INEQUALITY AS AFFECTED BY PEDAGOGICAL METHOD IN PHYSICAL EDUCATION

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I certify that the thesis entitled *Inequality as affected by pedagogical method in physical education* and submitted as part of the degree of Master of Philosophy is the result of my own work, except where otherwise acknowledged and that this research thesis (or any part of the same) has not been submitted for any other degree to any other university or institution.

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Abstract

It is the author's contention that one of the functions of a state education system within a democracy is to educate its citizens so that they can fully participate in society. Fulfilling that function as a school physical educator requires one to be concerned with movement outcomes based on a good citizen model. A good citizen model of physical education translates to a physically well-educated populace that has benefits for citizens at individual, community and national levels. For the individual there are health benefits of a physical, emotional and spiritual kind. At a community level, there are the social capital benefits associated with the interaction and fellowship that transpire when people meet to play sports, recreate or take part in leisure. Such interaction encourages socialisation and can even give communities a focus and direction. Nationally, a fit and active populace promotes greater participation in society, involvement with issues and less demand on health services.

This study evaluated, using instruction in tennis in a physical education context, whether a personalised mastery learning programme of instruction that incorporated individualised goal setting, accelerated motor-skill learning towards achieving mastery or competency in movement at a rate faster and, therefore, more effectively than traditional motor-skill learning instruction. If it did, then a recommendation from this study would be that in order for teachers to fulfil their function within a 'good citizen' model of instruction in physical education that they adopt, where applicable, mastery learning strategies to ensure that as many students as possible achieve mastery of fundamental movements. It found that those learning conditions produced a positive learning environment and notable final student competency levels that appeared counter intuitive to the plateau effect frequently associated with motor-skill instruction and learning.

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TABLE OF CONTENTS

CHAPTER THREE Methodology

CHAPTER FOUR Results of the study

CHAPTER FIVE Discussion and Conclusions

SECTION ONE

SECTION TWO

Philosophical discussion of results principally in relation to the notion of a good citizen model of teaching in physical education

SECTION THREE

Future research ideas

APPENDICES

LIST OF TABLES AND FIGURES

TABLES

FIGURES

CHAPTER ONE

Introduction

1.1 Introduction

This thesis evaluates the effectiveness of a personalised mastery learning programme of instruction, incorporating individualised goal setting in a physical education context as a means to develop student movement competency in basic tennis skills.

1.2 Overcoming inequality of opportunity through a 'good citizen' model of pedagogical instruction in physical education

It is the author's contention that one of the functions of a state education system within a democracy is to educate its citizens so that they can fully participate in society. In fulfilling that function as a school physical educator, one is, therefore, concerned with movement outcomes based on a good citizen model. Within this model, the author suggests that it is the responsibility of the physical educator to strive to have as many students as possible achieve competence in a wide variety of movement skills that will enable them to elect to participate in sport, recreation or leisure activities of their choosing. A good citizen model of physical education translates to a physically well-educated populace that has benefits for citizens at individual, community and national levels. For the individual there are health benefits of a physical, emotional and spiritual kind. At a community level, there are the benefits associated with the interaction and fellowship that transpires when people meet to play sports, recreate or take part in leisure. Such interaction encourages socialisation and can even give communities a focus and direction. Nationally, a fit and active populace promotes greater participation in society, involvement with issues and less demand on health services.

Through this interpretation of the role of a physical educator, one could argue that physical education contributes to democracy. If that argument is valid then perhaps the opposite also holds; namely that a person who is denied a chance to be physically well-educated is being discriminated against in terms of their ability to choose to be a fully functioning member of society. It, therefore, behoves those charged with teaching physical education to employ pedagogical methods that have the best chance of achieving basic movement competence for as many people as possible. Competence allows all citizens to elect to participate in physical recreational or leisure activities and, as a consequence, enables them to both benefit and in turn contribute to society to their fullest extent.

1.3 Comparative research studies of pedagogical instructional methodologies

Research into the effectiveness of different teaching methods in physical education has not produced a rich vein of conclusive findings. Indeed, Rink (2001) referred with some scepticism to the period of the 1970s and 1980s where many educational researchers were particularly active in such studies, as the era of the "methodological wars" (Rink, 2001, p. 112). Suggesting that there has been little change in such a position, Metzler (2005a), in a publication based on instructional models in physical education, noted that despite the extent of methodological research and development of models of instruction in physical education, physical education teachers appeared reluctant to adopt a method of instruction based on a theoretical construct.

From the author's perspective, not having physical educators ideologically bound to a single methodological approach to their teaching is potentially very sound. The author supports the Rink (2001) position that states that a teacher who can choose a method or model of instruction to best suit the content, context and learning needs and styles of their students is well placed to be an effective teacher. However, what the author has witnessed over many years of

teaching and observing physical education is that the lack of any ideological position or application of a theoretical method of instruction by physical educators, is not generally a considered position but a default one; that is, they have not considered their position. Typically, as Kirk's (2005) study implies, what one usually sees in physical education lessons is a traditional form of skill based instruction that frequently ignores the basic components of good teaching practice.

While this study is a comparative one, the position of the author is not just to compare methods for the purpose of trumpeting one over the other. It is to investigate whether a method of instruction, whose proponents (Bloom, 1976; Guskey, 1987a; Kulick, Kulick, & Bangert-Drowns, 1990) claim, that merely through its theoretical construct promotes good teaching practice, can also both accelerate the rate of student learning and provide for the teacher an accessible measure of student competency or mastery of movement skills. If the investigation reveals that those outcomes are achievable then a case might be made for teachers to consider adopting, where appropriate, a mastery learning methodology in order that they may fulfil their function as a teacher within a good citizen model of physical education instruction.

1.4   Justification for the study

Two physical education related developments, one unprecedented and the other without a comparative base, have recently emerged to suggest that there is a need to reflect on pedagogical method in physical education in New Zealand. The first development concerns the rapid growth of obesity and diabetes in young New Zealanders. Childhood obesity and an alarming increase in the incidence of diabetes are being recorded in New Zealand at levels unheard of just two decades ago. In a New Zealand Ministry of Health report on obesity to the Minister of Health (Obesity Social Report, 2005), it was noted that obesity was associated with heart disease and diabetes and that the prevalence of obesity among New Zealand adults aged 15 - 74 years had doubled between

3

1977 and 2003. Typically, diabetes was a disease of older people, but now the Obesity Social Report (2005) suggests that through a combination of poor diet and low activity levels, in New Zealand this disease is fast becoming one involving young people, especially young Polynesians in South Auckland. Obesity levels in South Auckland are reported at 24% for Pacific Island children compared with 9% for Caucasian children aged 5 - 11 years (Gordon, et al., 2003). While acknowledging that in today's society there are competing interests and demands on young people and that 'their world' is fundamentally different from how it was as little as a generation ago, one still needs to question what those in the business of teaching physical education might do to help reverse this trend towards obesity and ill health in society. In relation to these trends it would seem imperative that those who teach physical education ensure their methodologies of instruction contribute to arresting and overcoming these trends in New Zealand society.

The second development has been the identification that young people cannot perform fundamental movement skills well. A study by Sanders and Kidman (1998), identified that large numbers of New Zealand primary school children (83%) do not appear to be mastering fundamental movement skills. The inability to perform fundamental movements such as, running, dodging, kicking, catching, throwing or striking, results in what is known as the movement proficiency barrier. According to Taggart and Keegan (1997), failure to overcome the movement proficiency barrier - that is, to master the basic rudiments of movements associated with sports or leisure activities - frequently in adolescence translates to a perception that one cannot participate in games or sports. In turn, the adolescent who does not participate in games or sports is unlikely to embrace sport related leisure or recreation as an adult. Such findings raise questions about the effectiveness of current instruction in physical education and sport.

One answer to these developments that is currently being supported by the New Zealand Government and its agencies, e.g., Sport and Recreation New

Zealand (SPARC), is through the provision of additional physical education advisors in primary schools. It is hoped that quality physical education programmes will then emerge that will reignite an interest in physical activity and, with that, overcome trends towards, for example, obesity and diabetes. A measure of the quality of instruction in physical education will undoubtedly be the extent to which it ensures student competence in fundamental movement skills.

These developments suggest that there is a need to reflect on pedagogical method as it is applied in New Zealand school physical education programmes. It might even be argued that the importance of that reflection is greater now than in any other time in New Zealand's history.

1.5   The democratic function associated with state schooling and the case for mastery learning and goal setting

In order, therefore, for physical education to fulfil its role within a democracy, to promote equality of opportunities and other human values, it needs those who teach it to become accountable for all student learning and not just that of an elite few. If physical education is going to concern itself with this democratic function then it needs to employ methodologies that ensure as many students as possible achieve basic competency in a wide range of movement activities and do not succumb to the movement proficiency barrier. Anecdotal evidence suggests that parents who did not enjoy sports pass on similar feelings to their children and so continue a cycle of deprived citizens. In order to break that cycle, one needs to ensure that as many people as possible are taught to master basic movement skills and are encouraged to participate in fun and vigorous physical activity that will contribute to reversing the alarming obesity and diabetes trends documented in the 2005 Obesity Social report.

1.6   Mastery learning and goal setting

Goal setting and mastery learning are not new pedagogical concepts. The success of goal setting as a vehicle for facilitating success in a wide range of human endeavours is well documented. The person most associated with research that established the model for the successful application of goal setting was Edwin Locke whose early research took place in the 1960s and 1970s. However, despite its well-documented use and success in the sport domain, goal setting appears to be less frequently employed in the physical educators' armoury of teaching skills.

