Shifting Trends in Fitness Testing and PE

Historically, physical fitness and fitness testing have been synonymous with physical education. As Fitzpatrick (1982) illustrated in his historical overview of physical fitness in Manitoba schools from the 1870s to the mid-1970s, physical fitness was generally accepted as a legitimate goal of the education system. The concept of fitness encouraged students to develop the knowledge of the principles of exercise, positive attitudes toward physical activity and a functional level of physical well-being. In the 1950 - 60s, physical educators, governments and professional associations initiated large-scale fitness testing such as The Physical Fitness Testing Project (in 1959) and the CAHPER Fitness Tests in order to develop national norms (Fitzpatrick). With 1967 marking the 100th anniversary of confederation, national fitness norms were used as a foundation for the celebratory Centennial crests (Gold, Silver, Bronze, Participant) which were awarded in unprecedented numbers to Canadian students for achievement according to age-based fitness rankings. Fast forward to the start of the new millennium, and physical fitness development remains a key component within school programs, riding a wave of new outcome-based physical education curricula across Canada (e.g., see Manitoba Education and Training, 2000).

Despite the widespread use of physical fitness as a measure of healthy outcomes for children and youth, we still have much to learn about the impact of fitness testing on students' motivations to be physically active. While many students have learned to hate fitness testing (e.g., see Hopple & Graham, 1995), evidence suggests that the use of fitness assessments can be validating for some (e.g., those who perform well) while discouraging for others (Halas, Mandigo & Thompson, 1998). Undoubtedly, the Canada Fitness Awards were created as a means to motivate all students to be physically active: yet, as many adults now recall, their memory of this extrinsic reward system often includes the feelings of disappointment associated with not achieving the badge one expected. The continued administration of tests where students' scores are recorded, ranked and rewarded (with grades) raises a number of questions about how student performance is interpreted. For example, our current understanding of fitness training principles for children and youth suggests that norm based fitness testing may positively reinforce those students whose bodies mature more quickly than those whose bodies may be developmentally delayed. Are there lessons to be learned from the past that can inform how we use fitness testing today? We think so. In this paper, we examine current research related to the fitness training principles and discuss possible implications for fitness assessment. Our goal is to encourage teachers of physical education to be more fully informed about the principles of physical fitness development, and to communicate this information to students as they use this knowledge to interpret their individual performance on fitness tests in physical education.

Principles of Physical Fitness Development: Implications for Fitness Assessment

Physical fitness is determined by the functional ability of specific attributes or characteristics of the body to perform physical activity. Contemporary terminology has defined these attributes as contributing to either health-related fitness or performance-related fitness. Health-related fitness focuses on body composition, cardiorespiratory endurance, muscular strength and endurance, and muscular flexibility. Performance-related fitness includes power, agility, balance and reaction time; these attributes are important for performance outcomes in specific sports or occupations. Physical fitness has been defined in the following ways:

Well-being: A set of attributes, primarily respiratory and cardiovascular, relating to ability to perform tasks requiring expenditure of energy (Stedman's Concise Medical Dictionary, 2001).

The ability to perform moderate to vigorous levels of physical activity without undue fatigue and the capability of maintaining such ability throughout life. (American College of Sports Medicine, 1998).

In the remainder of this paper, we discuss the factors that influence this set of attributes that young people have or achieve. In each case, we discuss the influence of these factors on fitness assessment practices.

