities into recreational and competitive aquatic sports and activities with their nondisabled peers. An adventure education model, described by Nichols (1997b), proposed using kayaking as a successful means of integrating students with cerebral palsy into regular physical education classes. Nichols (1997a) also described an adapted rudder system for more competitive kayaking. The Moving to Inclusion (1994) series from Canada includes modifications, teaching techniques, and tips to help physical educators include students with various limitations and abilities in aquatic activities, such as swimming, canoeing, kayaking, and sailing.

Nearing, Johansen, and Vevea (1995) described a method of placing gymnastics mats in the pool so that children with disabilities can more easily participate with their nondisabled peers. The gymnastics mats create a raised pool bottom which allows children to touch the bottom of the pool and therefore feel more secure while attempting new skills. As well, some mats will float on the surface of the water allowing them to work more independently on skills and have access to the water without fear of falling from a high place. It is claimed that children with disabilities can play cooperatively with nondisabled children and develop social skills through play activities and games using the mats (Nearing et al., 1995).

Kozub and Porretta (1996) discussed including athletes with disabilities in interscholastic sports alongside nondisabled athletes. It was argued that, as students with disabilities were integrated into inclusive educational settings, the same should hold true for extra-curricular activities. Benefits for participants with and without disabilities in interscholastic sports inclusion were identified. These included societal acceptance, improvement of team dynamics and coach/participant and participant/participant relationships, increase in athletic enrollment, and increased motivation through a greater understanding of using desire and hard work to overcome difficulties and personal limitations. In addition, Lindstrom (1992) discussed the integration of athletes with various levels of disabilities into elite sport and competition with able-bodied athletes. Suggestions for creating policies to integrate the athletes into international able-bodied sport competitions were given.

Finally, as more syndromes and disabilities are identified and gain attention within adapted physical education, programs are developed and teaching methods are suggested which address the unique nature and specific needs of these children. Rider and Modell (1996) described an adapted aquatics program for children with Angelman Syndrome. Their specific characteristics are discussed as well as physical, breathing, relaxation, and social skill activities which can be helpful when teaching them. Also, Culbert (1987) discussed some specific teaching techniques and tips when using swimming therapy for girls with Rett Syndrome.

As the goals and objectives of aquatics for individuals with disabilities have changed over the years, so has terminology (Grosse, 1996). When water was used in a therapeutic fashion to help individuals with physical impairments, the term was Hydrotherapy (Grosse, 1985, 1996; Reid & O'Neill, 1989; Sherrill, 1993). Aquatics for individuals with disabilities split into two main directions as programs took on a more educational focus. One direction, Hydrotherapy, remained medical in nature, with therapists prescribing and performing exercises with clients to help in the rehabilitative process. The second direction was educational as physical educators realized that individuals with disabilities were able to learn to swim, with potential physical, mental, and emotional benefits. The term employed was simply Swimming for the Handicapped (Brown, 1953; Grosse, 1985, 1996; Kelly, 1954). The 1970s brought about another change in focus and terminology in the field. Swimming for the Handicapped became Adapted Aquatics as individuals with disabilities participated in other aquatic sports and leisure activities such as water fitness, canoeing, sailing, synchronized swimming, SCUBA and skin diving, water-skiing, and surfing (Grosse, 1985, 1996; Reid & O'Neill, 1989; Sherrill, 1993). Currently, the focus is less on the specific terminology and more on the quality of the services and programs provided (Grosse, 1996).

2.2 The Ecological Theory of Motor Control

The ecological theory of motor control is a relatively new perspective on motor development which has emerged and developed over the past 20 years (Haywood, 1993). It is founded on the notion that there exists a strong interrelationship between the individual or performer and the environment in which he/she is performing (Balan & Davis, 1993; Block, 1994; Burton, 1987; Burton, 1990; Burton & Davis, 1992; Davis, 1984; Davis & Burton, 1991, 1997; Haywood, 1993).

A major tenet of the ecological approach is that individuals are composed of multiple complex systems which work cooperatively to produce movement outcomes (Burton, 1990; Davis, 1984; Haywood, 1993). This is in contrast to other developmental theories. The information processing theory, for example, postulates that there is an executive function (the central nervous system) which, decides upon an appropriate response based on perceptual information and existing knowledge. Then it controls the muscular system to produce the action (Davis, 1984; Haywood, 1993). The ecological perspective proposes that behavior emerges as a function of many interacting systems, such as muscular, skeletal, cardiovascular, neural, perceptual, and emotional, (Burton, 1990; Davis, 1984; Haywood, 1993). These systems develop independently from one another, at different rates (Haywood, 1993), and therefore affect the behavior exhibited by an individual. In other words, the development of a skill or movement is the product of the development of the individual systems. A corollary to this is that the necessary system for a particular movement which develops at the slowest rate dictates or controls the development of that skill by reaching a critical point (Haywood, 1993). This system is called the rate limiter for that skill because that system's development determines when the skill will emerge. It is for this reason that the ecological model argues that development is discontinuous in nature (Davis, 1984; Haywood, 1993).

A second related tenet of the ecological perspective is that the various body systems are able to spontaneously self-organize or self-assemble, in response to direct perception of the environment, to produce a movement behavior or outcome (Haywood, 1993). This contrasts with the notion of one executive function which controls all movement. Rather, the various systems are able to reduce the decisions made by higher brain centers by taking on some of the load themselves. As indicated above, a movement can only emerge as a result of the dynamic interplay between the self-organization of the body systems, the nature of the performer's environment, and the demands of the task (Haywood, 1993). Simply stated, a motor skill or movement outcome is dependent upon the interaction between the performer's characteristics, the environmental constraints, the task demands, and the individual's perceptions of these factors (Balan & Davis, 1993; Block, 1994; Davis & Burton, 1991, 1997; Haywood, 1993).

Since the interrelationship of these three components (person, task, environment) gives rise to a particular movement, it is logical to conclude that if one of the components is altered in any way, the resultant movement will also change. Balan and Davis (1993), Burton and Davis (1992), and Davis and Burton (1991) illustrated this point by explaining that an individual with a physical impairment could locomote using several different movement skills (rolling, swimming, crawling, walking with a prosthetic device, propelling a wheelchair, hopping, ...). The choice of movement skill would depend on the environment in which the skill was to be performed (a flat surface, a slope, in water, obstacles, on uneven or rough terrain, with others, carrying an object,...), the task to be accomplished (move with speed, accuracy, go over/under/through, distance, duration,...), and the performer's attributes and perceptions of the environment and task, as well as self-perceptions (range of motion, height, perceptual systems function, physical impairment, assistive device, fears, self-esteem, previous experiences, ...).

Research has been conducted explaining the effects of manipulating task, environment, and performer constraints (Burton, 1990; Burton, Greer, & Wiese, 1992), as well as how to manipulate the conditions to optimize movement performance for children with physical disabilities (Burton & Davis, 1992). Burton and Davis (1992) describe a study by Agre, Findley, McNally, Habeck, Leon, Stradel, Birkebak, and Schmaltz with children with spina bifida who could walk or propel themselves by wheelchair. Walking was much more strenuous for them than wheeling, even when wheeling three times faster than walking. For these children, therefore, if the task was to locomote for a lengthy period of time, it would seem that propelling themselves using a wheelchair would be most appropriate skill to use.

Burton et al. (1992) looked at the effects of ball size on changes in overhand throwing patterns of males and females in four age/grade groups: kindergarten, second grade, fourth grade, and young adults. Results demonstrated that increasing ball size changed the resultant throwing pattern. The researchers were not able to pinpoint a ball size that would elicit an optimal throwing pattern for all subjects, as this is dependent on the ball diameter:hand width ratio. This study lends support to the strong relationship between the performer, task, and environment constraints which work together to produce a movement outcome. The resultant movement will be different if one or more of the variables is manipulated.

Burton (1990) looked at how children in different groups (developmentally delayed preschoolers, nonhandicapped kindergarteners, and nonhandicapped fourth graders) move through an obstacle course (crossbars of different heights). Results showed that the fourth graders moved through the course much faster than the two other groups, and that the preschoolers with developmental delays negotiated the obstacles much more slowly, and made many more mistakes than the nondisabled kindergarteners. When examining how the children negotiated the crossbars (over/under, under with body parts besides feet on ground/walking under), it was found that although most fourth graders and kindergarteners jumped over the crossbars at 44% of their standing height, and walked under crossbars at 56% of their standing height, most preschoolers chose to creep under the crossbar in both of these conditions. These results once again demonstrate that when an individual performs a movement, the task at hand and the environment affect the outcome. In addition, the abilities and limitations of the performer, as well as how the performer perceives him/herself, the task, and the environment also greatly affect the movement outcome. There was not one absolute 'ball size' or 'crossbar height' which elicited optimal performance in the above studies. Rather, optimal performance depended partly on the relationship between this variable and the individual. This can be explained by the concept of affordances.

An affordance is the functional utility of an object in the environment, or the opportunity for action it offers a person (Davis & Burton, 1991). The concept of affordance is directly related to the ecological model because an object's affordance is perceived by an individual in terms of his or her own personal characteristics (personal constraints). Using the example of the crossbar height from Burton's study (1990), a crossbar that is high in comparison to a shorter performer's height will afford 'going under' for the person, whereas to a performer who is taller, that same height of crossbar will afford 'going over'. For the child with a developmental delay who may perceive differently, the crossbar afforded going under in a creeping fashion for several of the crossbar:performer height ratios, however this was not the case for many of the other nondisabled children. This relates to a central tenet of the ecological model, not every person will use the same movement to reach the same task goal. Rather, the interaction or relationship between the task at hand, the environmental constraints, and a performer's attributes (body systems) and perceptions of these constraints will affect the movement outcome of each person.

Ecological Task Analysis, first presented by Davis and Burton in 1991, is an assessment and instructional model which is grounded in the ecological model of motor development. It is defined by Davis and Burton (1991) as "the process of changing relevant dimensions of a functional movement task to gain insight into the dynamics of the movement behavior of students, to provide teachers with clues for developing instructional strategies, and ultimately to promote the success of students in performing the task" (p. 160). In contrast to a more traditional developmental model for teaching physical education, which tends to use a bottom-up approach to assessment and instruction, ecological task analysis uses a top-down approach. A top-down ecological approach determines what a student needs for participation in current and future physical activities, assesses current abilities and limitations, and teaches skills, in as typical a context as possible. The skills taught are directly related to successful involvement in current and future physical activities (Block, 1992, 1994; Burton, 1987; Kelly, 1989). Conversely, bottom-up or developmental task analysis essentially involves analysing the factors affecting a skill and presenting these factors in a sequence, from least to most complex, to elicit successful performance (Austin, 1978; Block, 1994; Roberton, 1989). When teaching physical education to a child with a physical disability using a bottom-up approach, assessment determines the child's developmental age, and the discrepancy between this and age expectancies (Austin, 1978; Block, 1994). The child is taught an assortment of tasks to improve fundamental motor skills to overcome deficits so that the child can move up the developmental scale (Austin, 1978; Block, 1992, 1994; Roberton, 1989).

Ecological Task Analysis is an appropriate tool for motor assessment because it addresses two main assumptions that Davis (1984) has criticized as being weaknesses of criterion-referenced tests, such as those used within the Red Cross or YMCA aquatic programs. The first assumption is that criterion-referenced tests assume only one biomechanically optimal movement for performing a skill. The ecological perspective disputes this assumption by arguing that every movement is dependent on a unique set of task, environment, and performer variables (Balan & Davis, 1993; Block, 1994; Burton, 1987; Burton, 1990; Burton & Davis, 1992; Burton, Greer, & Wiese, 1992; Davis, 1984; Davis & Burton, 1991, 1997; Haywood, 1993). Thus, each person may have his/her own biomechanically optimal movement. The second assumption of criterion-referenced tests is that all individuals progress through the same sequence of motor developmental steps, although on different time frames. The ecological approach contends that development may be discontinuous in nature and depends on the development of the separate body systems and their interactions with one another and the environment (Burton, 1990; Davis, 1984; Haywood, 1993).