As with goal setting research, mastery learning was a product of research in the 1960s and 1970s, the period previously referred to by Rink (2001) as the era of the methodological wars. Benjamin Bloom (1968, 1976, 1984a, 1984b) was the principal champion of mastery learning. Bloom (1968) raised concerns regarding the effectiveness of a state schooling system to overcome inequalities in society that were the result of circumstances of birth or environment. He suggested that despite years of schooling, students typically emerged unchanged relative to their entry point. He believed that the adoption of mastery learning could result in almost everyone learning what currently only a few appeared to be learning. Schooling that achieved that end would also achieve its democratic function, because it would better allow all citizens the potential to participate fully and equally in society.

1.6.1   A merged position on goal setting and mastery learning

Within physical education research, more recent writing has merged the functions of both goal setting and mastery learning methodologies. It is the author's view that this has occurred because research in physical education has moved away from a purely sport paradigm towards a more inclusive educational environment. Such a merger can perhaps be seen as cyclical in that it tends to capture again the original motivation of Bloom (1968), to ensure that

pedagogy in formal schooling was structured to ensure all citizens had the potential to fully participate in society. The merged approach now being advocated is not based on comparative research - for example, of making a case for a one or two sigma advantage of one methodology of instruction over a rival method (Bloom, 1984a & 1984b) - but on opinion that the adoption of the methodology is likely to create a positive learning environment. It is suggested (Papaioannou, 1998) that a learning environment that encompasses mastery learning is likely to focus on students making an effort resulting in greater involvement and more intrinsic interest in their learning. Papaioannou (1998) and Nicholls (1989) also suggest that physical education programmes that concern themselves with issues of democracy and equity need to embrace mastery learning and goal setting.

1.7 Authentic field-based motor skill learning research: ecological validity

Undertaking field-based human motor skill research is extremely difficult. Richard Schmidt one of the world's foremost researchers in motor skill learning and the author of texts that are international standards in motor skill instruction (e.g., Schmidt, 1988, 1992), notes the difficulty associated with authentic field-based motor skill learning research relative to that undertaken in a laboratory. In motor learning research, "the most important point of unreliability is the performer's not being able (or willing) to perform the same act twice in exactly the same way...some of these intra-subject variations..attention, fatigue, boredom strategy...tend to obscure the constructs that scientists are attempting to measure" (Schmidt, 1988, p. 49). Schmidt (1992) noted that the laboratory environment could control many of the variables associated with human motor skill learning research that cannot always be so easily managed in authentic game or sport environments. However, despite the apparent need for laboratory conditions for producing reliable data, Schmidt (1988) still urged caution regarding the ecological validity of laboratory research over field-based experiments. He noted, "[o]ur

motor system was created through evolution and the interactions with the physical characteristics of the environment, therefore we understand the function of the motor system by using more natural research settings" (Schmidt, 1988, p. 15).

1.7.1 This investigation

Schmidt's (1992) observations of the challenges of authentic motor skill learning research suggest that this study, undertaken with a randomly selected class, in an authentic physical education setting is likely to pose many problems in terms of controlling variables and consequently interpreting the data in any confirmatory way. Typically, motor skill research that does move out of the laboratory generally confines itself to single discrete movements in closed skill environments; for example, target shooting in archery (Barnett & Stanicek, 1979) or a novel floor-hockey flicking task (Edwards, 1988), or rifle shooting (Boyce, 1992). However, despite the challenges faced about managing reliability and controlling human variables in this investigation, the value in providing, in Schmidt's (1992) words, ecologically valid data from an authentic teaching context, is likely to strike a sympathetic chord with readers with a teaching background in physical education.

1.8 Interpreting the data: exploratory or confirmatory data analysis?

Having asserted the desirability of undertaking authentic motor skill learning research but the difficulty it involves, the question arises how then to interpret the data? Should it be analysed as part of an exploratory data analysis (EDA) procedure or a confirmatory data (CDA) one? Exploratory data analysis is in the nature of what Tukey (1977) describes as detective work. He suggested that it is important to use data to uncover trends, issues and concepts and that we should do this in the simplest way possible. He stated that the greatest value of data is that it provides us with a picture "that forces us to notice what we never expected to see" (Tukey, 1977, p. vi).

Hartwig and Dearing (1979) suggest that exploratory data analysis is a way of thinking and relies on two principles "scepticism and openness" (p. 9). They also state that part of openness is re-expression. "The scale on which a variable was originally observed and recorded is not the only one on which it can be expressed" (Hartwig & Dearing, 1979, p. 12). Tukey adds, "restricting one's self to the planned analysis - failing to accompany it with exploration - loses sight of the most interesting results too frequently to be comfortable" (Tukey, 1977, p. 3).

Alternatively, should the focus of the interpretation of the data be within the nature of confirmatory data analysis? Confirmatory data analysis is defined by Tukey (1977) as, "using very restrictive procedures...to try and conclude...what does the data confirm in respect of the sample population it came from to the population as a whole?" (Tukey, 1977 p. vii). The answer, as to what type of analysis to use, according to Tukey (1977), lies within both kinds of measures. Tukey (1977) suggests that confirmatory and exploratory descriptive analysis should work side by side.

Consequently, the data from this investigation will be used in two ways. Firstly, confirmatory data analysis will be undertaken to establish if anything can be stated with the regard to student rates of learning. Measures will be made between the two pedagogical methods of traditional skill based learning and individualised mastery learning incorporating goal setting and pre-instruction base line data. Measures will also be taken that compare the rates of learning between the two treatment interventions. Secondly, exploratory data analysis will be used to provide simple pictures of trends in relation to the objective of observing whether competence in movement relates to aspects of a good citizen model of instruction in physical education. In this way the data, trends and observations raised by this investigation will be used as sources for a discussion of teaching and learning processes associated with physical education.

1.9 The research question and observation

Research question

1. Does adopting a personalised system of instruction (PSI) incorporating individualised goal setting (GS) result in a better rate of student improvement in motor skills than traditional skill based learning practices?

Research observation

2. Does the adopting the stated system of instruction contribute to potentially providing all students with equal opportunities to participate in movement activities of their choice?

1.9.1 Examining the research design.

Various experimental designs were considered to examine these questions. Initially, the design favoured involved a between-subject experimental design. Two separate cohorts of students from different schools were to be selected and both cohorts would have received the same treatments but in reverse order. Namely, the first group would have received Treatment A conditions followed by Treatment B. The second group would receive Treatment B conditions followed by Treatment A. However, in the period immediately before the study began, and following extensive preparations and planning, the circumstances of one of the cohorts changed dramatically, such that it could not be involved in the study. In order to continue with the study a within-subject experimental design had to be employed.

In ideal conditions, the group would be divided in such a way that some would receive the treatment A followed by treatment B protocols and others in the reverse order. However, constraints associated with practicalities did not make this possible. This design then was of an A > B nature.

1.9.2 Within-subject experimental design analysis

In a within-subject experimental design, typically, treatment effects are measured by comparing the changes in performance following the introduction of the experimental treatment protocols against the same subjects' performance prior to the treatment period (Church, 1994). In this study, prior to the first treatment period students undertook an assessment of their ability to serve and rally in tennis. Within the first treatment period the students received instruction in particular tennis skills using a traditional whole class, teacher paced, command delivered, skill based instruction method. They were then reassessed in their ability to serve and rally in tennis. In the second treatment period they received instruction in specific tennis skills using a personalised mastery-learning programme that incorporated individualised goal setting. At the completion of the second treatment, students were again assessed in their ability to serve and rally in tennis.

The results were analysed to evaluate the relative rates of learning or improvement between the two treatment periods, to investigate whether one treatment resulted in a better rate of learning towards competence in basic movement skills in tennis than the other.

1.10 Organization of the thesis

The thesis is structured to present the research through a literature review of mastery learning and goal setting both within an historical perspective and as applied in physical education (*Chapter Two*). Then attention is given to methodology, subjects, procedures and ethics, and also a detailed discussion of the within subject experimental design structure and its application to this study (*Chapter Three*). A report and analysis is made of the results (*Chapter Four*), and then follows a discussion of those results and recommendations for future research (*Chapter Five*).

CHAPTER TWO

Literature Review

The mastery process operates on the proposition that almost every student can learn the basic skills and knowledge that are the core of the school curriculum when the instruction is of good quality and appropriate for him [sic] *and when he* [sic] *spends adequate time in learning* (Torshen, 1977, p. 41).

2.1 Introduction

This study seeks to investigate the merits of a personalised mastery learning instructional methodology incorporating individualised goal setting as a vehicle for enhancing movement competence in physical education. The examination of the literature that underpins this investigation will:

- define mastery learning and goal setting and establish the components of both pedagogical methodologies;

- briefly outline the development of mastery learning and goal setting and explore the positions of the principal advocates of the methodologies;

- record and briefly outline any controversy that surrounded the development of the methodologies;

- examine the literature in respect to the methodologies applied to learning and teaching in physical education;

- examine the current literature that reflects an evolved integrated classroom perspective on the application of mastery learning and goal

setting that encourages all students to participate and benefit from competence in movement.