Important Factors that Influence Physical Fitness

1. The Influence of Genetics on Standard Physical Fitness Scores: Recent research indicates that fitness scores for youth are largely determined by heredity and physical maturity and not by behaviour (i.e., physical activity and diet) or environmental factors, which suggests that fitness scores in children and adolescents are largely predetermined factors (Jones, Hitchen & Stratton, 2000; Pate, Dowda & Ross, 1990; Malina, 1990; see Figure 1 adapted from Pangrazi & Corbin, 2001). Because of this strong association between maturation and fitness scores, interpretation of the influence of other factors warrants careful consideration by physical educators. For adults, research has illustrated the existence of a positive, strong relationship between the amount of
physical activity and aerobic fitness (U.S. Department of Health and Human Services, 1996). While we assume that participation in physical activity will influence a young person's fitness score, this is not necessarily the case, and children's adaptability to physical training is not as clearly defined (Armstrong et al., 1991; Boreham et al., 1997; Ekelund et al., 2001; Katzmarzyk et al., 1998; Payne & Morrow, 1993; Rowland, 1992; Shephard, 1997). Consequently, the influence of genetics on standard fitness scores raises cautionary concerns about how we assess fitness in physical education. Many physical educators have already discontinued the practice of using fitness norms for grading purposes, as this practice of comparison to others de-motivated many students. Taken one step further, physical educators should use caution when recording, ranking and rewarding physical fitness as the sole outcome measure of participating regularly in physical activity. Rather emphasis should also be on recording and rewarding increased physical activity as an outcome of physical education.

If teachers are to continue using physical fitness tests, students must be given information on how to interpret their scores on these tests. Otherwise, students who rank poorly on a fitness test may become frustrated, even if they see themselves as physically active and capable participants. Such may have been the case for the many Canadian adults who now recall with great disappointment their Participation badge from the days of the Canada Fitness Tests.

In the following sections, we discuss the Principles of Training (overload, individuality, diminishing returns, specificity, and reversibility) and how these might be interpreted with regard to fitness assessment and instruction in physical education. While the Principles of Training are well accepted for the adult population, the dose-response relationship between physical activity and physical fitness is not as clearly defined for children and adolescents. Having said this, a review of the principles is important for understanding how children may respond to physical activity and how physical educators assess their students' performance.

2. The Dose–Response Relationship of Physical Activity & Physical Fitness: The principle of overload suggests that for students to experience an improvement in fitness (i.e., a response) the training load (i.e., the dose) must exceed that to which the individual is already accustomed. Known as the FITT Principle, the dose of physical activity is controlled by the manipulation of frequency, intensity, time (duration), and type (mode) of exercise. This principle suggests there is a dose–response relationship between physical activity and physical fitness and in order for a response to occur a specific dose threshold must be surpassed. This principle raises two important questions: What is the relationship between dose and response (i.e., linear, curvilinear, exponential) and what is the dose threshold that must be exceeded for a response to occur? With regard to children and adolescents, this relationship is not clearly defined. In other words, we don't know yet how much exercise is enough, or how exactly a child or adolescent will adapt to a given load of exercise (Corbin, Pangrazi, & Welk, 199; Twisk, 2001).

We do know, however, that the dose–response relationship can be generally described by three separate curves (Bouchard, 2001; Kesaniemi et al., 2001). As Bouchard (2001) illustrates in Figure 2, Curve A suggests that most

![Figure 1: Factors That Influence Physical Fitness](image1)

Standard fitness scores for children/adolescents are influenced more by maturation and heredity than by behaviour or environmental factors (adapted from Pangrazi & Corbin, 2001).

![Figure 2: Factors Dose-Response Relationship](image2)

The nature of the relationships between regular physical activity (dose) and most health outcomes (response) generally conform to either curve A, B, or C (Bouchard 2001)
of the benefits are attained at low to moderate levels of activity. Curve B suggests that any increase in activity leads to greater adaptation, while curve C suggests that the greatest benefits are obtained only when the level of physical activity is rather high. In any physical education class students may specifically respond to only one of these three dose-response relationships; this suggests that physical educators should emphasize the importance of using a variety of training loads (i.e., exercise intensity and volume) within their exercise prescription.

3. **The Principle of Individuality:** The principle of individuality, which is strongly influenced by heredity, suggests that an individual response (i.e., adaptation) to training is highly heterogeneous (see Figure 3, Bouchard & Rankinen, 2001). In other words, no two individuals will respond in exactly the same way to a similar training stimulus (i.e., load). Regardless of the training programme you develop, some individuals will demonstrate improvement (i.e., responders) while others will not (i.e., non-responders).