There are four basic and linked steps to the Ecological Task Analysis model (Balan & Davis, 1993; Davis & Burton, 1991, 1997). The first step involves establishing the movement or task goal. The environment must be structured, and the task must be presented, in a way that the student will understand the goal of the task, the conditions under which the performance will take place, and the criteria necessary to reach the intended goal. Davis and Burton (1991, 1997) pointed out that it is essential that the task goal be based on a functional task (locomotion in water) rather than a specific movement skill (front crawl). There are three important aspects to consider when introducing a goal to a learner (Davis, 1989). The instructor must first be aware of the intention of the goal;

what the student actually does. The instructor must then know what he/she wants to accomplish with the goal; the purpose. Finally, the instructor must provide meaning to the goal/task for the student, which likely provides motivation for the task. Burton (1987) argues that a performer will be more willing to perform a particular task if it is purposeful in nature and is not simply a movement without any objective beyond the performance of the movement itself. Basically, by providing meaning and purpose to a movement, for example asking a child to swim across the pool to retrieve a favorite toy, the child may be more motivated to perform that task.

The program descriptions of Rivers and Temple (1997) and Arbuthnot (1997) support this notion of movement goals. Arbuthnot (1997) gave the example of a child who is asked to perform a typical assessment task of walking along a line on the floor by a therapist, versus a child who is asked by a gymnastics coach to walk along a balance beam which is 'a bridge that passes over an alligator's home'. It is expected that the child who is walking along the 'bridge" will concentrate more, not falling into the alligator pit, and will probably have more fun performing the task. Once the goal of the task has been established and the environment has been appropriately structured, the child should be provided freedom to respond in his/her own way (Balan & Davis, 1993; Davis & Burton, 1991, 1997).

Allowing the students to make choices is the second step of the Ecological Task Analysis model (Balan & Davis, 1993; Davis & Burton, 1991, 1997). Students should be allowed to choose the skill or movement form they will employ to achieve the task goal, as well as the equipment to use, if appropriate. By providing students with the freedom to make choices and initiate their own actions, they will feel more empowered and motivated, and will therefore participate to a greater extent. At this point the instructor should step back and observe the skills and movement patterns each child has chosen to achieve the task goal, and should evaluate how successful that child has been at reaching the task criterion. The instructor should then proceed to the third step.

The third step of the Ecological Task Analysis model involves manipulating the relevant task, environment, and/or performer dimensions to provide the student with success and challenge (Balan & Davis, 1993; Davis & Burton, 1991, 1997). By manipulating task and environment constraints, the instructor can determine under which conditions a student can always, sometimes, and never accomplish a task goal (Davis & Burton, 1991, 1997). The instructor can also assess a student's preferred skills, his/her feelings of self-esteem and confidence, as well as task, performer, or environment variables which may be limiting a student (Balan & Davis, 1993; Davis & Burton, 1991, 1997).

Instruction is the final step of the Ecological Task Analysis model (Balan & Davis, 1993; Davis & Burton, 1991, 1997). An instructor can use any number of instructional strategies. However, when using the Ecological Task Analysis model, it is very important that the end-goal of the task always be maintained if instructional variations are to be used, otherwise the movement outcome will be disrupted.

Davis and Burton (1997) state that not all children with physical disabilities will be able to achieve every motor skill or movement pattern, due to the interaction between the performer, task, and environment constraints. All children can however achieve the functional task goal, if the goal of that task is properly presented, if the students are free to make their own movement choices, and if the environment is properly structured.

Ecological task analysis and the ecological model of motor control support the notion that all proposed prerequisite skills of a specific task goal may not be necessary, especially if the goals of the prerequisite skills differ from the end-goal of the task. An example is front swim progressions. The goal of the front swim is to locomote in the water from one point to another. However, the goal of one of the proposed prerequisite skills, the front float, is to support one's body along the surface of the water with no movement. This particular contradiction and the overall need of each of the usual progressions in learn-to-swim programs led to the purpose of this study; to determine the developmental validity of traditional learn-to-swim progressions for children with physical disabilities.

2.3 Traditional Learn-to-Swim Programs and Progressions

Traditional aquatic programs which aim to teach swimming generally follow the same set of learn-to-swim progressions, although they may have different teaching philosophies and stem from different educational models. These progressions are commonly termed water orientation/entry and exit, breath control, buoyancy, gliding (with push-off), arm and leg action, and combined limb aquatic locomotion (Canadian Red Cross Society, 1983, 1996a, 1996b; Langendorfer & Bruya, 1995; Sherrill, 1993; YMCA, 1993a). These basic aquatic skills are believed necessary to learn how to swim. The skills are taught in sequential format, often linked to badges or certification at each level. Although traditional programs such as the Red Cross (1983, 1996a) and the YMCA (1993b) indicate that there can be variance in the sequence in which the skills are presented, the structure of the programs does not facilitate this approach. Moreover, Langendorfer and Bruya (1995) stated that traditional aquatic programs have not considered the developmental validity of their progressive programs. Work is being done by Langendorfer and Bruya to create a learn-to-swim sequence for preschoolers, however, the applicability of the sequence to children with disabilities has not yet been addressed. In a search of related literature, no studies were found which addressed the issue of the developmental validity of traditional learn-to-swim programs. Killian, Arena-Ronde, and Bruno (1987) dealt with the interobserver agreement and validity of two instruments designed to assess water orientation, the Water Orientation Checklist-Basic (WOC-B) and the Water Orientation Checklist-Advanced (WOC-A). They found that the tasks employed to assess water orientation of pre-schoolers, children, and youths, with and without disabilities, were in fact valid sequences. This was an important step in determining the developmental validity of progressive sequences and programs, however, the WOC-B and the WOC-A only dealt with the first level of traditional learn-to-swim progressions - water orientation/entry and exit.

The new Canadian Red Cross Water Safety Program (1996a, 1996b) attempts to help instructors adjust their teaching to integrate students with various types of special needs. The basic learn-to-swim progressions are maintained in the new program, however, there have been some modifications and additions. One change is the addition of skills, such as the butterfly, at higher levels. As well, levels have been added so that transitions are smaller, and therefore learners experience more success. The creation of the new program was made through the Canadian Red Cross incorporating feedback and information from participants, instructors, instructor trainers, and aquatic directors regarding the previous program. The Red Cross also examined statistics within the National Drowning Report and aimed to create a program, suitable to participants of all ages, which would reduce the number of drownings and water related fatalities and injuries through the instruction of water safety skills and techniques. Pilot projects were then implemented in key areas across Canada to determine the appropriateness and feasibility of the new program. Feedback was once again collected at the pilot project sites, modifications were made, and ultimately the new Red Cross Water Safety Program was established (Y. Bessette, personal communication, May 20, 1997).

The Steps to Success Activity Series (Vickers, 1990) is founded on the knowledge-based approach (Wall, McClements, Bouffard, Findlay, & Taylor, 1985). It states that students should not only be taught skills needed for a particular sport or activity, but that they should also learn the strategies and concepts within that particular sport or activity so that learning is more meaningful and complete. This model proposes that information should be presented in a top-down fashion: The end skill, strategy, or concept is presented first to create a clear idea of the intended goal of instruction. Once the knowledge structure of the activity has been presented, and environmental constraints, student characteristics, and present skill levels have been identified, the specific skills or steps of the end goal can be sequenced and taught, while allowing the students to keep the overall concept in mind (Vickers, 1990).

Thomas (1989) has identified the learn-to-swim sequence of the Steps to Success series as: buoyancy, back float, sculling, arm movement on back, kicking on back, prone float (prone float with push-off/glide), kicking on front, arm movement on front, breathing, and front swim with breathing. During the creation of the learn-to-swim sequence, experienced instructors in the field were consulted, and instructors and participants provided feedback on model prototypes, so that the most useful and appropriate instructional guide could be developed (Thomas, 1989). However, no studies were found which determined the validity or reliability of the learn-to-swim sequence, or of any of the learning sequences, of the Steps to Success Activity Series. Although the Steps to Success model advocates a top-down approach for teaching an activity, where the end-goal is presented first, skills or concepts are taught while constantly focusing on the end-goal, little leeway is given for adaptations to the sequences to accommodate the specific needs and abilities of learners who may have special needs. If a child already possesses a particular skill (for example, kicking on front) in an activity sequence, why should that child spend time to acquire a skill (for example, prone float) that precedes the attained skill if it makes no difference in the performance and success of the end activity (for example, front swim)?

The main goal of this study is to address this question by attempting to determine if the proposed progressive skills of traditional learn-to-swim programs are in fact progressive or sequential in nature for a learner with a physical disability.

CHAPTER 3

Methodology

The purpose of this study was to determine the developmental validity of traditional learn-to-swim progressions for children with physical disabilities. The following chapter is divided into four sections: (3.1) Subjects; (3.2) Instrumentation; (3.3) Procedures; and (3.4) Treatment of the Data.

3.1 Subjects

Forty-seven children with physical disabilities were identified as potential participants in the study. Four children were not given permission by their parents or guardians to participate. As well, three children did not pass a water orientation-adjustment test when administered by the researcher. Therefore, a total of 40 children participated.

The children were described in several ways. The first was according to disability type. Of the 40 participants, 21 had cerebral palsy, eight children had spinal cord impairments, and nine children had other physical disabilities. In addition, six children were diagnosed as having a developmental delay (these do not add up to 40 since several children were identified as having a particular physical impairment along with the developmental delay). A second method of describing the participants was according to their mode of ambulation. Twenty children were ambulatory, walking without any assistive devices. Four children required assistive devices such as a walker or crutches, 11 required a wheelchair which they propelled themselves, and five required motorized wheelchairs for ambulation. The children were also described using the Cerebral Palsy and National Wheelchair Athletic Association functional sport classifications (for level descriptions, see Appendix B), and according to whether or not they used a floatation device. Table 1 provides a summary of the number and percentage of children in each subcharacteristic. For a complete subject description, see Table A-1 and A-2 in Appendix A.

Table 1: The Number and Percent of Students Within Each Descriptive Subcharacteristic

CHARACTERISTIC	SUBCHARACTERISTIC	N*	PERCENT**
Disability Type	Cerebral Palsy	21	52.5
	Spinal cord impairment	8	20
	Other	9	22.5
	Developmental delay	6	15
Functional Classification	CP I	5	12.5
	CP II	2	5
	CP III	5	12.5
	CP IV	1	2.5
	CP V	2	5
	CP VI	0	0
	CP VII	4	10
	CP VIII	8	20
	S5	3	7.5
	S6	2	5
	S 10	16	40
	B 7	1	2.5
Mode of Ambulation	Ambulatory	20	50
	Assistive device	4	10
	Wheelchair	11	27.5
	Motorized wheelchair	5	12.5
Use of Floatation Device	Yes	25	62.5
	No	15	37.5

* N = number of students (total N = 40)

** The percent of students may not total 100% for each descriptive characteristic because some students were included in several subcharacteristics to better describe them.

The children ranged in age from 5 to 12 years. They attended a reversely integrated school in the Montreal area and took part in aquatic classes as a regular part of their school curriculum once a week for approximately 45 min. As a criteria for admittance into the study, all children were identified by their regular aquatic instructor as having an advanced level of comfort in the water. This prerequisite was reassessed by the researcher prior to testing. Upon request by the researcher, the participant demonstrated voluntary entry into the water with no apparent fear or hesitation. Any child who did not meet this qualification was removed from the study and further testing. As stated previously, three children were excluded for this reason.