2.2   Mastery learning defined

Mastery learning refers to the attainment of adequate levels of performance in those things identified as being the subjects of instruction. Researchers in this field, for example, Carroll (1963) and Bloom (1976), note that the mastery process operates on the supposition that every student can learn the basic skills and knowledge that are the core of the school curriculum. They state that this can be achieved when the instruction is of good quality and appropriate for the student and when the student spends an adequate amount of time in learning. Of course what they considered as good quality in terms of instruction included the parameters they assigned to mastery learning. They agreed that adequate time to learn means that the time required to learn equals the time available to learn. Torshen (1977, p. 49) captured their views through the following formula:

$$\text{Degree of Learning} = f\left(\frac{\text{Time spent to learn}}{\text{Time needed to learn}}\right)$$

2.2.1   The essential elements of mastery learning

There are various version of mastery learning, but Guskey (1987a), in a review of the mastery learning literature, identified two essential elements that differentiated mastery learning from other forms of instruction. The first element was feedback, including corrective and enrichment processes; and the second was congruence among instructional components.

13

2.2.2 Feedback, correctives and enrichment

In their review of the research on mastery learning, Kulik, Kulik, and Bangert-Drowns (1990) suggested that feedback by itself would not necessarily bring about a change in learning. They considered that the feedback used in mastery learning programmes needs to be both diagnostic - identifying strengths and weaknesses - and also prescriptive; that is, offering activities of either a remedial or enrichment nature to correct errors or extend knowledge. Kulik et al. (1990) also noted that in the case of correctives, the form of instruction or the type of activity offered must differ from the initial instruction. They argued that if the initial instruction had not been successful then one should not assume that more of the same would be, so alternative approaches are required to tap into different learning styles and enhance student motivation.

For students who master the work, as measured in a formative assessment, enrichment activities need to be exciting, rewarding and challenging. This ensures continuity of instruction in the class while students yet to master the prescribed learning outcomes undertake remedial activities. They saw this structure as also having the effect of individualising the instruction.

2.2.3 Congruence among instructional components

The second essential element identified by Guskey (1987a), was that within the mastery learning structure there needed to be obvious and transparent links and congruence between stated outcomes, content and assessment. For example, within a unit of work the following three points should be clearly observable:

1. Specific learning outcomes.
2. Content that engages students in opportunities to achieve the specific outcomes.
3. Assessment that evaluates the specific learning outcomes within the context of the instruction.

Kulik et al, (1990) identified a criticism sometimes levelled at the mastery learning methodology; namely that mastery learning becomes teaching to the test. However, by way of rebuttal, they stated that if congruence within the structure was logical, the teacher, having established the learning outcomes, content and instruction, would be in a position to undertake the assessment as a means of testing what they teach. They argued that this is good teaching, a position certainly supported within the physical education literature on effective teaching (e.g., Siedentop & Tannehill, 2000).

2.3   The development of group-based mastery learning as a formal teaching methodology

The person most associated with the formalisation of mastery learning as a teaching methodology was Benjamin Bloom. In observing the typical classroom instructional scenario, Bloom (1968) noted that instruction was usually centred on a unit of work or a topic. That instruction then covered the content within the unit and at the completion of the unit some form of assessment would take place - usually in the form of a test that measured a student's ability to recall the content of the unit. The test score results were then used to rank the students and the next unit of work was embarked upon. He noted that generally this was the only one-off opportunity the students had to be taught or assessed on the content of that unit. Bloom (1968) observed that under this regime of instruction, typically, only 20% of students achieved excellence scores or what one might call mastery of the content.

2.3.1   Most favourable learning conditions

It appeared to Bloom that the most favourable learning conditions in education were found within one-to-one tutoring. In observing the teaching strategies associated with individual one-to-one tuition, especially the scenario that provided for instant prescriptive feedback and the learning strategies of

successful students. Bloom (1976), noted that given time most students, although working at different rates, could learn well.

What he sought to do was to identify a methodology that would translate the success of individual tutoring to the class or group learning scenarios found in the school environment. Bloom believed that the discovery of such a methodology would lead to nearly all students achieving the same high levels of attainment usually reserved for the high achievers. Bloom (1976) believed that group-based mastery learning was the methodology that could deliver such a level of achievement in state schools.

Given his concerns about the ability of schools to deliver on creating a society that allowed for all to pursue a fulfilling life with equal opportunity, one can appreciate how Bloom's (1976) claims for mastery learning generated considerable excitement within the educational community. The Bloom (1976) model of mastery learning became known as group-based mastery learning.

2.4   Group-based mastery learning components

By most descriptions Bloom's (1976) group-based mastery learning model has the components listed below. The interpretation and relative importance of these components is sometimes debated but generally, within the literature, the following (summarised from Torshen, 1977) are recognised as being the hallmarks of the group-based, mastery learning methodology.

Objectives. These represent the outcomes or goals of the instruction that one expects the students to achieve with these being made quite transparent to the students. The learning outcomes also become the criteria for assessment. A student needs to acquire the skills, key concepts, ideas or specific facts in order to complete the course successfully.

Minimum pass levels or the mastery standard. These are defined by the objectives but represent the minimum level of performance a student is required to attain in order to show that they have achieved mastery or have achieved the minimum pass level.

Pre-assessment. This is used to determine the student's entry point and what type of instruction they might require within the unit of work. This assessment measures the student's prior performance against the expected outcomes. This is sometimes referred to as 'criterion referenced assessment'. The criteria are the outcomes so the assessment must be clearly referenced to these outcomes.

Instruction. There is no one methodology, but there is an expectation that the components of mastery learning would be contained within that instruction. However, during the period of Bloom's work (1970s - 1980s), the favoured methodology, especially in physical education using mastery learning, was prescriptive, teacher paced, command centred, skill based instruction.

Assessment. Assessment is both diagnostic and summative. Drawing on the work of others - notably Carroll (1963) - Bloom (1976, 1984a, 1984b) argued that criterion standards needed to be established in relation to the objectives or stated learning outcomes of the unit of work, and a diagnostic test undertaken in relation to those criteria.

Feedback. The results of the test or assessment was not seen to be an end of the work on the unit. The test, as a diagnostic tool, was to be used to provide feedback to students as to what they had learned and to identify gaps in their comprehension. This formative assessment would then be used to target specific difficulties and students would then receive individual instruction or remedial programmes to master the content in the areas identified as weaknesses. Bloom (1976) suggested various means by which this remedial work could take place but, importantly, all students should receive specific feedback on what they needed to learn/master in order to reach the desired

learning outcomes for the unit of work. Hence, within the Bloom (1976) model, assessment and feedback were inextricably linked.

A further assessment would then be undertaken following the remedial work. This was seen as necessary to check the effectiveness of the remedial instruction and activities and to provide the student with another chance at achieving success.

Enrichment activities. In group-based mastery learning programmes, for those who mastered the work before others, two scenarios typically transpire. Firstly, they receive enrichment activities to further develop their ability in a related activity. Secondly, they work in a co-operative and reciprocal learning environment, helping their fellow students to achieve mastery by providing them with feedback against the mastery standards the teacher sets.

In establishing the role of assessment and feedback, the mastery methodology exemplified the comments of Bobbitt (1941, as cited in Torshen, 1977), who noted that there needed to be a move away from everyone working at the same pace or receiving the same amount of time to learn or master work. He compared such strategies to the mass treatment of the patients in a hospital where, regardless of the patients' illnesses, they all received the same amount of time with the doctors and the same treatment.

Establishing a group-based mastery level. Bloom (1976), stated that the next unit of work should not be undertaken until 80% of the class had mastered the content. Typically, but not always, mastery was recognised when a student demonstrated competency with at least 85% of the stated learning outcomes. These percentages fluctuated between programmes, with some requiring 100% pass rates in content knowledge (for example, Keller, 1968), or 60% (Metzler, 1986, as cited in Pieron & Graham, 1986). The percentage of mastery required to pass the unit appeared, to a certain extent, to depend on the subject matter and the programme designer. Bloom (1976), believed that this systematic

approach to instruction and learning, coupled with the stated mastery levels, would result in more favourable learning conditions and many more students would learn thoroughly and truly master the subject.

2.5   Keller's model of individualised mastery learning

Bloom's interpretation of mastery learning was not the only model developed during the 1960s-1980s. In 1968, Fred Keller published an individualised format/plan for mastery instruction, frequently referred to as a personalised system of instruction (PSI). Although of similar mode, the individualised mastery programme of Keller (1968) was in some respects fundamentally different from the Bloom (1976) group-based mastery model. For example, the mastery levels within the Keller individualised programmes were frequently set at 100%. The pace of the learning was individually based, with students operating at their own pace and not tied to 80% of the class demonstrating mastery before the individual could move to the next module of work.

In the Keller (1968) model, little use was made of lectures. In their place extensive use was made of comprehensive study guides that all students received. Where lectures were given, the main purpose was to either introduce the subject matter or to motivate students, but it was not used to deliver content. Finally, while the Bloom (1976) model used diagnostic and summative tests and feedback, the Keller model used frequent tests/quizzes with student proctors employed to evaluate an individual's performance as a means to establish mastery and, subsequently, progression to the next unit of work.

2.5.1   Personalised system of instruction mastery learning components

A meta-analysis of Keller's model of individualised mastery learning programmes (Kulik, Kulik & Cohen, 1979) identified the following five

characteristics of mastery learning in his personalised system of instruction (PSI). The characteristics required the work to be:

- mastery oriented
- individually paced
- distinctive by the minimal use of whole class lessons which were primarily used for stimulating and motivating students
- supplemented with printed study guides to guide students work
- summatively assessed by tutors who provided prescriptive feedback.