With the response to physical activity being so heterogeneous, all students will not respond in the same way to the daily lesson plan or training program. If fitness tests are to be used to assess improvement, students must be taught how to interpret their individual scores in light of this training principle. Moreover, students should be encouraged to experiment with different types of training routines as a means to determine what type of training appears to influence their fitness development. They can do this by developing their own training programs, and using fitness tasks as goals to work toward. All the while, they must have the knowledge of how to interpret any fitness scores they incorporate into their personal training programs.

4. **The Principle of Diminishing Returns:** The principle of diminishing returns suggests the rate of fitness improvement diminishes over time as fitness approaches its ultimate genetic potential (Figure 4). Simply stated, as fitness improves you receive less bang for your buck. Therefore, the training response is not only associated with heredity, but is also highly influenced by an individual’s current level of fitness. The more fit a person is the less likely they are to improve further, and thus may be unduly penalized if the grading is based on improvement over time (a common practice in many of today’s physical education programs).

Again, physical educators are encouraged to focus attention on the process of getting fit and being active, as opposed to recording students’ fitness scores as an indicator of their achievement over time. With knowledge of how performance on fitness tests is influenced by current fitness levels, students will be in a better position to interpret where they stand in relation to their own fitness goals. For example, sedentary students can look forward to larger gains in fitness scores after a period of training, provided of course, that they are responders to the type of training they undertake.

![Figure 3: Heterogeneous Response to Physical Training](image1)

The amount of adaptation in fitness to a standard exercise dose varies widely and is under genetic control (Bouchard & Rankinen, 2001).

![Figure 4: Principle of Diminishing Returns](image2)
5. **The Principle of Specificity**: The principle of specificity (also known as a specific adaptation to imposed demands, or the SAID principle) suggests improvements in physical fitness are specific to the characteristics of the training stimulus. These characteristics include the choice of speed, angle, acceleration, and muscle group, etc. used during the physical movement. The principle of specificity also applies to fitness assessment, such that, fitness scores are specific to the choice of test. For example, the fitness component muscular strength can be assessed by several different tests such as chin-ups, grip strength, vertical jump, etc., and students may score better on one specific muscular strength test than on another. This aspect of testing specificity is important to consider when students interpret their test score results. Physical educators should convey the message that no single test is a complete measure of any one fitness component.

6. **The Principle of Reversibility**: The principle of reversibility suggests that any improvement in physical fitness is entirely reversible. Therefore, with regard to physical fitness students must use it or lose it. Physical educators should constantly remind students that regularity and consistency of physical activity are important determinants of both maintaining and improving fitness.

7. **Relationship Between Activity & Health**: Finally, it is important to teach students that one can be fit but not necessarily healthy. In fact, many elite athletes have become sick due to the overwhelming physical and psychological demands of high performance training (i.e., overtraining syndrome). This suggests that the motto, more is better, does not always hold true when applied to the relationship between physical activity and health. In other words, there is a positive relationship between levels of physical activity (i.e., dose) and health up to a particular threshold. Beyond this threshold of activity, health may deteriorate. Therefore, this relationship generally conforms to what is described as the inverted U relationship (Figure 5).

From a health perspective, this has led to the generality that a moderate amount of exercise is better than a small amount, while a large amount could potentially be harmful. Promoting the “more is better” without regard to the “inverted U” relationship may ultimately result in poor health if the individual takes physical fitness/activity to the extreme.

**Summary**

In summary, fitness testing and assessment should be implemented and taught in conjunction with the principles of physical fitness outlined in this paper. Without this understanding, students, physical educators and parents may misinterpret the meaning of physical fitness scores. Teachers are advised to carefully consider the design of their fitness assessment practices because fitness scores are determined in large part by such factors as heredity, maturity, individuality, specificity and diminished returns. We recommend that teachers teach the principles of fitness training in their physical education classes so that students learn how they may or may not respond to different regimens of physical activity. While we do not advocate the end of fitness testing (used effectively, fitness tasks can be meaningful for students and motivate their continued involvement in physical activity), we do strongly suggest that students be given the knowledge of how to interpret their fitness scores. With a focus on the process of being active, assessment practices will be more appropriate and meaningful for the student.