3.2 Instrumentation

A water orientation-adjustment test adapted from the work of Langendorfer and Bruya (see Table 2) was administered to all subjects to ascertain that they were comfortable in the water. This test consisted of the child being asked to enter the water in any manner, wearing a floatation device if needed, whereby initial reactions to the demand were assessed. The child was assessed in a pass/fail manner. A pass signified voluntary entry into the water with no apparent fear or hesitation, whereas a fail signified entry with some expression of fear or hesitancy, or a complete refusal to enter the water (Langendorfer & Bruya, 1995).

Contingent upon successful completion of the water orientation-adjustment test, subjects proceeded with testing. The subjects were tested on the following skills: rhythmic breathing, unassisted front float with recovery, front glide, front swim, unassisted back float with recovery, back glide, and back swim. The skills were assessed in random order for each child. They were judged in a pass/fail manner. In order to receive a pass, all criteria for success of the skill had to be met. These criteria are listed in Table 3 and are adapted from the works of the Canadian Red Cross Society (1996) and Langendorfer and Bruya (1995).

Table 2: Water Orientation-Adjustment Test

STEP/LEVEL	DECISION
1. No voluntary entry into the water; demonstrates obvious expressions of fear of the water including crying or refusal to enter the water	Fail; excluded from study
2. Voluntary entry into the water with expressions of hesitancy or reluctance which interfere with movement or submersion activities in the water	Fail; excluded from study
3. Voluntary entry with no expressions of hesitancy or fear of the water	Pass; included in study

Adapted from Aquatic readiness: Developing water competence in young children (p. 39) by S.J. Langendorfer and L.D. Bruya, 1995, Champaign, IL: Human Kinetics.

Throughout the testing, one individual, called the demonstrator, performed all necessary demonstrations prior to each skill test. The demonstrations were performed to ensure that each participant received the same information prior to testing and to ensure that each participant was fully aware of the task being requested. Demonstrations were not performed for the water orientation-adjustment test, the front swim test, nor the back swim test, so that participants felt comfortable in doing these tasks in any way they chose. This is consistent with a major tenet of the ecological model of motor control (Balan & Davis, 1993; Block, 1994; Burton & Davis, 1992; Davis & Burton, 1991, 1997; Haywood, 1993) which argues that not every performer will use the same movement pattern to attain the same end-goal.

Table 3: Criteria for Success of Skills Tested

Rhythmic breathing/breath control

- bobs submerging head completely (top of head, including ears & hair, goes under)
- exhales through mouth and/or nose underwater, inhales just above water, with noticeable and effective exhalation & inhalation on EACH repetition
- performance is rhythmic, relaxed and continuous
- performs at least 5 repetitions in any body position in chest deep water

Front float (unassisted with recovery)

- assumes stable floating position on front; with face in water, feet off the ground and body along the water surface
- legs no more than 45° below the water surface from the head position to be considered a front/prone position float
- holds stable position with minimal or no movement for at least 5s in a relaxed manner
- comfortably recovers to original position

Front glide

- uses push-off from pool bottom or side
- levels off to a near horizontal position (legs no more than 45° below water surface) from a near vertical position
- glide is prone with face in water, unsupported, and in a relaxed manner with minimal or no movement
- body is in as streamlined a position as possible (ask them to show us how high they can stretch prior to attempting the glide)
- glides for at least 2 body lengths
- comfortably recovers to original position

Front swim/propulsion

- forward movement in prone position
- body approaches horizontal position (no more than 45° below water surface)
- any arm & leg movements or combination of both
- face does not have to be submerged or in the water (can be a head up swim)
- does not touch bottom of pool
- swims for a minimum of 10 m in at least chest deep water

Table 3 (continued)

Back float (unassisted with recovery)

- assumes stable floating position on back; feet off the ground and body along the water surface
- legs no more than 45° below the water surface from the head to be considered a back/supine float
- holds stable position with minimal or no movement for at least 5s in a relaxed manner
- comfortably recovers to original position

Back glide

- uses push-off from pool bottom or side
- levels off to a near horizontal position (legs no more than 45° below water surface) from a near vertical position
- glide is supine, unsupported, and in a relaxed manner with minimal or no movement
- body is in as streamlined a position as possible (ask them to show us how high they can stretch prior to attempting the glide)
- glides for at least 2 body lengths
- comfortably recovers to original position

Back swim/propulsion

- forward movement in supine position
- body approaches horizontal position (no more than 45° below water surface)
- any arm & leg movements or combination of both
- does not touch bottom of pool
- swims for a minimum of 10 m in at least chest deep water

Adapted from Canadian Red Cross water safety services: Water safety instructor manual. (p. 85-90, 154-160) by the Canadian Red Cross Society, 1996, St. Louis, MO: Mosby Lifeline and Aquatic readiness: Developing water competence in young children. by S.J. Langendorfer and L.D. Bruya, 1995, Champaign, IL: Human Kinetics.

The demonstrator, who had extensive aquatic as well as adapted physical activity experience, was trained by the researcher prior to the commencement of the study in the following manner. The demonstrator was briefed on the necessary criteria for success (see Table 3) of each skill. The demonstrator was then asked to perform each skill item. The researcher and an independent observer (called second observer) observed and scored each skill performed by the demonstrator. To ensure each skill was being performed correctly by the demonstrator during this training period, both the researcher and the second observer had to agree that each criterion for success of each skill, as outlined in Table 3. The agreement by the researcher and the second observer ensured that the demonstrator was aware of how to perform each skill and would then be able to successfully demonstrate during the study.

The second observer also participated in the testing to assess objectivity of observations by the researcher. This observer was trained prior to testing in the following manner: The two observers (the researcher and the second observer) independently observed and scored five children on each skill test. The observers then compared and discussed results until there was 100% agreement on which performance criteria were apparent in the skills observed.

3.3 Procedures

There were five people involved in the testing of each child; the aquatic instructor, the researcher, the demonstrator, the second observer, and the child. All testing took place on a one-to-one basis, in the child's regular pool environment, during his/her regular swimming class period. The aquatic instructor, their regular teacher, was present to ensure the participants were comfortable throughout the testing procedure. All information and pass/fail results for each skill was recorded by the researcher.

Upon successful completion of the water orientation-adjustment test, the demonstrator performed the first skill to be tested. The skills of rhythmic breathing, front float, front glide, front swim, back float, back glide, and back swim were assigned to each child in random order. If the first skill to be tested was rhythmic breathing (called 'bobs'), testing would have proceeded as follows (for graphic representation see Figure 1). The aquatic instructor followed the same script for the testing of each subject (see Appendix E). The instructor pointed out each criterion for success to the student as they were performed by the demonstrator, for example "the top of the head, including the ears and hair has to go underwater for each bob". These criteria were written on a sheet of paper for the aquatic instructor to follow (see Table 3), to ensure identical information was given to each participant. The subject was then asked by the aquatic instructor to perform the rhythmic breathing skill; "name of child, please do 5 bobs." The child had five seconds to respond to the request. If the child responded successfully and demonstrated all the criteria delineated in Table 3, a pass for the rhythmic breathing skill was recorded. If the child did not make any attempt to respond to the request through voluntary movement resembling a bob after a five second time delay, the child was asked a second time to perform the bob (in the same way as above). If there was still no response following the second request and the five second time delay, a second demonstration was performed by the demonstrator, and the aquatic instructor asked the child a third time to perform the skill. If the child once again did not respond to the request within the five second time allotment, the child received a fail for the skill of rhythmic breathing.

If there was an incorrect response on the first attempt, the child was asked to try again; "name of child, could you please try to do the 5 bobs again?" If the response was then correct, the child received a pass for the rhythmic breathing skill. If the response was still incorrect, the demonstrator once again demonstrated the five bobs and the aquatic instructor asked the child to perform the skill for the third time; "name of child, could you please try to do the 5 bobs again?" If the response was correct and all the criteria for success of the rhythmic breathing skill were present, the child received a pass for this skill. If the response was once again incorrect, the child received a fail for the rhythmic

1st request (with demonstration*)

↓

5s time delay

↙ ↘

no/incorrect response — correct response → **PASS**

↓

2nd request (without demonstration*)

↓

5s time delay

↙ ↘

no/incorrect response — correct response → **PASS**

↓

3rd request (with demonstration*)

↓

5s time delay

↙ ↘

no/incorrect response — correct response → **PASS**

↓

FAIL

*Demonstrations will not be included during front and back swim skill tests so that the child is free to perform the skill in any manner he/she chooses.

Figure 1: Flow Chart Determining Pass or Fail of an Aquatic Test Item.

breathing skill. The researcher recorded the skills passed by each child, the number of attempts made for each skill by each child, as well as the criteria not met in all failed items. Throughout the testing process, the aquatic instructor only pointed out the criteria for success of each skill during its demonstration, but provided general verbal encouragement or verbal prompts (Watkinson & Wall, 1982) to the child.

The same procedures were applied to the testing of all identified skills: rhythmic breathing, front float, front glide, back float, and back glide. The front swim and back swim tests proceeded in the same manner, with the exception that there was no skill demonstration. For the front swim skill test, the child was asked by the aquatic instructor to swim on his/her front from point A to point B (a distance of 10 m). For the back swim skill test, the child was asked to swim on his/her back from point A to point B (a distance of 10 m). Point A and point B were clearly marked by flutter boards on the side of the pool so they were recognizable to the child. There was a 15s rest time between each skill test.

The second observer participated in the initial testing of 23 of the 40 children in the study (evenly spaced out among the subjects), along with the researcher. The researcher and the second observer independently observed and scored the chosen children in order to assess the objectivity of observations by the researcher.

Two weeks following initial testing, 25% of the children were randomly chosen and retested on all items, using the same procedures as described above, to assess temporal stability of performance. The random selection of subjects for retesting was performed using a random numbers table and the method described by Thomas and Nelson (1990). Since the regular swimming class periods were 45 min. per week, it was assumed that there would not be a substantial increase in skill performance between initial testing and retesting to have an effect on data collection or results.

3.4 Treatment of the Data

The data were analyzed to determine whether, the proposed progressive skills of the new Canadian Red Cross program (1996), rhythmic breathing, front float, and front glide, were true prerequisites of the end-goal of the front swim. As well, were the proposed progressive skills of back float and back glide necessary prerequisites for the end-goal of swimming on the back?

Reliability of observations was assessed through the use of the second observer to determine percent agreement as to the criteria for success that were apparent in the performance of each skill. The results of the researcher were compared to those of the second observer to calculate percent agreement, and hence, to assess the objectivity of observations by the researcher.

Temporal stability was estimated through the reassessment of 10 randomly chosen children (Thomas & Nelson, 1990). The percent agreement between initial test results and retest results of this sample were calculated to determine temporal stability of performance.

The developmental validity of the traditional learn-to-swim progressions was determined through calculating and comparing the number and percent of children who did not follow the typical learn-to-swim pattern (atypical), leading to the front or back swim, to the number and percent of children who did follow (typical) the proposed traditional pattern. Descriptive analysis was performed on the main dependent variables which were the percentages and number of children per category. The three main categories were atypical progressions, typical progressions, and no skills passed. The data were analyzed to determine whether or not the said prerequisite skills were in fact necessary for the acquisition of either forward or backward propulsion by the child with a physical disability.

The data were analyzed to determine if there were any specific skills that were not necessary for the end-goal of front swim or back swim. The number and percent of children who failed each skill test was calculated. Logically, if a certain skill was failed by a large majority of students, it would be possible to conclude that the skill should not necessarily be part of the learn-to-swim progressions. As well, the results were analyzed to determine whether there was a link between any of the descriptive characteristics of the subjects and the appropriateness of the progressive skills through an assessment of the description of the students in each category.