As with Bloom's (1976) model, the units of work had to have explicit instructions, transparent and specific learning outcomes, and stated instructional strategies and resources. Despite the extensive use of study guides the model did require teacher direction. When one sees mastery programmes used in physical education (e.g., swimming instruction) it is, perhaps, the Keller (1968) model or variations on it that are most frequently employed.

2.6 Controversy surrounding the advocacy of the mastery learning methodology

The controversy evident within the literature surrounding mastery learning covers several issues. The issue of most debate centred on the claim (Bloom, 1984a, 1984b), that group-based mastery learning in conjunction with other good teacher practice could achieve an effect-size (ES) increase of 2-sigmas over normal norm referenced group-based teaching methods. The second issue of controversy was the claim that the use of mastery learning would eventually result in all students learning new material at the same rate; i.e., student variability in cognitive and affective entry levels would reduce to zero. A third issue was the notion that what schools had to teach could always be broken down into chunks of knowledge and learned or mastered in a hierarchical sequence.

Researchers, for example, Guskey (1987a) and Kulik, Kulik and Bangert-Drowns (1990), refer to findings supporting the Bloom (1984a, 1984b) position, which claimed that mastery learning had the potential to significantly change students' performance to a point that given time, most students could learn what typically only a few students appeared to be capable of learning. Countering those claims of support were Resnick (1977) and, notably, Slavin (1987a, 1990) who were more sceptical about the claims of those champions of mastery learning.

2.6.1   The 2-sigma problem

Bloom's (1976) development of mastery learning as a method of instruction became controversial when he claimed (Bloom, 1984a, 1984b), that the correct application of the methodology could achieve effect sizes of one or two standard deviations over standard forms of instruction – with this claim being known as the '2-sigma problem'. Bloom (1984b) stated that the correct application of the methodology to achieve those effect sizes required that mastery learning be coupled with good teaching practice. Bloom supported his claims through reference to research by his students (Bloom, 1984a, 1984b) that indicated that there were significant differences in learning when students were taught using conventional methods but with mastery or individual tutoring methodologies.

The claims were that in the tutoring classes students achieved results that were two standard deviations above the average of the control class or that average students under tutoring conditions outperformed 98% of students in the control class. For mastery learning classes the claim was for one standard deviation, or having the average student outperform 84% of students in the control class. Students working for Bloom (Bloom, 1984a, 1984b), also claimed results on post-instruction tests that 90% of the tutoring class and 70% of the mastery classes were attaining scores that only the top 20% of the conventional class or control class students were achieving. Bloom (1984a, 1984b), argued that these

results indicated that most students did have the potential to reach high levels of learning. He illustrated his learning improvement projections with graphs, as for example, in Fig. 2.1 below (Bloom, 1984a, p. 5).

Bloom's projection of achievement distribution for students under conventional, mastery learning and tutorial instruction methods

FIGURE 1. Achievement distribution for students under conventional, mastery learning, and tutorial instruction.
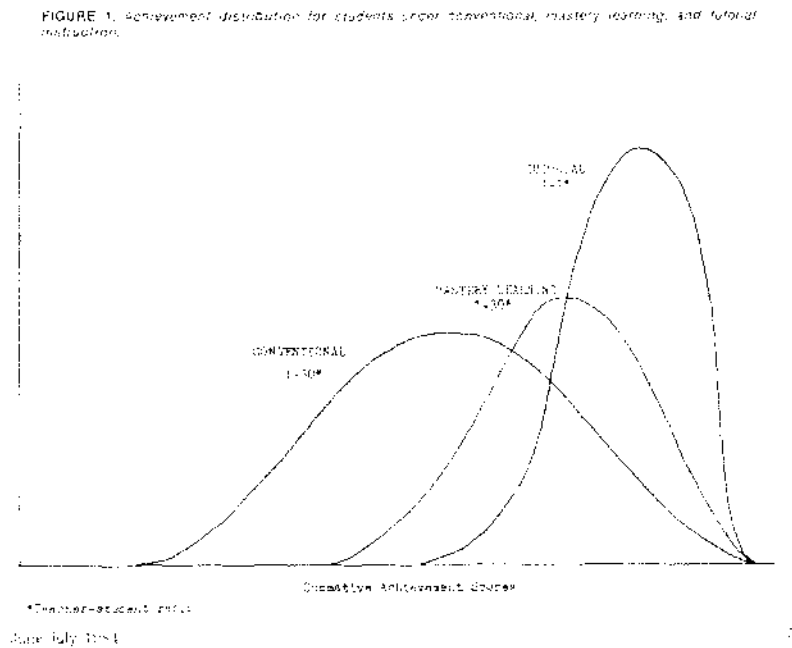
Fig. 2.1

Bloom's dilemma was how to achieve these outcomes under more realistic typical school conditions; hence, the 2-sigma problem. He suggested that variables other than mastery learning strategies required consideration to achieve effect sizes over 1 sigma. He divided the variables into four categories: Category A was the learner; Category B the instructional material; Category C, the home environment; and Category D, the teacher and the teaching process. He further identified the variables of quality of teaching, use of time (that is, engagement with the specific outcomes), cognitive and affective entry characteristics, formative testing, rate of learning and the home environment as all being important in achieving the 2- sigma difference (Bloom, 1984a, p. 6).

22

Bloom also stated that in trying to achieve the 2-sigma differences, it was better to work with two variables from two different categories than two from within the one category. For example, he noted that Leyton (1983, as cited in Bloom, 1984a), using mastery learning and initial enhancement of cognitive prerequisites for an Algebra and French language class, produced results on a summative test of 1.6 sigmas above the control group. In terms of improving the teaching process, Bloom cited work by Nordin (1979, as cited in Bloom, 1984b), where work was done on improving instruction through the more efficient use of time, enhanced cues (explanations) and participation. Bloom noted that Nordin claimed an improved effect score of 1.5 sigmas (93%) over the control group.

Bloom (1984b) observed that not all of the variables identified would have the same effect. For example, one-on-one tutorials would have an effect size (ES) of 2.00, corrective feedback within mastery learning an ES of 1.00, graded homework an ES of 0.8, teacher expectancy an ES of 0.3 and peer group influence an ES of 0.2. Bloom (1984a, 1984b), also speculated that two or three variables used together would contribute more to learning than any singular use of one variable alone. Considering mastery learning in combination with other variables, Bloom (1984a) claimed that mastery learning plus corrective feedback would provide yields of at least 1 sigma effect. In combination with other variables mastery learning outcomes would approach a 2-sigma effect.[1]

2.6.2   Support for Bloom's claims

Bloom's claims received support from a review of the literature by Guskey and Gates (1986) and again from a meta-analysis of the mastery learning research

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[1]   Critics of Bloom's (1976) projections, e.g., Resnick (1977), tended to focus on the fact that his suggestions about the effectiveness of mastery learning supplemented by these other alterable variables, were in fact only suppositions. He merely projected or hypothesized that by combining the variables within a teaching environment then those would be the results. For example, the graph in Fig. 2.1 is only a projection - it was not actually a research result, though it is easy, when reading the work, to take it as a research outcome.

by Kulik et al. (1990). Without actually claiming to have found an exact 2 sigma effect, both sets of researchers still concluded that group-based mastery learning, produced distinctly positive effects on a broad range of student learning outcomes. They also claimed that teachers expressed very positive attitudes towards implementing mastery learning strategies. Kulik et al. concluded, that, using mastery learning strategies in the correct environment, it was probable to achieve the one-sigma claim (Bloom, 1976) and, in certain instances, a one-point five-effect size improvement.

Guskey and Gates (1986), and Kulik et al. (1990), claimed that these gains in learning scores came about in the first instance because learning outcomes and instruction were transparent. Secondly, they observed that the diagnostic assessment and remedial instruction enabled all students over time to develop the basic skills that capable students had and, eventually, as new material was introduced, they learned it in the same manner and at almost the same pace as the fastest learners. They also claimed that the methodology helped focus teachers on what was important to teach. They stated this was not a 'teaching to the test' scenario but one that involved teaching to the stated learning outcomes, and that this is what good teachers should do.

2.6.3 Personalised system of mastery learning instruction

Little controversy surrounded the use of the Keller (1968) mastery-learning model incorporating a personal system of instruction (PSI). Perhaps this was because the claims made in favour of the methodology did not include any attempt to draw comparisons with other norm referenced approaches in terms of time spent in achieving mastery and that there was no attempt to hold back those who mastered material early with extension or other activities, but to move them on at their own pace.

However, Kulik et al. (1990) in their meta-analysis of the effectiveness of mastery learning still produced some very positive findings for the use of the

Keller (1968) PSI method. In their investigation of the Keller model, they reviewed 108 studies at 72 colleges. They found the programmes were mainly used within the disciplines of economics, physics, psychology, business studies, mathematics and engineering. They reported an average effect size (ES) score across these studies of +.52 over conventional instructional programmes. They also noted that in relation to control studies they found a slightly higher course completion rate for students under the PSI system, and that attitudes were generally positive to the subject and the instructional model.

2.7 The counter claims to mastery learning's effectiveness

Claims against the effectiveness of mastery learning methods were lead by Resnick (1977) and Slavin (1987a, 1990). Slavin, in particular, provided a scathing counter against the claims of Bloom (1984a, 1984b) in relation to his hypothesised 2-sigma claim. He was also sceptical regarding the meta-analysis of Guskey and Gates (1986) and what he referred to as "their extraordinarily positive claims for the effect size scores of mastery learning over conventional methods of instruction" (Slavin, 1987a, p. 176) and whether the mastery learning method represented an effective use of available teaching time.

2.7.1 Slavin's objections

Two of Slavin's principal questions against the effectiveness claims made for mastery learning were:

1. Is mastery learning more effective than traditional instruction even when instructional time is held constant and achievement measures register coverage of material as well as mastery of specific outcomes?

2. Is mastery learning an effective use of additional time and instructional resources to bring almost everyone to an acceptable minimum level of achievement? In this second question Slavin is also posing the question:

"What would the control group achieve if it too was allocated additional time?" (Slavin, 1987a, p. 187).

Slavin sought to answer these questions through his own review of the literature (Slavin, 1987a). As in the previous literature reviews, he replicated the use of effect size scores as the criteria for establishing the difference between both experimental groups and the controls. Where he differed though was that he used standardised tests to distinguish the effect size scores between the test results of the experimental and control groups. In contrast, the other reviews had relied on experimenter-constructed tests for effect size scores.

Slavin (1987a) noted in response to the claims of Guskey and Gates (1986) that, in relation to his first question, some evidence in favour of the claim was found in experimenter made summative tests. He noted "the effects of mastery learning on experimenter made criterion referenced measures were generally moderate but consistently positive" (Slavin, 1987a, p. 199). However, away from measures on experimenter made assessment tests, he stated that he could find "little support for his first question"... claiming that, "not one study reached conventional levels of statistical significance when scored on a standardised test" (Slavin, 1987a p. 191). Slavin (1987a), found that when standardised tests, such as the California Achievement Tests, were employed on both experimental and control groups that the effect size score dropped significantly.

Slavin also concluded that effect size scores were more in favour of mastery learning in lower school than middle school classes, as was the case in one of his own investigations (Slavin & Karweit, 1984). He also found that mastery learning effects were greater for lower than higher achievers.

In respect to Slavin's second question, the extra time claim, he noted that if time was to be held constant, then extra time needed to be given to those who do not readily achieve the outcomes. This can only come at the expense of

those who master the concepts or content early. To illustrate the problem, Slavin (1987a) outlined research by Arlin and Webster (1983) on work undertaken on sailing under mastery learning and non-mastery learning conditions. In the mastery learning conditions those that did not reach 80% on the quizzes received further instruction. Non-mastery classes did not receive any additional instruction. "At the end of the unit the mastery learning sailing class achieved at twice the level of the non-mastery class in terms of percent correct on daily chapter tests, with an effect size of 3.0" (Slavin, 1987a, p. 178). Slavin noted that an analysis of the time spent by the respective groups revealed that the mastery-learning cohort spent more than twice the amount of time learning the same material as the non-mastery group. On a follow-up post-programme test, the ES score in favour of the mastery group had dropped to 0.7 and, based on per-hour of instruction, the non-mastery group retained far more information per hour of instruction, which he estimated into an effect size score in their favour of 1.7 (Slavin, 1987a). Building on this specific example, Slavin (1987a) estimated across his study that work quoted by Bloom (1984a, 1984b) requiring all students to master a minimum of 80% of the set learning outcomes before the whole class could move to the next unit, required "an additional 20-30% of extra time" (Slavin, 1987a, p. 179). He estimated that this percentage of extra time equated to about one day extra per week than that given to norm referenced controls used in the studies.[2] The differences in time to learn prompted the obvious question, which Slavin (1987a) was quick to ask, namely, what could the control group or class learn if they received the same amount of learning time?[3]

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[2] While not addressing Slavin's actual concern, proponents of mastery learning, e.g., Guskey and Gates (1986), had previously argued that the time to learn difference between those who initially struggled with material and those who did not, would diminish over time. Slavin (1987b) agreed that this appeared to be the case in short term studies but in Arlin's (1984a) study over a four year period that the time taken to achieve mastery by those initially slower actually increased from 2.5 - 1 ratio to a ratio of 4.2 - 1.

[3] Slavin's questioning of the validity of this research, where the time to learn variables were not held constant between the experimental and control groups, do not appear to be directly addressed within the literature, though Guskey (1987a) did provide general comments.

2.7.2 Immediate prescriptive feedback

Slavin (1987a) suggested that perhaps it was not so much mastery learning but the use of immediate prescriptive feedback within the mastery learning model that could account for improved learning. Referencing work by Long, Okey and Yeaney (1978), Slavin (1987a), noted that while teacher directed feedback and corrective work in the study provided a claimed effect size of + 0.43, the same study without the mastery learning variable only exceeded the control cohort to a much smaller degree, i.e., ES +. 19. This, Slavin suggested, raised the question of whether it was mastery learning per-se that was responsible for the differing effect sizes or the students receiving "frequent and immediate feedback on their performance?"(Slavin, 1987a, p. 200)

2.7.3 Resnick's objections

Slavin's criticisms highlighted issues previously raised by Resnick (1977) regarding Bloom's (1976) claims. Resnick (1977) had stated that, while Bloom's claims read as research, they were, in many instances, in fact, speculations regarding the potential of the methodology. She noted that Bloom (1976) documented ES results from eight different studies of approximately one week duration undertaken by his students. These studies covered such variables as the effects of good teaching practice, homework and mastery learning on student learning. He then used these results to speculate that if combined with group-based mastery learning the two results, e.g., mastery learning plus homework, would account for a two-sigma difference in learning outcomes between the control and experimental group. Resnick (1977) noted that the actual combined studies had not been undertaken.

2.7.4 Can all students learn what other students learn?

Resnick (1977) also questioned Bloom's (1976) claim that, over time, variability in cognitive and affective entry levels would reduce to zero and that

as a consequence, all students could learn the same things at the same rate. Resnick (1977) noted that this would still require all students to react at the same level of achievement and she "found no evidence for this especially given that even within the mastery classes the mean scores indicated a range of mastery" (Resnick, 1977, p. 449). She also noted that even the final learning scenarios of the evidence produced by Bloom (1976), indicated at least a 2:1 time ratio from slowest to fastest learners and this raised serious questions of practical application as the slow learners require more and more extra learning time.

2.7.5 The role of the school

Resnick (1977) also posed the philosophical question as to whether school curriculum content could or should be ordered hierarchically and that all things taught were "facilitators of and even prerequisites to the things taught later?" (Resnick, 1977, p. 446). This raises an important ethical question. Was Bloom's (1976) programme only possible when the material to be learned was defined in a limited way in terms of basic skills and knowledge? In putting this question Resnick also questioned whether this was the role of schools and if it was ethical to reduce the possible learning outcomes of faster learning students. Resnick's questions later became known, in a publication by Fitzpatrick (1985), as the Robin Hood effect.[4]

2.7.6 Summary of objections

In summary, Slavin's (1987a) best evidence review of the research on mastery learning suggested that group-based mastery learning in periods of at least four weeks duration showed no evidence to support the claims of Bloom (1984a, 1984b) and Guskey and Gates (1986a), when the results between the

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[4] This is an interesting concept debated by both sets of protagonists. Essentially the critics argue that slowing down the rate of learning and what is possible for faster learners, robs them (the rich) in order to give sufficient time for the slower learners (the poor) to learn - hence the Robin Hood analogy. The supporters feel that for the over-all good of society this condition was tolerable. They also argued that over time, the differences in learning rate would disappear.

experimental groups and the controls were measured against standardised achievement tests. He noted that results on experimenter made tests or measures were "generally positive but moderate in magnitude with little evidence that the positive effects were maintained over time" (Slavin, 1987a, p. 175).

He scathingly suggested that the 2 sigma challenge (Bloom, 1984a, 1984b), was probably unrealistic within the context of group-based mastery learning. He argued that the beliefs had been based on brief, small, artificial studies that compromised academic standards by allowing additional instructor time for the experimenter groups over the controls. On larger, longer studies, using instructor measures, an effect size of +.25 was achievable, but on standardised tests the difference was nil (Slavin, 1987a, p. 207). Slavin (1987a) concluded that the 2-sigma claim was, therefore, misleading, out of context and potentially damaging.

2.8   The 'masters' fight back

The controversy did not end there. Other protagonists, namely Anderson and Burns (1987), asserted that Slavin (1987a) had neglected to consider the values inherent in mastery learning and "ultimately the conduct and interpretation of mastery learning research" (p. 215). They suggested that Slavin was unwilling to examine the "underlying belief systems critical to the implementation of mastery learning in schools or districts" (p. 215). They also suggested that Bloom and his students' research was focussed on what was possible, not what was likely. They suggest that one had to comment on their studies on the basis of "the purpose they were designed for" (1987, pp. 215 - 216).

Anderson and Burns also questioned Slavin's reliance on standardised tests as a valid indicator of measurement of learning. While they advocated testing that is keyed to what both the treatment and control groups are expected to learn, they still rejected Slavin's (1987a) notion of the use of standardised tests as an

equal measure for both groups. Also, in rebuttal of Slavin's (1987a) use of standardised tests in his research, Guskey (1987a) maintained that a review of curriculum outcomes, as measured by standardised tests by Leinhardt and Seward (1981, as cited in Guskey, 1987a), had established that "standardised tests are usually very poorly aligned with curriculum objectives and instructional content" (Leinhardt & Seward, 1981, as cited in Guskey, 1987a, p. 226).