CHAPTER 4

Results and Discussion

The purpose of this study was to determine whether the progressive skills of traditional learn-to-swim programs were developmentally valid for use with children with physical disabilities. The present chapter is divided into the following sections: (4.1) Reliability of Observations and Temporal Stability of Performance; (4.2) Validity of Progressions; (4.3) Summary of Anecdotal Information; (4.4) Necessity of Skills Within the Traditional Front and Back Learn-to-Swim Progressions; and (4.5) Relationship Between Validity of Progressions and Descriptive Characteristics of Subjects.

4.1 Reliability of Observations and Temporal Stability of Performance

The reliability of observations by the researcher was calculated using a second observer. They recorded the presence of the criteria for success for skill performance. The researcher was the primary observer and recorded the criteria for success that were apparent for each participant's performance of each skill item, as well as any anecdotal information that may have been useful for understanding the data. The second observer independently recorded the presence of criteria for success of 23 of the 40 subjects (57.5%). These recordings were random. Agreement consisted of the two observers recording the same response (presence / absence) for a particular criterion for success. The percent agreement between the two observers was calculated separately for each skill by dividing the number of agreements by the total number of responses. The percent agreements for each skill are presented in Table 4. The average percent agreement was 98.4%. Due to the high agreement between the two observers, it was concluded that the observations performed by the researcher were accurate. In the small number of disagreements between the two observers, the overall agreement of whether the skill was passed or failed was not affected.

Table 4: Percent Agreements of Reliability of Observations and Temporal Stability of Performance

Skill	Reliability of Observations	Temporal Stability
Rhythmic breathing/breath control	100	97.5
Front float	96.7	100
Front glide	97.8	98.3
Front swim/propulsion	100	100
Back float	98.9	97.5
Back glide	95.7	98.3
Back swim/propulsion	100	100
Average	98.4	98.8

The temporal stability of performance was determined through the calculation of the percent agreement between initial and retest results. The retest was performed by the researcher on ten (25%) randomly chosen subjects, two weeks following initial skill tests Due to high reliability of observations by the researcher, as described above, it was deemed unnecessary to utilize a second observer for the assessment of temporal stability. An agreement consisted of the same response (presence / absence) for a particular criterion for success of an individual in both the initial skill test and retest. Percent agreement was calculated separately for each skill by dividing the number of agreements by the total number of responses. The individual skill percent agreements are included in Table 4. The average percent agreement was 98.8%. The high level of agreement between initial and retest results signified that there were no drastic changes in performance ability over time. Thus, the performance of subjects during initial testing was reliable and indicative of their abilities. In all cases but one, there was no change over the two weeks as to whether a skill was passed or failed. In one case however, there was a difference: Subject #19 had difficulty during the initial testing with the back float criterion 'holds stable position with minimal or no movement for at least 5s in a relaxed manner'. During the retest, although there was still some movement, the subject was able to remain stable for the full 5s and therefore passed the item.

4.2 Validity of Progressions

The purpose of this study was to explore the developmental validity of traditional learn-to-swim progressions for children with physical disabilities. This was achieved through a comparison of the number of subjects who followed the traditional pattern and the number of subjects who did not follow the traditional learn-to-swim pattern, for the front swim and back swim separately. The suggested progressions leading to the front swim are rhythmic breathing, front float, and front glide (Canadian Red Cross Society, 1983, 1996a, 1996b; Langendorfer & Bruya, 1995; YMCA, 1993a). The back float and the back glide are the suggested prerequisite skills leading to the back swim (Canadian Red Cross Society, 1983, 1996a, 1996b; Langendorfer & Bruya, 1995; YMCA, 1993a). A subject was identified as having followed the suggested progressions if each skill leading to a successful front swim or back swim was passed was preceded by a passed skill. If any successfully completed skill in the suggested progressions was preceded by a failed skill, that subject was identified as having not followed the pattern. Logically, it was expected that a failed skill should not be followed by success on a subsequent skill which is supposed to be more difficult and possibly dependent upon the skill that was failed. Of the 80 total cases (40 front skill patterns and 40 back skill patterns) 67.5% of subjects did not follow the pattern and 7.5% of the subjects followed the suggested learn-to-swim progressions. The remainder were not successful at any of the progressions, despite having passed the water orientation-adjustment test. Table 5 provides a complete breakdown of the percent of students who followed and who did not follow the front skill and back skill progressions.

Table 5: The Percent of Subjects Per Category for the Front Skill and Back Skill Sequences.

	PERCENT OF STUDENTS (and NUMBER)	
CATEGORY	FRONT SKILLS	BACK SKILLS
Atypical Progression	80 (32)	55 (22)
Typical Progression	7.5 (3)	7.5 (3)
No Skills Passed	12.5 (5)	27.5 (11)
Total	100 (40)	90 (36)

The total percent on back skills does not add up to 100% due to the fact that 10% (4) of the students exhibited a pattern of Pass/Fail/Fail; the students passed the back float, however they were unable to meet all the criteria for success for the back glide and the back swim. Since there was no break in the pattern, i.e. a passed item was not preceded by a failed item, these cases cannot be included under the Atypical Progression category. However, without knowing whether the children will be able to perform the subsequent skills, it cannot conclusively be determined whether the individuals will fall under the Typical or Atypical Progression category.

The results shown in Table 5 for the front skills strongly suggested that the proposed prerequisite skills for the front swim were not developmentally valid for all children with physical disabilities, since 80% of them did not follow the learn-to-swim sequence, compared to only 7.5% who did follow the sequence. Within the 80% of children whose progression was atypical for the front learn-to-swim sequence, two children passed three of the four skills, including the front swim; three of the children passed two skills, again including the front swim; and 27 children failed all three prerequisite skills of the front swim and yet passed the front swim skill. This lent further support to the conclusion that the proposed learn-to-swim progressions of the front swim were not developmentally valid for children with physical disabilities. Of the three children who followed the typical progressions, all passed the three prerequisite skills to the front swim, as well as the front swim.

In terms of the back skills, the results are not as strong as for the front skills. Eight children of the 55% who fell into the Atypical Progression category of the back learn-to-swim sequence, failed one item, yet passed the back swim. Fourteen children failed both back swim prerequisite skills, yet passed the back swim skill. Once again, these data provided evidence that the learn-to-swim progressions leading to the back swim are not developmentally valid for children with physical disabilities. The three children who followed the typical back learn-to-swim progression achieved all three skills. However, since 27.5% of the children were in the No Skills Passed category of the back learn-to-swim sequence, it can be suggested that the progression proposed by traditional programs for learning the back swim was not developmentally valid for children with physical disabilities.

Ecological Task Analysis (Balan & Davis, 1993; Davis & Burton, 1991, 1997) and the ecological model of motor control (Balan & Davis, 1993; Block, 1994; Burton, 1987; Burton, 1990; Burton & Davis, 1992; Davis, 1984; Davis & Burton, 1991, 1997; Haywood, 1993) support the conclusion that not all proposed prerequisite skills which lead to a specific task goal are in fact necessary, especially if the goals of the prerequisite skills differ from the end-goal of the task. Davis and Burton (1997) stated that not all children with physical disabilities will be able to achieve every motor skill due to the interaction between the performer, task, and environment constraints. However, they stated that all children can achieve the functional task goal if it is properly presented, if the students are free to make their own movement choices, and if the environment is properly structured. The present data are in agreement with this notion, since many children could achieve the functional swim, but not the prerequisite skills.

4.3 Summary of Anecdotal Information

The anecdotal information collected during each child's skill tests provides insight into some problem areas. There seemed to be three reasons to explain why some children had difficulty with, and subsequently failed, the front skill items. The first reason was that the children refused to put their faces into the water, possibly out of fear, despite passing the water orientation-adjustment test and being recommended by their instructor. Related to this, the children blew bubbles rather than submerging their heads completely for the rhythmic breathing skill. This is the main explanation why so many children passed the front swim without having passed any of the prerequisite skills. The front swim criteria as proposed by traditional programs do not require face or head submersion, however, one of the main criteria of the three front swim prerequisite skills is face and/or head submersion. Secondly, the children were not relaxed or confident enough to remain stable on the surface of the water for the front float and glide without moving their arms and/or legs to balance themselves and to keep afloat. Thirdly, many of the children had difficulty attaining a near horizontal, streamlined position which impeded their forward motion in the front glide. Since there is a strong interrelationship between an individual, the environment, and the task being performed, the performer's limitations will affect the movement outcome. Haywood (1993) discusses how an injury to a body system can act as a rate limiter for a particular skill or activity. In the same sense, a performer's limitation due to a disability may also affect a body system, and hence act as a rate limiter within particular skills. Thus, when discussing the end-goal of the front glide, it is logical to conclude that it is not functionally related to the front swim. Therefore, if a child is able to perform the front swim, this does not automatically mean that he/she can also perform the front glide, or any other proposed prerequisite skill that is not functionally related to the front swim. Although many traditional programs propose using the front glide as a lead up to the front swim, it may not in fact be useful to aid in the acquisition of the front swim.

The descriptive information collected during back skill tests suggested three main difficulties encountered by the children. First, many children did not feel comfortable or balanced enough to attempt a supine position, and were therefore unable to perform any of the back skills. A second, related difficulty the children encountered was sinking due to the fact that they did not achieve a near horizontal position but rather were in a sitting position, which decreased their buoyancy during the back float and glide skills. Third, when performing the back float or back glide, the children were unable to reach all the criteria for success because they were unable to remain stable and not move their arms and/or legs. Again, as described for the front skills, a performer constraint due to limitations from a disability can act as a rate limiter for a specific movement pattern. These observations are in agreement with statements made by Reid and O'Neill (1989) suggesting that it may be easier for children with physical disabilities to learn to swim on their backs.

4.4 Necessity of Skills Within the Traditional Front and Back Learn-to-Swim Progressions

Proponents of the ecological theory of motor control have stated that not all children with physical disabilities will be able to achieve every motor skill or movement pattern, yet all children can attain a functional task goal if there is an appropriate relationship between the environment, task, and performer constraints (Davis & Burton, 1997). To determine if any one skill within the traditional front or back learn-to-swim progressions was unnecessary, a comparison was performed between the total percent of students who failed each skill and is found in Table 6. A vast majority of students failed the various progressions of the front and back swim, yet only a few students failed the actual front and back swim tests. Clearly, these results indicate that the skills within both the traditional front and back learn-to-swim progressions are not necessary to achieve the end goal of the front or back swim for the learner with a physical disability.

Table 6: The Number and Percent of Students Who Failed Each Skill.

SKILL	NUMBER	PERCENT OF STUDENTS
Rhythmic Breathing	36	90
Front Float	34	85
Front Glide	34	85
Front Swim	5	12.5
Back Float	25	60
Back Glide	37	92.5
Back Swim	15	37.5

4.5 Relationship Between Validity of Progressions and Descriptive Characteristics of Subjects

The ecological theory of motor control states that the interaction between the environment, task, and performer is the main determinant of how a particular motor skill is learned and performed (Balan & Davis, 1993; Block, 1994; Davis & Burton, 1991, 1997; Haywood, 1993). In the previous section, it was determined that the traditional learn-to-swim progressions did not seem to be developmentally valid for all children with physical disabilities. To gain more information on some of the reasons why the progressions may not be developmentally valid, the data were analyzed further to determine a relationship between performance and the student characteristics: disability type, functional sport classification, mode of ambulation, and use of a floatation device. The percent of students of each descriptive characteristic was calculated for the following performance categories: Atypical Progression, Typical Progression, and No Skills Passed for the front learn-to-swim sequence, and Atypical Progression, Typical Progression, undefined back sequence pattern (P/F/F), and No Skills Passed for the back learn-to-swim sequence.