In defending the additional time claim, Guskey (1987a) commented that this is an important component of mastery learning. He agreed that some students spend more time to achieve mastery, but still contended that studies (e.g., Block, 1974, 1983; Guskey & Gates, 1986a) have demonstrated that the time required for slow learners to master the content does diminish. In supporting the Guskey (1987a) position, Anderson and Burns (1987), although agreeing with Slavin (1987a) and Resnick (1977) over the 'Robin Hood' effect, suggested that such imbalances in attention given to one group of learners over others was always the case in classrooms.

Resnick's (1977) reductionism concern as to whether mastery learning could only work if all curriculum content taught was that which could be reduced to chunks of knowledge, went unanswered in the literature at the time. It was perhaps the this kind of philosophical debate that should have accompanied Bloom's (1976) view of the role of the school and his perspective that indeed group-based mastery learning was the means by which potential inequality of opportunity in society might be addressed.[5]

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[5] Emeritus Professor, Ivan Snook, raised this very question in regard to the criterion-referenced assessment methods of the National Certificate of Educational Achievement (NCEA) developed by the New Zealand Qualification Authority. Snook stated that "while some subjects or trades lent themselves to a mastery type learning and criteria referenced assessment methodology others, for example, English and history and physics, could not be broken up into small discrete hierarchical units of knowledge and this was the underlying factor in the widespread dissatisfaction with the use of NCEA at scholarship level" (Snook, as cited in Manawatu Evening Standard, 2005, March 18, p. 5).

2.9   Conclusion

The controversy has remained. Slavin responded with further articles (Slavin, 1987b, 1990) and Bloom (1987) also re-joined the debate. Regardless of the debate, the mastery models enjoyed considerable attention and application in various guises. Unfortunately, the perhaps extravagant claims based on the controversial research methods of Bloom (1976, 1984a, 1984b), tended to cloud his important original philosophical position, namely that it was the role of a state education system to overcome inequalities of opportunity in learning brought about through environment and circumstances of birth. This philosophical position was not addressed in relation to mastery learning until more recent research: for example, Dweck (1986), Dweck and Leggett (1988). Nicholls (1989) and Papaioannou (1998). Papaioannou, (1998) has, for example, moved away from trying to establish the superiority of mastery learning over other methods of instruction, to focus on the process of mastery learning as an agent for creating positive classroom learning environments in relation to children's ego and achievement motivation.

2.10   Goal setting in an educational environment: introduction

The use of goal setting has long been advocated as a practical technique to motivate students to achieve motor skill acquisition in sport. Indeed, the use of goal setting in sport and physical activity is such a common place occurrence today that it is tempting to take for granted that this has always been the case. Reading the biographies of great sports people from previous eras, it becomes clear that establishing goals appears to have been a very common trait amongst those top performers.

Identifying the common trait elements is not difficult, but finding the specific conditions that make the employment of goal setting a probable variable for the athlete or learner was not so easy to establish. Early research in goal setting focused on isolating and then confirming the common conditions under which

goal setting was likely to be successful. Once this was established, research centred largely on the preference for and effectiveness of setting short or long term goals. More recently, studies have focused on the respective values of self-set or instructor-set goals, self-efficacy and goal commitment.

This component of the literature review focuses on the early research in goal setting that established the conditions in educational contexts under which goal setting would be successful. It then reflects on the debate that goal setting was in fact merely providing learners with knowledge of results. Finally, it documents the research findings on the use of short or long-term goals, and participant- or teacher-set goals.

2.10.1 Defining goal setting

A goal may be defined as the aim or object towards which an endeavour is directed. However, within the literature, goal setting is not merely a general aim that might or might not be achieved. For example, Locke (1966a) defined it more precisely as an individual's deliberate and conscious intentions that will regulate their actions towards achieving a specific outcome.

2.10.2 Establishing the conditions within which goal setting was likely to be successful

It is generally accepted that it is the propositions of Edwin Locke (see, for example, Locke, 1965; 1966a; 1966b; 1967; 1968) that underlie the development and extensive use of goal setting in educative settings. Prior to Locke's work starting in the 1960s much of the evidence on goal setting was anecdotal or related to industrial settings (e.g., Ronan, Latham & Kinne, 1973). However, Locke provided a new direction for research on goal setting, born from his belief that psychologists had given too little attention to the effect of goals on performance. He also sought, in collaboration with others, notably Bryan (Locke & Bryan, 1967), to investigate goal setting with specific

reference to performance. Thus, Locke has conducted much of the early research in this area and he is generally recognised as the person who established the formative literature on the effects of goal setting and performance.

Specifically, Locke predicted that in relation to performance, setting achievable but challenging goals would result in higher levels of performance than would setting easy goals, no goals or 'do your best' goals. He also predicted that setting specific performance goals could provide an antidote to boredom.

2.11 Early research on goal setting

In an early preliminary study, Locke (1966b) found conclusive results on an extended psychomotor task showing that interest in the task was higher for students who were given specific performance goals over those who were merely told to do their best. In a collaborative study involving a review of a study undertaken by Wyatt, Frost and Stock (1934, as cited in Locke & Bryan, 1967) on factory workers completing tasks that were repetitive and boring, Locke and Bryan (1967) noted that the workers occasionally set goals to complete set numbers of units in a particular time. It was observed that during those periods where goals had been set the workers produced "great outbursts of activity" (Locke & Bryan, 1967, p. 121). Locke and Bryan concluded that "the setting of a goal that is both specific and challenging leads to an increase in performance because it makes clear to the individual what he [sic] is supposed to do" (p. 124). They suggested that establishing and achieving work place goals might provide a person with a sense of achievement, recognition and commitment. This, they concluded, may, in turn, lead to "greater effort and even better methods for attaining their goals" (Locke & Bryan, 1967, p. 124)

2.11.1 Goal setting as a means of increasing motivation

Having, firstly, established that specific and challenging goals produce a higher performance than a 'do-your-best' goal (Locke, 1966a; 1966b; 1967; Locke & Bryan, 1967); secondly, that hard goals yield less overall task-liking and satisfaction than easy goals (Locke, 1965; 1966a), and; thirdly, that specific hard goals produce more interest in the task than 'do-your-best' goals (Locke & Bryan, 1967), Locke and Bryan also sought to establish the possibility of using goal setting as a means of increasing the performance of students who were previously diagnosed as lowly motivated.

In seeking to answer this question Bryan and Locke, (1967), in a study on students previously diagnosed as low motivated, produced positive results that appeared to reinforce the success of goal setting as a means of lifting performance and motivation. Interestingly, it also produced results that negatively reinforced the perception that 'doing your best' goals, even with previously highly motivated students, does not provide significant positive change in performance.

2.12 Debate surrounding the advocacy of goal setting

Unlike mastery learning, little controversy surrounded the advocacy of goal setting as a factor in improving performance. The only relatively short debate concerned whether improvements in performance was in fact related to goal setting or the impact of improved access to knowledge of results (KR) as a process of feedback. Locke (1967) concluded that KR equated with improved performance as opposed to not receiving any KR. However, he also suggested that it was not just KR, but, indeed, the prescriptive nature of the feedback and, even more importantly, what students do with the KR that had the greatest influence on performance. Locke (1967) suggested that where students take the KR and identify and set goals for improvement, then the difference in performance occurs. At a pragmatic level it appears that it is not enough to

35

establish goals and have students / learners tacitly agree to them, they really have to accept and believe that the goals, while challenging, are achievable.

Locke's (1967) conclusion regarding the relative attributes of goal setting and knowledge of results were further reinforced in a study by Latham and Baldes (1975), who investigated the practical significance of Locke's theory in an industrial setting. This study reinforced Locke's notion that the mere presence of knowledge of results does not increase performance unless it is used by an individual to set a specific challenging goal. It also reinforced Locke and Bryan's (1967) views of the necessary components that need to be part of the goal setting process; namely goals that are challenging, specific and attainable, in order that goal setting would positively influence performance.

2.13 Broad trends in the goal setting literature

Goal setting continued to be a major focus of research within the broad domain of cognitive psychology, so much so that a major literature review of the domain was undertaken by Locke, Shaw, Saari, and Latham (1981) covering the period 1969 - 1980. The broad trends that emerged from this study, which was conducted in both laboratory and field conditions, concluded that, "goals affect performance by directing attention, mobilising effort, increasing persistence and motivating strategy development" (Locke et al., 1981, p. 125). Their findings suggested that goal setting is most likely to improve task performance when the goals used are specific and sufficiently challenging, but not beyond the ability of the subjects. Goal setting will also improve task performance when feedback is provided to show progress in relation to the goal, and rewards are given for goal attainment. They also noted that a successful goal-setting environment required that the experimenter or manger was supportive and the assigned goals were acceptable to the individual. They did not find any reliable evidence regarding individual differences and goal setting studies. They suggested that this was probably because typically goals were assigned rather than self-set.

In summary, the Locke et al. (1981) study found that of the 110 research projects investigated, 99 demonstrated that specific and challenging goals led to higher performance than easy goals, 'do your best goals' or no goals. This represented a 90% finding in favour of adopting a goal setting methodology as a means to improving performance.