4.5.1 Students with Atypical Progression in the front sequence

Table 7 shows the percentage of students who were in the Atypical Progression category according to various characteristics. Fifty percent of these students were identified as having Cerebral Palsy (CP), and only 25% had spinal cord impairments. Although this seems like a fairly large difference, this represents approximately the same proportion of students in the complete sample, as is indicated in Table 1. Hence, these differences for atypical progressions are mirrored in the total sample. However, when looking at the functional sport classifications, and knowing that several students were included in several classification levels for better description, it is evident that the students are distributed across most of the levels. In addition, when examining the percent of students per mode of ambulation, no student required a motorized wheelchair. There was not a large difference between the percent of students who used a floatation device (62.5%) and the percent of students who did not use a floatation device (37.5%). In fact, this difference was reflected in the overall group of participants; 25 subjects (62.5%) required a floatation device, whereas only 15 subjects (37.5%) did not, as is indicated in Table 1. Therefore, when summarizing Table 7, it can be concluded that the students who were in the Atypical Progression category in the front sequence were spread across most of the subcharacteristic levels. Several of these students were middle to high functioning, and there was no substantial number of students at either the extreme high or low functional ability levels. Generally, these students had enough control of there bodies to perform the front swim skill, however, many of them were too fearful to put their faces in the water or didn't have enough balance, and therefore had difficulties with the rhythmic breathing, front float, and front glide skills.

Table 7: Students with Atypical Progression in the Front Sequence Per Four Descriptive Characteristics.

CHARACTERISTIC	SUBCHARACTERISTIC	N*	PERCENT **
Disability Type	Cerebral Palsy	15	46.9
	Spinal cord impairment	8	25.0
	Other	2	21.9
	Developmental delay	5	15.6
Functional Classification	CP II	1	3.1
	CP III	5	15.6
	CP IV	1	3.1
	CP V	2	6.3
	CP VII	4	12.5
	CP VIII	6	18.8
	S 5	3	9.4
	S 6	2	6.3
	S 10	13	40.6
	B 7	1	3.1
Mode of Ambulation	Ambulatory	17	53.1
	Assistive device	4	12.5
	Wheelchair	11	34.4
	Motorized wheelchair	0	0
Use of Floatation Device	Yes	20	62.5
	No	12	37.5

* N = number of students (total N = 32)
** The percent of students may not total 100% for each descriptive characteristic because some students were included in several subcharacteristics to better describe them.

4.5.2 Students with Typical Progression in the front sequence

There were only three children who possessed each of the four front skills and therefore were categorized under Typical Progression. Although the disability type descriptive characteristic identified one student as having CP and two students as having other disabilities, it was evident from the data within the other descriptive characteristics that these three students were very high functioning. The three students were all identified as being at the highest level of functional sport classification under both systems, CP VIII and S10. As well, the students were all ambulatory and needed no floatation device for swimming. Thus, these students appear to have no difficulty with body control and are not fearful of the water. Therefore, traditional learn-to-swim progressions seem appropriate for them, although it is impossible to determine whether these children followed the traditional front sequence when they were learning to swim.

4.5.3 Students with No Skills Passed in the front sequence

Five students did not possess any of the skills of the front learn-to-swim progression. These students all had CP, four had spastic quadriplegia and one had spastic diplegia. One student was also identified as having a developmental delay. The four students who were diagnosed as having spastic quadriplegia were classified as CP I under the Cerebral Palsy Athletic Association Functional Classification system, and the individual who was diagnosed as having spastic diplegia was identified as being CP I and CP II, due to the fact that the student used a motorized wheelchair for ambulation and had fairly good upper body control. All five students used a motorized wheelchair and needed a floatation device when in the water. The data collected, along with the anecdotal information from skill testing, provided strong support to conclude that, if a student has very little control of his/her body, particularly the head and neck muscles, it will be very difficult for that child to learn or perform any skills in a prone position. Once the head goes underwater, the child will no longer be able to lift it to breathe. It is often much more successful for these children to learn to swim on their backs (Reid & O'Neill, 1989).

4.5.4 Students with Atypical Progression in the back sequence

Table 8 provides a detailed description of all students who did not follow the back sequence. Sixty percent of the students within this category had CP, and approximately 20% fell into each of the other three subcharacteristics. The functional sport classification data indicated that the students were spread across several of the subcharacteristics, however there was no evidence to suggest that these students were concentrated at either extreme, high or low, of the functional ability scale. The mode of ambulation descriptive characteristic identified 50% of the students as ambulatory and 36.4% as requiring a wheelchair for ambulation which they propelled themselves. The results also indicated that the difference between the number of students who used a floatation device (36.4%) and those who did not (63.4%) was not important, since it is representative of the overall proportion of subjects who did or did not use a floatation device, as is shown in Table 1.

In summary, the information from Table 8 provided evidence that children who are identified as having middle to high functional ability generally will not follow the traditional learn-to-swim progressions leading to the back swim. Often, these children lack body control and have difficulty balancing themselves in the water, and therefore have difficulty reaching and maintaining a supine position with little or no body movement. However, these children are capable of performing a back swim because they are supposed to move their arms and or legs to propel themselves forward, which in turn helps them maintain a proper supine position. Reid and O'Neill (1989) discuss teaching swimming to children with cerebral palsy and other physical disabilities. They suggest that it is often more successful for these children to learn to swim on their backs since the head control needed for breathing in a prone position is not a concern.

Table 8: Students with Atypical Progression in the Back Sequence Per Four Descriptive Characteristics.

CHARACTERISTIC	SUBCHARACTERISTIC	N*	PERCENT**
Disability Type	Cerebral Palsy	13	59.9
	Spinal cord impairment	4	18.2
	Other	3	13.6
	Developmental delay	4	18.2
Functional Classification	CP I	1	4.5
	CP II	1	4.5
	CP III	4	18.2
	CP V	1	4.5
	CP VII	3	13.6
	CP VIII	6	27.3
	S 5	2	9.1
	S 6	2	9.1
	S 10	8	36.4
Mode of Ambulation	Ambulatory	11	50.0
	Assistive device	2	9.1
	Wheelchair	8	36.4
	Motorized wheelchair	1	4.5
Use of Floatation Device	Yes	14	63.6
	No	8	36.4

*N = number of students (total N = 22)
** The percent of students may not total 100% for each descriptive characteristic because some students were included in several subcharacteristics to better describe them.

One interesting point is that there was one student who did not follow the back sequence, yet was identified as having a lower level of functional ability. The student was identified as CP I/CP II and required a motorized wheelchair for ambulation. Upon examination of the anecdotal information collected during skill testing, it was found that this individual was able to perform the back float as well as the back swim, but was unable to perform the back glide. With the help of a floatation device, the student was able to remain in a stable, supine position, and therefore passed the back float skill. As well, the student had sufficient upper body mobility and control to move both arms enough to propel forward for the full 10 m to pass the back swim skill. The student did not however have sufficient lower body mobility to push off the side of the pool, and hence, the student did not pass the back glide.

4.5.5 Students with Typical Progression in the back sequence

Three students were identified as having followed the back learn-to-swim sequence, and all three students passed every skill within the sequence. Two of these children also passed all the skills within the front progressions. One student was diagnosed as having a spinal cord impairment and two students had other physical disabilities. All three students were identified as very high functioning; three students were classified as S10 in the National Wheelchair Athletic Association system, and two of the students were also classified as CP VIII. All three students were ambulatory, and could therefore walk without assistive devices. As well, none of the students who followed the back sequence used a floatation device. It is clear that students who were identified as very high functioning were able to perform the three skills included in the back learn-to-swim sequence, back float, back glide, and back swim. It is impossible to determine however, whether these children followed the traditional progressions when learning the back swim, or whether they were simply able to perform all the skills due to their level of ability and functioning.

4.5.6 Students with an undefined back sequence pattern

Four students passed the back float, the first skill of the back learn-to-swim sequence, yet were unable to perform the back glide or back swim. Thus, it cannot be stated that they did or did not follow the sequence. These students were all diagnosed as having CP, or more specifically, spastic quadriplegia, and one student was also diagnosed as having a developmental delay. The functional classification of each was CP I. The students therefore all used a motorized wheelchair for ambulation. As well, all four students required a floatation device in the water. It appears that children who have very low functional ability (minimal mobility and control of all four limbs) can in fact float in a supine position independently, most probably with a floatation device. Although it is difficult to conclude with certainty, it seems that each of the students has, or will gain, sufficient mobility and control in their arms and/or legs to eventually propel themselves forward in a supine position for the full 10 m. At the time of data collection, the students were able to move arms and legs enough to propel themselves a small distance in the water, however they did not have sufficient body and muscle control, or sustained energy to move themselves forward in a straight direction for the full 10 m.

4.5.7 Students with No Skills Passed in the back sequence

In contrast to the five students who possessed no front skills, 11 students did not pass any of the skills in the back learn-to-swim sequence. The description of the students in this category, as shown in Table 9, seemed to be similar to that of the students who did not follow the back sequence. The students who had no back skills ranged in functional ability from middle to high. Approximately 30% of the students fell into each of three disability type subcharacteristics: CP, spinal cord impairments, and other. As well, a few of the students were identified as having a developmental delay. The majority of the students were ambulatory (54.5%), however no students required a motorized wheelchair for ambulation. Approximately two-thirds of the students used a floatation device for swimming and one-third did not. This difference seemed to be representative of the group of participants as a whole, rather than indicative of a trend. Upon examination of the anecdotal information collected during the study, and the results obtained from Table 9, it seemed plausible to conclude that, although a child had a middle to high level of functional

Table 9: Students with No Skills Passed in the Back Sequence Per Four Descriptive Characteristics.

CHARACTERISTIC	SUBCHARACTERISTIC	N*	PERCENT**
Disability Type	Cerebral Palsy	4	36.4
	Spinal cord impairment	3	27.3
	Other	4	36.4
	Developmental delay	1	9.1
Functional Classification	CP II	1	9.1
	CP III	1	9.1
	CP IV	1	9.1
	CP V	1	9.1
	CP VII	1	9.1
	CP VIII	2	18.2
	S 5	1	9.1
	S 10	5	45.5
	B 7	1	9.1
Mode of Ambulation	Ambulatory	6	54.5
	Assistive device	2	18.2
	Wheelchair	3	27.3
	Motorized wheelchair	0	0
Use of Floatation Device	Yes	7	63.6
	No	4	36.4

*N = number of students (total N = 11)
** The percent of students may not total 100% for each descriptive characteristic because some students were included in several subcharacteristics to better describe them.

ability, if that child had difficulty maintaining a proper supine position, related to a lack of body control or strength due to a particular aspect of the child's disability, then that child had difficulties performing any of the back skills in the back sequence. A second reason that was found to contribute to a child's lack of back skills, was that in many cases the children were so uncertain of their body position and strength when in a supine position, that often they were too fearful to even try to perform any of the back skills.

Overall, the results of this study demonstrated that there seemed to be a relationship between the developmental validity of the traditional progressions and the descriptive characteristics. Generally, the children who were described as high functioning were able to perform all the front and back skills, whereas those described as low functioning often did not pass any of the front and/or back skills. More importantly, the children who did not follow the typical learn-to-swim progressions for the front and back swim were described as having a wide range of functional ability. These findings are consistent with the central belief of the ecological model that there is an interrelationship between the task, environment, and performer (i.e. descriptive characteristics) which affects movement outcomes. Related to this is the notion that a disability can lead to a particular body system being a rate limiter, or determinant, of a particular movement or skill.

CHAPTER 5

Conclusions and Recommendations

The purpose of this study was to determine whether the progressions proposed by traditional learn-to-swim programs are developmentally valid for children with physical disabilities. This chapter contains the summary and conclusions of the investigation and is divided into five sections: (5.1) Summary of the Methodology; (5.2) Summary of the Findings; (5.3) Conclusions, (5.4) Implications of the Study; and (5.5) Recommendations for Future Studies.