2.13.1 Goal setting as an agent for motivation and redefining tasks

Reflecting on this extensive review, Locke et al. (1981) concluded that goal setting challenged some well-held beliefs, namely the inverted U hypothesis that asserts that performance is maximal at moderate levels of motivation. They also concluded that goal setting was best seen as a motivational mechanism that fundamentally appears to direct attention and action. They also found, notably from a work by Bandura and Simon (1977) on dieting, that goal setting had the effect of sometimes causing the participants to devise different strategies to achieve their goals. In some instances, participants redefined the tasks to give a more specific focus to their goals in order to achieve the desired outcome.[6]

The survey also suggested that enhanced performance could be achieved through combining goal setting and knowledge of results (KR). While previous studies had sought to separate the performance effects of goal setting and KR (Locke, 1967) a major conclusion of the survey was that both goals and knowledge of results (KR) are necessary to improve performance. Locke et al. (1981) suggested that this finding "provided a clear prescription for task management. Not only should specific, hard goals be established, but also KR should be provided to show performance in relation to these goals" (Locke et al., 1981 p. 136).

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[6] Siedentop and Tannehill (2000) refer to this phenomenon in practical performance activities in physical education as part of the ecology of teaching. Within the ecology there is sometimes a negotiation of tasks that sees an assigned task modified to better suit the abilities or a means of achieving the outcomes as perceived by the student versus those assigned by the teacher.

2.13.2 Participatory vs. self set goals

Post-1980 studies in goal setting questioned whether participatory or self-set goals better contribute to improved performance. In response to this question, Latham, Steele and Saari (1982) undertook a study that investigated the effects of assigned versus participatory set goals and the effects of varying goal difficulty on an arithmetic task. As hypothesised, individuals with difficult assigned goals had higher performance than peers with lower goals set in a self-participatory manner. These results were later replicated by Boyce (1990, 1992) in a specific sport study.

This finding is interesting because within an educational setting teachers are typically concerned with trying to involve students in the setting of the goals. This is because participation is said to affect a person's cognitive, affective and behavioural responses by increasing understanding, satisfaction and effort to perform task requirements. The general outcome of the Latham et al. (1982) study appeared to clearly endorse the major finding of previous research in this area; that when goal demands are held constant, participation in the goal does not increase performance above that of working to assigned goals. It also supported findings that the harder the goal the higher the performance, providing that the goal is accepted. In summary, Latham et al. concluded that performance was only affected by whether a goal was assigned or self-set by the extent to which an individual accepted the goal and whether it was sufficiently challenging.

2.13.3 Goal setting: procedural vs. results

In a general sense one of the last areas of relevance in relation to this study was whether goal setting should focus purely on outcomes/results or process mastery dimensions of performance. Ames and Archer (1988), in a study of student learning strategies and motivational processes, used a questionnaire to obtain 176 junior high school and high school students' perceptions of

classroom goal orientation, use of learning strategies, task choices, attitudes, and causal attributions. Their findings, which suggested a direction for a more holistic approach to research on goal setting and mastery learning, established that "students who perceived an emphasis on mastery process goals in the classroom reported using more effective learning strategies, preferred challenging tasks, had a more positive attitude towards the class and had stronger belief that success follows from effort" (Ames & Archer, 1988, p. 260).

By contrast they found that students who thought that result/ outcomes goals were the sole focus of the classroom structure "tended to focus on their ability negatively and attributed failure to a lack of ability" (Ames & Archer, 1988, p. 260). Their findings suggest that the teacher's role in creating a mastery/process classroom environment is crucial to students adopting goal-setting standards that emphasise process over outcome. Ames and Archer (1988) suggested that an emphasis in the classroom on mastery learning and a decrease on social and normative comparisons might have the effect of reducing the students' focus on their abilities and the prospect of evaluating their abilities negatively.

2.14 Mastery learning and goal setting in physical education and sport settings: early research findings

During the period of extensive debate between those who supported the Bloom (1976, 1984a, 1984b) mastery learning position and those who argued against it (e.g., Resnick, 1977; Slavin, 1987, 1990), the research on the application of mastery learning strategies to sport and physical education was not extensive. In part this might be explained by the extensive employment of traditional motor skill instruction that already, in many respects, mirrored mastery learning, and so, perhaps, to use or not use mastery learning methodologies

was not so much of an issue.[7] There has long been a presumption by physical educators that mastery of one component of a skill or movement needs to be accomplished before moving to the subsequent one; for example, a gymnastic routine. Known as part learning and skill hierarchy sequences, these methods are widely employed in all movement teaching environments and are very similar to strategies employed in mastery learning. Perhaps, therefore, physical educators just ignored the debate.

For those that did not ignore the debate, early published work in this period (e.g., Ashy & Lee, 1984; Boyce, 1989) tended to focus on establishing the protocols under which mastery learning could be employed within a physical education environment. Other research at this time generally supported the effectiveness of mastery learning over other methods of instruction. For example, Ashy and Lee (1984) found in a study of first grade kindergarten children that "forcing learners to demonstrate mastery of subordinate skills was beneficial in promoting mastery of rhythmic rope jumping" (Ashy & Lee, 1984, p. 61). They reported that, "73% of the mastery and only 47% of the non-mastery learners achieved the final skill" (p. 61). In another work by Ashy (1983, as cited in Ashy & Lee, 1984, p. 61), on an overarm throwing task it was found that mastery learners significantly outperformed the non-mastery control group. More recently Mao (1997) reported results favouring the use of mastery learning strategies over non-mastery in gymnastic instruction on the long box, parallel and horizontal bars.

Interestingly, these and other studies that support the mastery position as a preferred instructional methodology tended to use single discrete and sometimes novel skills within closed skill environments within their methodologies.[8] A study by Edwards (1988) using a novel floor-hockey,

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[7] For example, swimming has always been taught through mastery progressions. Athletics, in throwing and jumping sequences is also frequently taught in a progressive mastery learning sequence.
[8] Discrete skills are defined as skills that are short in nature and having observable starts and finishes; for example, a kick or a throw. A closed skill environment is one in which the performance of the task is not overtly influenced by randomly changing factors. For example, indoor small bore rifle shooting is performed in a closed skill environment.

discrete, flicking skill showed that performance can be improved by establishing individual mastery or performance standards over not having standards. However, where the research paradigm involves open skill environments or where game play is involved, the research results have been more equivocal. Blakemore, Hilton, Gresh, Harrison and Pellett (1992), in a comparative study of students being taught basketball skills, found that while the mastery learners outperformed the non-mastery learners in tests of discrete basketball skills, there was no significant difference between the groups when the skills were performed in the open skill, game situation. Similarly, a study by Preece (1996), employing mastery learning strategies in teaching volleyball, showed no significant difference in the rate of learning for the forearm pass, serve or spike as measured in the open skill environment of actually playing the game. The equivocal nature of these results in open skill environments serves to reinforce the early comments referenced to Schmidt (1988, 1992) in the introductory chapter regarding the difficulty of undertaking human motor skill research in authentic environments.

2.14.1 Resnick's philosophical question on the role of the school

These results highlight aspects of the philosophical reductionist debate raised by Resnick (1977) associated with mastery learning about whether educational outcomes can or should be confined to chunks of knowledge. Clearly within the sport domain there appears to be a case for learning discrete skills in this manner but games, with the myriad of variables involved, perhaps cannot be addressed in quite the same way. Indeed, the relatively new instructional model 'Teaching Games for Understanding' (TGfU) (Bunker & Thorpe, 1982; Griffin & Butler, 2005), evolved from a concern that games taught as 'chunks of knowledge or discrete skills' was largely responsible for children leaving school with a poor understanding and negative feelings about games and physical activity.

2.14.2 An evolving position on the role of mastery learning

Early research on mastery learning in sport has provided other information that perhaps better explains the evolvement of this methodology in regards to how it is perhaps best employed today. This is well illustrated in a study by Metzler (1986) that employed a personalised mastery learning programme within a study involving tennis instruction. Metzler reported that both in the efficient use of management of time and in quality motor engaged time (ALT-PE)[9] as measured in the number of times students made repeated successful easy trials of a skill, those students in the mastery programme significantly outperformed those in the non-mastery programme.

Researchers in physical education (e.g., Metzler, 1989; Rink, 1985; Siedentop & Tannehill, 2000) all agree that the key to successful learning outcomes in motor skill instruction occurs as a result of student engagement in repeated easy trials of a skill. Metzler (1986) stated that his research could not answer the key question posed by Bloom, (1976), namely, 'does a mastery learning personalised system of instruction result in a two sigma difference over other methodologies?' (Metzler, 1986, p. 70). However, he did feel it supported the notion that physical education instruction should look more to educational instructional design theory for improving learning outcomes in that field. Edwards' (1988) study on the effects of individual performance standards on children's motor skill achievement levels also supported those conclusions. She established that mastery standards resulted in students knowing exactly what was required of them resulting in "better and more efficient use of their allocated time" (Edwards, 1988, p. 98). Edwards suggested that this better use of time perhaps explained why mastery learning of discrete motor skills produced superior results to traditional methods.

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[9] ALT-PE (Academic learning time - physical education) is a concept used to describe the measure of time a student is successfully motor-engaged with the specific learning outcomes of the lesson.

2.15 Goal Setting: process or outcome?

Further evidence of an evolving position between goal setting mastery learning and the role of feedback is seen in efforts by researchers to answer the question as to whether goal setting should have a purely outcome focus or should also include the process of performance that also carries with it a requirement of prescriptive feedback. This question was addressed by Barnett and Stanicek (1979), who through the medium of archery, sought to ascertain whether goal setting with a process focus would be an effective tool for improving performance. The methodology used in their study for the goal-setting group started with a conference between the participant and the instructor. The nature of this conference was to focus the participant on technique in archery rather than scores achieved. Their findings clearly indicated that the goal setting process group outperformed the non-goal setting group and that the process goal setting was effective in improving performance.