5.1 Summary of the Methodology

There were 40 children between the ages of 5 and 12 years who participated in the study. These children were described according to disability type, functional sport classification, mode of ambulation, and the need for a floatation device. They attended a reversely integrated school in the Montreal area and took part in aquatic classes as a regular part of their school curriculum, once a week for approximately 45 min.

As criteria for admittance into the study, the children had to be recommended by their aquatic instructor as being comfortable in the water, and each had to pass a water orientation-adjustment test (adapted from the work of Langendorfer & Bruya, 1995).

Testing took place on a one-to-one basis, in the children's regular pool environment, during regular swimming class periods. The aquatic instructor was present to ensure that participants were comfortable throughout the testing procedure. All information and pass/fail results for each skill were recorded by the researcher. The skills tested were: rhythmic breathing, front float, front glide, front swim, back float, back glide, and back swim. These skills were assigned to each child in random order, and all testing followed the same procedure. A demonstrator was used to perform all skills except the front and back swim.

The dependent variables were the number and percent of children who fell into one of three categories. For both the front and back skills these categories were: Atypical Progressions, Typical Progressions, and No Skills Passed. The back skill also included a fourth category, Undefined Back Sequence, for the children who fell into none of the above categories. Descriptive analysis was performed to determine whether the front and back traditional learn-to-swim progressions were developmentally valid for these children. Also, the data were examined to ascertain whether there were any skills that were not necessary within the traditional progressions. As well, the results were analyzed to assess whether a relationship existed between the validity of progressions and various characteristics of the subjects.

5.2 Summary of the Findings

The findings for the front skills revealed that 80% of the students fell into the Atypical Progression category, which meant that they did not follow the traditional learn-to-swim sequence. In contrast, results indicated only 7.5% of the children were in the Typical Progression category. In addition, 12.5% did not pass any of the skills in the front sequence. It seemed that none of the prerequisite front swim skills were necessary for many of the children with physical disabilities to achieve the front swim. It was revealed that a few (n=3) high functioning children were often able to achieve all skills in the front progression, whereas, those with little functional ability (n=5) were not able to pass any of the skills. In addition, the students in the Atypical Progression category were spread across most functional sport ability levels.

The findings for the back skill were: 55% of the children were in the Atypical Progression category, 7.5% followed Typical Progression, 27.5% did not pass any of the skills in the sequence, and 10% of the students passed the first skill yet failed subsequent skills. In terms of the necessity of the skills within the back learn-to-swim progression, results indicated that often, neither the back float nor back glide were essential for the acquisition of the back swim. The students who fell into the Atypical Progression category were scattered throughout the functional sport ability subcharacteristics. In addition, those at the high end of the scale (n=3) were often able to achieve all back skills, and those who did not pass any of the back skills (n=11) were at the low end of the scale.

5.3 Conclusions

Based upon the findings of this study, and considering its cross-sectional design, the following conclusions are drawn:

1. The traditional learn-to-swim progressions leading to the front and back swim are not developmentally valid for many children with physical disabilities.

2. The prerequisite skills, rhythmic breathing, front float, and front glide, which lead to the front swim, and the prerequisite skills for the back swim, back float and back glide, are not necessary for all children with physical disabilities in order to acquire the front and back swim.

3. High functioning children will generally be able to perform all front and back learn-to-swim progressive skills, as well as the front and back swim.

4. The children who had very low functional ability did not pass any of the front and/or back skills.

5.4 Implications of the Study

It has been suggested that the use of a set progression of skills leading to an end-goal may not be appropriate when teaching individuals with special needs due to their unique characteristics (personal constraints). The findings of this study strongly support this proposition.

One major implication of this study is that instructors should take the strengths of their students with physical disabilities into account, and familiarize themselves with them, when teaching swimming. Instructors should therefore always individualize their teaching approach and should keep the end-goal of the skill in mind at all times.

As well, traditional learn-to-swim programs should stress more prominently that instruction should be adapted to the learners' capacities, than is presently stated in their instructor manuals. In traditional learn-to-swim programs, children cannot pass into a level without successfully completing all skills in the previous level. In other words, a child that has not passed the front float will not progress to the next level and be given the opportunity to try the front swim. Although some of the proposed prerequisite skills could not be accomplished by the children in this study, they remain important and should be taught when circumstances permit. However, stroke development should not be delayed through the employment of inappropriate skills, since children with disabilities may have unique learning patterns.

In addition, a parallel program should be explored whereby certifications and awards are granted for the achievement of groups of skills; such as front skills, back skills, deep water skills, and entry skills, rather than for levels encompassing prerequisites of these groups of skills.

5.5 Recommendations for Future Studies

This study begins to explore the question of the use of progressions when teaching swimming to children with disabilities, and therefore, on the basis of the results, the following suggestions are recommended for future research:

1. The developmental validity of traditional learn-to-swim progressions should be explored for various populations with disabilities, such as intellectual disabilities, as well as for specific physical disabilities, i.e. cerebral palsy, amputations, muscular dystrophy, etc.

2. This study focused solely on children with physical disabilities, however, since all individuals have different strengths and learn differently, the developmental validity of these progressions should also be studied with nondisabled populations.

3. A limitation of this study was that it was a cross sectional study, therefore a longitudinal study should be undertaken where the effects of a traditional and nontraditional approach are compared as to their effectiveness for the various populations.

4. The question of the developmental validity of progressions for teaching any skill should be explored with various populations, both with and without disabilities.

REFERENCES

Active Living Alliance for Canadians with a Disability. (1994). Moving to inclusion. Active living through physical education: Maximizing opportunities for students with a disability. Gloucester, ONT: author.

Albright, C. (1995). Swimming techniques for individuals with physical disabilities. Palaestra, 11(2), 16-21.

Allen, A. (1981). Sports for the handicapped. New York: Walker.

American Association for Health, Physical Education, and Recreation. (1969). A practical guide for teaching the mentally retarded to swim. Washington, DC: Author.

Arbuthnot, S. (1997, May). Gymnastics. Presentation at the 11th International Symposium for Adapted Physical Activity and the 8th National Forum on Physical Activity and Disability, Quebec City, Canada.

Austin, P.L. (1978). A model of adapted physical education. Canadian Association for Health, Physical Education, and Recreation Journal, 44, 6-13.

Balan, C.M. & Davis, W.E. (1993). Ecological task analysis: An approach to teaching physical education. Journal of Physical Education, Recreation, and Dance, 64(9), 54-61.

Block, M.E. (1992). What is appropriate physical education for students with profound disabilities? Adapted Physical Activity Quarterly, 9, 197-213.

Block, M.E. (1994). A teacher's guide to including students with disabilities in regular physical education. Baltimore, MD: Brookes Publishing.

Bond, G. (1975). An adapted surfing device. Journal of Physical Education, Recreation, and Dance, 46(7), 57-58.

Brown, R.L. (1953). Swimming - Activity for the handicapped. Journal of the American Association for Health, Physical Education, and Recreation, 24(4), 14-15, 51.

Burgess, S. & Davis, T. (1993). Water exercise. In S.J. Grosse & D. Thompson (Eds.), Play and recreation for individuals with disabilities: Practical pointers (pp. 117-131). Reston, VA: American Alliance for Health, Physical Education, Recreation, and Dance.

Burpee, A.D. & McCuaig, D.S. (Eds.). (1993a). YMCA advanced swimming instructor's guide. Toronto, ONT: YMCA Canada.

Burpee, A.D. & McCuaig, D.S. (Eds.). (1993b). YMCA advanced swimming trainer's guide. Toronto, ONT: YMCA Canada.

Burton, A.W. (1987). Confronting the interaction between perception and movement in adapted physical education. Adapted Physical Activity Quarterly, 4, 257-267.

Burton, A.W. (1990). Assessing the perceptual-motor interaction in developmentally disabled and nonhandicapped children. Adapted Physical Activity Quarterly, 7, 325-337.

Burton, A.W. & Davis, W.E. (1992). Optimizing the involvement and performance of children with physical impairments in movement activities. Pediatric Exercise Science, 4, 236-248.

Burton, A.W., Greer, N.L. & Wiese, D.M. (1992). Changes in overhand throwing patterns as a function of ball size. Pediatric Exercise Science, 4, 50-67.

Campbell, W. (1993). Aqua Percept instructor's manual. Pointe-Claire, QUE: Aqua-Percept

Canadian Red Cross Society. (1983). Water safety instructor guide and reference: Water safety, skills and strokes for safe, enjoyable aquatics (Vol 2). Ottawa, ONT: Canadian Red Cross Society

Canadian Red Cross Society. (1996a). Canadian Red Cross water safety services: Water safety instructor manual. St. Louis, MO: Mosby Lifeline.

Canadian Red Cross Society. (1996b). Swimming and water safety. St. Louis, MO: Mosby Lifeline

Case, E.J. & Bearman-Bucher, I. (1987). Therapeutic swimming program, P.L. 94-142: Evaluation report. Albuquerque, NM: Albuquerque Public Schools, Planning, research, and accountability
(ERIC Document Reproduction Services No. ED 299 268)

Chanias, A. & Reid, G. (1996, September). Content of introductory textbooks on adapted physical activity. Poster presented at the meeting of the North American Federation of Adapted Physical Activity, Banff, Alberta.

Christie, I. (1985). Aquatics for the handicapped - A review of literature. The Physical Educator, 42(1), 24-33.

Clarke, H.H. & Clarke, D.H. (1963). Developmental and adapted physical education. Englewood Cliffs, NJ: Prentice-Hall.

Culbert, L.A. (1987). Rett Syndrome. Fort Washington, MD: International Rett Syndrome Association.
(ERIC Document Reproduction Service No. ED 290 276)

Daniels, A.S. & Davies, E.A. (1965). Adapted physical education (2nd ed.). New York: Harper & Row.

Daniels, A.S. & Davies, E.A. (1975). Adapted physical education (3rd ed.). New York: Harper & Row.

Davis, W.E. (1984). Motor ability assessment of populations with handicapping conditions: Challenging basic assumptions. Adapted Physical Activity Quarterly, 1, 125-140.

Davis, W.E. (1989). Utilizing goals in adapted physical education. Adapted Physical Activity Quarterly, 6, 205-215.

Davis, W.E. & Burton, A.W. (1991). Ecological task analysis: Translating movement behavior theory into practice. Adapted Physical Activity Quarterly, 8, 154-177.

Davis, W.E. & Burton, A.W. (1997). ETA Partners. Unpublished manuscript.

Fait, H.F. (1966). Special physical education: Adapted, corrective, developmental. Philadelphia, PA: W.B. Saunders.

Fitness Canada. (1986, March). A Canada fitness survey report: Physical activity among activity-limited and disabled adults in Canada. Ottawa, ONT: Canadian Fitness and Lifestyle Research Institute.

Federal Register (1977, August). U.S. 94th Congress. Public Law 94-142. The Education for All Handicapped Children Act (pp. 42480).

Gaon, S. (1997). Taking a new tack: Sailing opportunities for all. Active Living, 6(3), 42-47.

Grosse, S.J. (1974). Small craft safety: A valuable addition to your swimming program. In American Association For Health, Physical Education, and Recreation. The best of Challenge: Vol. 2 (pp. 64-65). Washington, DC: American Association for Health, Physical Education, and Recreation.

Grosse, S.J. (1985). It's a wet and wonderful world. Palaestra, 2(1), 14-17, 40.

Grosse, S.J. (1993). Aquatic adventure recreation. In S.J. Grosse & D. Thompson (Eds.), Play and recreation for individuals with disabilities: Practical pointers (pp. 22-34). Reston, VA: American Alliance for Health, Physical Education, Recreation, and Dance.

Grosse, S.J. (1996). What's in a name? Adapted aquatics - Back to the future. Palaestra, 12(3), 20-21.

Grosse, S.J. & McGill, C.D. (1979). Independent swimming for children with severe physical impairments. Practical Pointer, 3(2), 1-15.

Hackett, L.C. & Lawrence, C.C. (1976). Waterlearning: An alternative classroom. The Pointer, 21(2), 27-29.

Haywood, K.M. (Ed.). (1993). Life span motor development (2nd ed.). Champaign, IL: Human Kinetics.

Hoffer, R. (1995, August 14). Ready, willing, and able. Sports Illustrated, 83(7), 64-76.

Hunt, V.V. (1955). Recreation for the handicapped. Englewood Cliffs, NJ: Prentice-Hall.

Johannsen, S. (1985). A process toward the integration of mentally handicapped students into community learn-to-swim programs. In M.E. Berridge & G.R. Ward (Eds.), International perspectives on adapted physical activity: Selected papers presented at the International Symposium on Adapted Physical Activity (pp. 109-117). Champaign, IL: Human Kinetics.

Karman, P. (1975). Waterskiing. Sports 'n Spokes, 1(2), 17.

Kelly, E. (1954). Swimming for the physically handicapped. Journal of the American Association for Health, Physical Education, and Recreation, 25(4), 12-13, 52.

Kelly, L.E. (1989). Physical education. In G.A. Robinson, J.R. Patton, E.A. Polloway & L.R. Sargent (Eds.), Best practices in mild mental disabilities (pp. 243-262). Division on Mental Retardation - The Council for Exceptional Children.

Killian, K.J., Arena-Ronde, S. & Bruno, L. (1987). Refinement of two instruments that assess water orientation in atypical swimmers. Adapted Physical Activity Quarterly, 4, 25-37.

King, T. (1997). Making a splash: A new wave of prosthetics for water sports. Active Living, 6(3), 48-52.

Kozub, F.M. & Porretta, D. (1996). Including athletes with disabilities: Interscholastic athletic benefits for all. Journal of Physical Education, Recreation, and Dance, 67(3), 19-24.

Lahay, L. et al. (1976). Programme handbook: Swimming for the disabled. Vancouver, BC: Canadian Red Cross Society.

Lampos, C.J. (1947). Paraplegics swim to a comeback. Hygeia, 25(7), 520-521, 562-563.

Langendorfer, S.J. (1989). Aquatics for young children with handicapping conditions. Palaestra, 5(3), 17-19, 37-40.

Langendorfer, S.J. & Bruya, L.D. (1995). Aquatic readiness: Developing water competence in young children. Champaign, IL: Human Kinetics.

Lindstrom, H. (1992). Integration of sport for athletes with disabilities into sport programmes for able-bodied athletes. Palaestra, 8(3), 28-32, 58-59.

Lowman, C.L. & Bright, A.E. (1935). Hydrogymnastics from the physical education standpoint. Journal of Health and Physical Education, 6(4), 8-10.

Mayse, J.S. (1991). Aquacise and aquafitness for adapted aquatics. Palaestra, 7(2), 54-56.

Meister, P., Villareal, P. & Villareal, R. (1976). Skin diving for fun and growth development. In The Alliance (Ed.), Proceedings of the 5th National Conference on Physical Activity: Programs and Practices for the Exceptional Individual (pp. 97-106). Los Angeles, CA: The California State Department of Education.

Meyer, H.C. (1955). Swimming for the deaf. Journal of Health, Physical Education, and Recreation, 26(5), 12.

Mielzarek, L.A. & Mielzarek, R.H. (1975). Reaching out + reasonable risk = growth adventure. Challenge, 11(1), 1,3.

Muhl, W.T. (1976). Aquatics for the handicapped. Journal of Physical Education and Recreation, 47(2), 42-43.

Nearing, R.J., Johansen, D.A.K., & Vevea, C. (1995). Gymnastics mats in the pool? Palaestra, 11(2), 22-30, 64.

Newman, J. (1970). Swimming for the Spina Bifida. Journal of Health, Physical Education, and Recreation, 41, 67-68.

Newman, J. (1971). Handicapped? Who's handicapped? Journal of Health, Physical Education, and Recreation, 42, 64.

Newman, J.(1971). Swimming for the child with multiple birth defects. Journal of Health, Physical Education, and Recreation, 42, 68-69.

Newman, J. (1976). Swimming for children with physical and sensory impairments. Springfield, IL: Charles C. Thomas.

Nichols, D.R. (1997a, May). Adapted rudder system for kayak touring. Presentation at the 11th International Symposium for Adapted Physical Activity and the 8th National Forum on Physical Activity and Disability, Quebec City, Canada.

Nichols, D.R. (1997b, May). Leisure identity: An adventure education model. Presentation at the 11th International Symposium for Adapted Physical Activity and the 8th National Forum on Physical Activity and Disability, Quebec City, Canada.

Petrofsky, J.S. (1994a). Diving with spinal cord injury: Part 1. Palaestra, 10(4), 36-41.

Petrofsky, J.S. (1994b). Diving with spinal cord injury: Part 2. Palaestra, 11(1), 30-31, 49-51.

Petrofsky, J.S. (1995). Diving with spinal cord injury: Part 3. Palaestra, 11(2), 34-38.

Priest, L. (1979). Integrating the disabled into aquatic programs. Journal of Physical Education and Recreation, 50(2), 57-59.

Priest, L. (1983). Aquatics for disabled persons. Journal of Physical Education, Recreation, and Dance, 54(3), 36-37.

Reid, G. & O'Neill, K. (1989). Adapted aquatics: Promoting aquatic opportunities for all. Toronto, ONT: The Canadian Red Cross Society.

Rider, R.A. & Modell, S. (1996). Aquatics for young children with Angelman Syndrome: Earning your water wings. Palaestra, 12(4), 28-33.

Rivers, J. & Temple, J. (1997, May). Trailblazers: A summer hiking programme for young people with physical disabilities. Presentation at the 11th International Symposium for Adapted Physical Activity and the 8th National Forum on Physical Activity and Disability, Quebec City, Canada.

Roberton, M.A. (1989). Developmental sequence and developmental task analysis. In J.S. Skinner, C.B. Corbin, D.M. Landers, P.E. Martin, and C.L. Wells (Eds.), Future directions in exercise and sport science research (pp. 369-381). Champaign, IL: Human Kinetics.

Roeren, F.R. (1985). Sport for all: Sailing is fun. In M.E. Berridge & G.R. Ward (Eds.), International perspectives on adapted physical activity: Selected papers presented at the International Symposium on Adapted Physical Activity (pp. 209-211). Champaign, IL: Human Kinetics.

Ryan, C. (1997). Getting up on the water. Active Living, 6(3), 35-38.

Sherrill, C. (1993). Adapted physical activity, recreation and sport: Crossdisciplinary and lifespan (4th ed.). Dubuque, IA: Wm. C. Brown & Benchmark.

Smith, V.M. (1985). Aquatic remediation of communication disorders. Academic Therapy, 21(2), 229-236.

Thomas, D.G. (1976). Do go near the water. Journal of Physical Education, Recreation, and Dance, 47(2), 33-44.

Thomas, D.G. (1989). Swimming: Steps to success. Champaign, IL: Leisure Press.

Thomas, J.R. & Nelson, J.K. (Eds.). (1990). Research methods in physical activity (2nd ed.). Champaign, IL: Human Kinetics.

Turner, D. (1988). Roughing it smoothly. Exceptional Parent 18(2), 54-57.

Vickers, J.N. (1990). Instructional design for teaching physical activities: A knowledge structures approach. Champaign, IL: Human Kinetics.

Wall, A.E., McClements, J., Bouffard, M., Findlay, H., & Taylor, M.J. (1985). A knowledge-based approach to motor development: Implications for the physically awkward. Adapted Physical Activity Quarterly, 2, 21-42.

Watkinson, E.J. & Wall, A.E. (1982). PREP: Play skill manual. Ottawa, ONT: Canadian Association of Health, Physical Education and Recreation.

Winnick, J.P. (Ed.) (1995). Adapted physical education and sport. (2nd ed.). Champaign, IL: Human Kinetics.

APPENDIX A

DESCRIPTION of SUBJECTS

Table A-1: Description of Subjects By Disability and Disability Type

SUBJECT	DISABILITY	DISABILITY TYPE
1	spina bifida	spinal cord impairment
2	congenital left hemiplegia	CP
3	mild CP/developmental delay	CP/developmental delay
4 to 8	----	----
9	thoracic myelomeningocele/hydrocephalus	spinal cord impairment
10	spastic quadriplegia	CP
11	head trauma/post motor vehicle accident	other
12	spastic quadriplegia	CP
13	spastic diplegia	CP
14	----	----
15	left hemiplegia/ataxia	CP
16	spastic diplegia	CP
17	spina bifida	spinal cord impairment
18	----	----
19	right hemiplegia/severe speech disorder	CP
20	chronic poly arthritis/neurofibromatosis	other
21	congenital right hemiplegia/developmental delay	CP/developmental delay
22	spastic diplegia	CP
23	spina bifida	spinal cord impairment
24	spastic diplegia	CP
25	posterior fossa tumor	other
26	cerebellar dysgenesis	other
27	spastic quadriplegia/global developmental delay	CP/developmental delay
28	spastic quadriplegia	CP
29	multiple congenital amputations	other
30	developmental delay	developmental delay
31	right hemiplegia	CP
32	right hemiparesis	CP
33	mild spastic diplegia/developmental delay	CP/developmental delay
34	spastic quadriplegia	CP
35	myeloschisis/hydrocephalus	spinal cord impairment
36	meningomyelocele/hydrocephalus	spinal cord impairment
37	double hemiparesis post trauma	CP
38	hydrocephalus post meningitis	other
39	severe closed head injury/right hemiparesis	CP
40	spastic quadriplegia/hydrocephalus	CP
41	spina bifida	spinal cord impairment
42	spastic diplegia/hydrocephalus	CP
43	myelomeningocele T12-L1	spinal cord impairment
44	severe language delay	other
45	severe speech delay	other
46	severe speech disorder	other
47	developmental delay	developmental delay

---- Subject did not participate in skill testing

Table A-2: Description of Subjects By Functional Classification, Mode of Ambulation, and Floatation Device Needed

SUBJECT	FUNCTIONAL CLASSIFICATION	MODE OF AMBULATION	FLOATATION DEVICE NEEDED
1	B7	ambulatory	yes
2	CP VII	ambulatory	yes
3	CP VIII	ambulatory	yes
4 to 8	----	----	----
9	S5	wheelchair	yes
10	CP III	wheelchair	yes
11	S10	ambulatory	no
12	CP I	motorized wheelchair	yes
13	CP I/CP II	motorized wheelchair	yes
14	----	----	----
15	CP III	wheelchair	yes
16	CP III	wheelchair	no
17	S6	wheelchair	yes
18	----	----	----
19	S10	ambulatory	no
20	S10	ambulatory	yes
21	CP VII	ambulatory	no
22	CP V	assistive device	yes
23	S6	wheelchair	yes
24	S10/CP V	assistive device	no
25	CP III	wheelchair	yes
26	CP IV	assistive device	yes
27	CP I	motorized wheelchair	yes
28	CP I	motorized wheelchair	yes
29	S10	ambulatory	no
30	S10/CP VIII	ambulatory	no
31	CP VII	ambulatory	no
32	CP III	wheelchair	yes
33	S10/CP VIII	ambulatory	yes
34	CP I	motorized wheelchair	yes
35	S5	wheelchair	yes
36	S10	ambulatory	no
37	CP VII	assistive device	yes
38	S10	ambulatory	no
39	CP VIII/S 10	ambulatory	no
40	CP II	wheelchair	yes
41	S10	ambulatory	no
42	S10	ambulatory	yes
43	S5	wheelchair	yes
44	S10/CP VIII	ambulatory	yes
45	S10/CP VIII	ambulatory	no
46	S10/CP VIII	ambulatory	no
47	S10/CP VIII	ambulatory	no

---- Subject did not participate in skill testing.

APPENDIX B

FUNCTIONAL SPORT CLASSIFICATIONS

Table B-1: NWAA Functional Classifications - swimming

CLASS	DESCRIPTION
S1	Very severe quadriplegic with poor head and trunk control.
S2	Tetraplegic, complete below C5/6, severe MD; amputation of four limbs.
S3	Tetraplegic, complete below C6; a lower tetraplegic with an additional handicap; severe MD.
S4	Tetraplegic, complete below C7; some incomplete C5; polio with nonfunctional hands for swimming; MD comparable with C7
S5	Complete tetraplegic below C8, incomplete C7 or C6 with ability to keep legs horizontal and functional hands for swimming.
S6	Complete paraplegia below T1-T8, incomplete C8 with ability to keep legs horizontal
S7	Complete paraplegia below T9-L1, double above-knee amputation shorter than 1/2
S8	Paraplegia L2-L3 with no leg propulsion but ability to keep legs straight, double above-knee amputation, double below-knee amputation no longer than 1/3
S9	Paraplegia L4-L5; polio with one nonfunctional leg; single above-knee amputation, double below-knee amputation no longer than 1/3
S10	Polio or cauda equina lesion with minimal affection of lower limbs, single below-knee amputation, double fore-foot amputation
B7	Paraplegia and polio L4, poor leg propulsion, double below-knee amputation shorter than 1/2.

From Adapted physical education and sport (2nd ed.). (p. 200-201) by J. P. Winnick (Ed.). 1995. Champaign, IL: Human Kinetics.

Table B-2: USCPAA Functional Classifications

	CLASS DESCRIPTION	MODE OF AMBULATION
I	Severe spasticity and athetosis in all extremities; poor to non-existent trunk control; poor functional range of motion and strength; only thumb and one finger for opposition; can grasp only beanbag.	Motorized wheelchair
II	Severe to moderate spastic and/or athetoid quadriplegic; poor functional strength in all extremities and poor trunk control; classified as Class II lower if one or two lower extremities are functional; otherwise, classified as Class II upper (can manipulate and throw a ball).	Propels wheelchair on level surfaces and slight inclines (lower ClassII with legs only)
III	Moderate quadriplegic or triplegic; severe hemiplegic; fair to normal strength in one upper extremity; limited extension in follow through when throwing with dominant arm; normal grasp of round objects, but release is slow	Can propel wheelchair independently, but may walk a short distance with assistance or assistive devices
IV	Moderate to severe diplegic; good functional strength and minimal control problems in upper extremities and torso, normal follow through is evident when throwing	Assistive devices used for distances; wheelchair is usually used for sport.
V	Moderate to severe diplegic or hemiplegic; moderate to severe involvement in one or both legs; good functional strength; good balance when assistive devices are used; minimal control problems in upper limbs	No wheelchair; may or may not use assistive devices

Table B-2 (continued)

VI	Moderate to severe quadriplegic; fluctuating muscle tone producing involuntary movements in trunk and both sets of extremities; greater upper limb involvement when spasticity/athetosis present; running gait often shows better mechanics than walk.	Ambulates without aids.
VII	Moderate to minimal spastic hemiplegic; good functional ability on nonaffected side.	Walks and runs without assistive devices, but has marked asymmetrical gait.
VIII	Minimal hemiplegic, monoplegic, diplegic, or quadriplegic; may have minimal coordination problems and good balance.	Runs and jumps freely with little or no limp.

From Adapted physical education and sport (2nd ed.). (p. 171) by J. P. Winnick (Ed.). 1995. Champaign, IL: Human Kinetics

APPENDIX C

LETTER OF INFORMED CONSENT

I give permission for my child ________________________ to participate in the above study.

Date | Signature of Parent or Guardian

I do not grant permission for my child to be included in the study.

Date | Signature of Parent or Guardian

APPENDIX D

SAMPLE DATA COLLECTION FORM

DATA COLLECTION FORM

SUBJECT #:___________

Rhythmic breathing/breath control PASS FAIL

______bobs submerging head completely (top of head, including ears & hair, goes under)
______exhales through mouth and/or nose underwater, inhales just above water, with noticeable and effective exhalation & inhalation on EACH repetition
______performance is rhythmic, relaxed and continuous
______performs at least 5 repetitions in any body position in chest deep water

Front float (unassisted with recovery) PASS FAIL

______assumes stable floating position on front: with face in water, feet off the ground and body along the water surface
______legs no more than 45° below the water surface from the head position to be considered a front/prone position float
______holds stable position with minimal or no movement for at least 5s in a relaxed manner
______comfortably recovers to original position

Front glide PASS FAIL

______uses push-off from pool bottom or side
______levels off to a near horizontal position (legs no more than 45° below water surface) from a near vertical position
______glide is prone with face in water, unsupported, and in a relaxed manner with minimal or no movement
______body is in as streamlined a position as possible
______glides for at least 2 body lengths
______comfortably recovers to original position

Front swim propulsion PASS FAIL

______forward movement in prone position
______body approaches horizontal position (no more than 45° below water surface)
______any arm & leg movements or combination of both
______face does not have to be submerged or in the water (can be a head up swim)
______does not touch bottom of pool
______swims for a minimum of 10m in at least chest deep water

Back float (unassisted with recovery) PASS FAIL

______assumes stable floating position on back: feet off the ground and body along the water surface
______legs no more than 45° below the water surface from the head to be considered a back/supine float
______holds stable position with minimal or no movement for at least 5s in a relaxed manner
______comfortably recovers to original position

Back glide PASS FAIL

______uses push-off from pool bottom or side
______levels off to a near horizontal position (legs no more than 45° below water surface) from a near vertical position
______glide is supine, unsupported, and in a relaxed manner with minimal or no movement
______body is in as streamlined a position as possible
______glides for at least 2 body lengths
______comfortably recovers to original position

Back swim propulsion PASS FAIL

______forward movement in supine position
______body approaches horizontal position (no more than 45° below water surface)
______any arm & leg movements or combination of both
______does not touch bottom of pool
______swims for a minimum of 10m in at least chest deep water

APPENDIX E

INSTRUCTOR'S SCRIPT FOR TESTING

INSTRUCTOR'S SCRIPT

- Say : "_______________, please watch the ___________________".
  (name of child) (name of skill)

and point out the criteria for success of the skill to be tested to the child as it is demonstrated by the demonstrator.

- (A) Then say "________________, please show me the___________________".
  (name of child) (name of skill)

  - if the response is correct, stop.
  - if there is no response, repeat this request (A).
  - if the response incorrect, say request below (B).

- (B) Say "______________, could you please try to do the ________ _______ again".
  (name of child) (name of skill)

  - if the response is correct, stop
  - if there is no response, repeat request (A).
  - if the response is incorrect, repeat request (B).

* after the 2nd request, the demonstration will be repeated followed by a 3rd and final request

- End with " Great job, thank-you!"

NAME OF SKILL	- 5 bobs
(assigned by researcher)	- 5 second front float
	- 5 second back float
	- front glide
	- back glide

*** Instructions for the Front and Back Swim Tests ***

- Standing next to the flutterboards at Point A, say

"_________________, please swim on your _____________ from these flutterboards to
(name of child) (front / back)
the other side of the pool where the other flutterboards are".

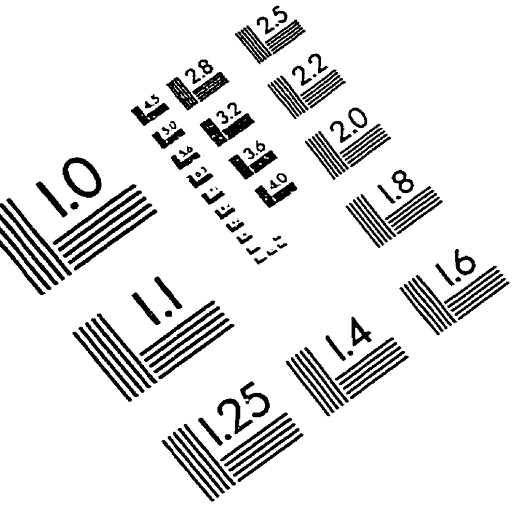
  - repeat this request a maximum of 3 times for the front swim and a maximum of 3 times for the back swim (no demonstrations for these two tests)

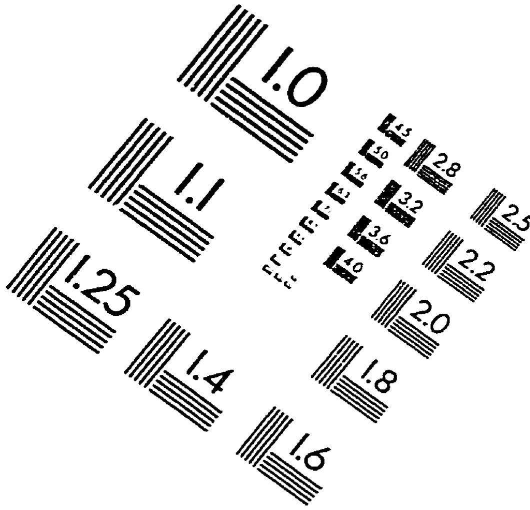
End with " Great job, thank-you!"

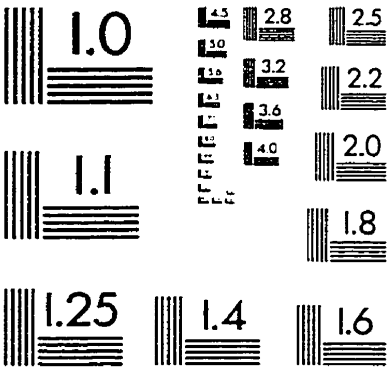
APPENDIX F

CERTIFICATE OF ETHICAL ACCEPTABILITY FOR RESEARCH INVOLVING HUMAN SUBJECTS

IMAGE EVALUATION TEST TARGET (QA-3)

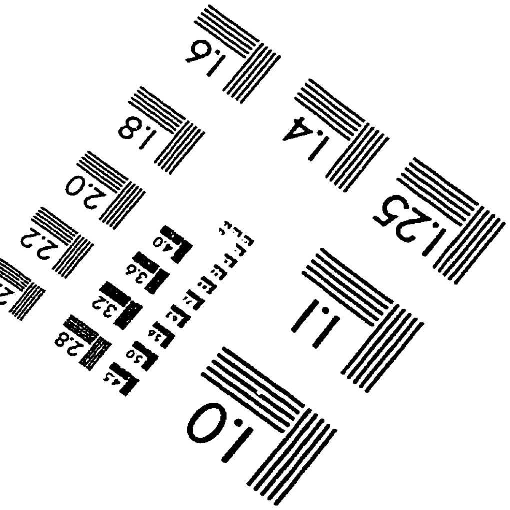


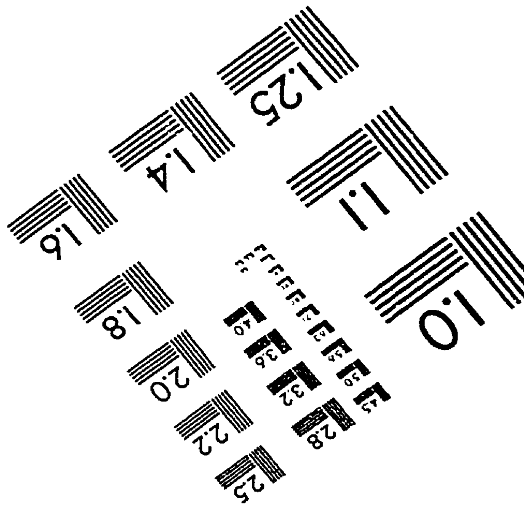




150mm

6″





APPLIED IMAGE . Inc
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989