In establishing the protocols for their study Barnett and Stanicek had expressed concerns regarding the employment in goal setting studies of motor activities such as juggling. They suggested that such tasks naturally produced a goal setting effect even in the control group and that the true extent of difference between those who did or did not set goals on a motor skill task could not be clearly seen. Having expressed this quite legitimate concern it is surprising that they then chose archery as a motor skill activity for their investigation. Performance in archery provides almost immediate feedback of knowledge of results. Upon releasing the arrow one is able to see whether one's shot is successful or not. Given that one's final evaluation of performance in archery is expressed as a numerical value, it is difficult to imagine that unless a class or participant was participating under duress that a participant would not, before or during the event, set an informal goal to improve their score or outperform their friend or colleague in the same class.

While the author here raises the question of suitability of archery as a motor task, by Barnett and Stanicek's (1979) own previously stated concerns, their results may offer an even greater endorsement for the combined use of goal setting and knowledge of performance/process feedback. If all participants in their study did set at least informal goals to improve their performance in archery, then the process goal setting results of the treatment group, in significantly out-performing the control group, provide an even stronger case for employing process goal setting as a means to improve motor performance.

Barnett and Stanicek's (1979) study found additional support in work by Ames and Archer (1988) that established that where process or technique is emphasised over the results and outcomes, students tend to believe that performance relates more to effort and learning strategies than ability.

2.15.1 Goal setting and task completion in sport and physical education

Research by Locke and Bryan (1967) had pointed to the positive motivational effects of setting goals as opposed to not setting them in terms of maintaining interest in an activity for an extended period. The Barnett and Stanicek (1979) archery study also supported this finding. They suggest evidence for this by examining the dropout rates from their study by students in the goal-setting and non-goal setting group. In total, 10 from 40 students 'dropped out' of the study. Three of these occurred because the students missed testing dates but they still continued to participate in the archery programme. Of those students, two were from the goal setting group and one from the conference only group. The remaining seven who dropped out of the class did so because of poor attendance. Those seven students were all from the non-goal setting group.

2.15.2 Assigned or self-selected goals in sport and physical education

Having generally asserted the value of goal setting as an aid to improving performance, educational researchers contemplated whether it would be better

to assign learners goals or allow them to set their own. The general findings related to this question were investigated in school settings by Lee and Edwards (1984) and Boyce, Johnston, Wayda, Bunker and Elliot (2001) using motor skills associated with tennis and, with adults, in a rifle-shooting task by Boyce (1992). In all studies, groups were given a general goal of 'do your best,' were asked to set individual goals each day, or were assigned high but achievable goals each day by the teacher.

The results for all studies again pointed to the value of goal setting with both the assigned and self-set goal groups outperforming those subjects just asked to do their best. This reinforced the notion that specific goals set by either the individual or the teacher can be effective in students achieving higher performance levels than those simply encouraged to do their best. Another interesting outcome discussed by Lee and Edwards (1984) related to the student-teacher relationship. They speculated students in this age group (students were approximately 10 years of age) "may be influenced more favourably when the goals are set by the teacher because they trusted the teacher's judgement to assign them goals which they considered attainable" (Lee & Edwards, 1984, p. 87).

2.15.3 Long and short-term goals in sport and physical education

One of the last pieces of the mosaic of research on goal setting concerns the use of long or short-term goals in physical education and sport. One of the few studies on the use of long or short-term goal setting in physical education (Howe & Poole, 1992), produced less than conclusive outcomes for the adoption of any one strategy. The authors had sought to ascertain whether achievement motivation was related to goal proximity (i.e., short or long-term goals) for high school boys in a basketball-shooting task. No significant difference between the variables was revealed but a post-experiment survey revealed that in fact all students were setting short-term goals (Howe & Poole, 1992, p. 248)

From the author's experience it is not unusual that students might all set short-term goals, albeit informally, in such a teaching environment. The nature of the task involved was closed skill and discrete and coupled with immediate knowledge of results (did the ball go in the basket?). With time to adjust technique, students instinctively would have tried to improve on their previous shot and, consequently, in the short term, 'beat their score.'

Of more interest, in light of more recent research on both goal setting and mastery learning, is the assertion by Howe and Poole (1982) that this study supports Bandura's (1982) position in relation to goal setting. This claimed that short-term goal setting provides inducements for action and a feeling of self-satisfaction that reinforces and sustains the individual's efforts to achieve longer-term goals. That is, the results in regard to short-term goals provide instant feedback on competence and, thus, information to sustain an effort to achieve a longer-term goal.

2.16 Mastery learning and goal setting in sport and physical education: an evolving position

Ames and Archer mooted a new direction for mastery learning and goal setting as a methodology within a physical education environment as early as 1988. They argued that achievement in the school environment could be best achieved by identifying what motivated student learning. A little later, Ames (1992) suggested that within education there were two types of goals, distinguishing them as mastery and performance goals. She proposed that a mastery orientation produced better outcomes than performance focused goals, noting that central to mastery learning was a 'belief that effort and outcome were covary" (Ames, 1992, p. 262). She asserted that it was essential to develop in learners this attributional belief pattern in order to maintain achievement over time, stating that "it was important that learners recognised that effort will lead to success" (p. 262). By contrast she felt that a focus on

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performance led to a belief that "success was related to inherent ability and as a consequence could promote failure avoidance" (p. 262).

Ames (1992) further stated that learning and assessment in physical education needed to have variety and relevance; that assessment needed to be mastery driven; and that students should be encouraged to establish individual goals in conjunction with mastery and should be assessed against those goals and not against their peers. She claimed that this would promote self-efficacy and student willingness to take up challenges and engage with the content on a more intensive scale. She was supported in this view by an earlier work by Hogan and Santomier (1984) that demonstrated that the use of mastery swim standards with older adults resulted in increased self-efficacy and that this appeared to transfer to other movement situations.

Ames' (1992) perspective was further endorsed by results on a golf practicing study by Dorsel and Slainsky (1990). They reported that while no difference in actual putting performance was found, perceptions of the usefulness of the practice and a willingness to practice were enhanced by the employment of mastery learning levels and when these levels were presented to the learners as goals.

2.17 Mastery learning and goal setting: methodologies for overcoming inequality and promoting equity in physical education

Papaionannou (1998) noted that if sport and physical education were going to promote democracy and equity and other human values, then those that teach it needed to become accountable for all student learning and not just for an elite few or for those who reflected their own interests. He noted that research that promoted those values, (e.g., Deci & Ryan, 1985; Nicholls, 1989; Vallenrand & Lasier, 1994) all stressed the "importance of adopting a mastery orientation

and intrinsic reasons for achievement in these contents" (Papaionannou 1998, p. 273). He stressed those physical education class environments that placed an emphasis on effort, task involvement and mastery, resulted in indexes that reflected positive student motivation and intrinsic interest. Conversely, where the class environment reflected a performance focus, the student perception was not positive. Papaionannou (1998) felt that a mastery-learning environment could change both student and teacher perceptions of what were possible. Xing and Lee (1998), in a study of student self-perceptions and achievement goals, reinforced Papaionannou's findings. They argued that it was important to construct physical education learning environments that have a task orientation in which "student's belief in that ability can be enhanced through effort and judged in a self-referenced way" (Xing & Lee, 1998, p. 239).

One can see that the evolvement of the relevance of mastery learning and goal setting to physical education has not been about whether these methodologies outperform other approaches in terms of mean scores or performance achievements; rather, it is about their contribution to establishing a physical education class learning environment that defines success in terms of mastering the task rather than outperforming others in the class. Within the literature, the evolved position of mastery learning and goal setting is seen as providing a methodological structure that has the potential to promote the learning process; "providing a vehicle for participation at an individual's own level and recognising individual accomplishments" (Xing & Lee, 1998, p. 239).

In this guise, Papaionannou (1998) also stated that mastery learning provides accountability measures for the teachers. It provides information on individual student progress towards achieving basic competence in a wide range of sports and physical activities that would eventually allow them the opportunity to fully participate in their society. Unfortunately, he also felt that typically in physical education classes there was little or no accountability for teachers and

consequently there was no high expectation to make an effort to teach all children (Papaionannou, 1998).

2.18   Summary

This literature review has shown that the early research on mastery learning quickly became part of what Rink (2001) referred to as the methodological wars. The original thrust by Bloom (1976), to find a method of instruction that would help overcome inequality in educational opportunity, was sidetracked into disputes between research peers over research methods and the validity of research outcomes claimed for mastery learning. Bloom's desire, for a method of instruction as effective as one-to-one tutoring, instead of uniting, divided the educational community. Consequently, instead of focusing on the issue of overcoming inequality, the literature reflected an ongoing debate over research standards.

The central question posed by the early research on mastery learning in relation to physical education and sport was whether mastery learning results in better movement outcomes than traditional methods of instruction. This research resulted in findings generally in favour of a mastery learning design, especially where discrete skills were measured in closed skill environments. The literature also indicates that there is a general agreement, even between the protagonists who debated quite vehemently at times, on the efficacy of the mastery learning methodology as a means for establishing competence with beginners and slower learners. However, the question relating to the extent of that methodological superiority, especially in relation to elite level movement or sporting performance, remains equivocal.

Less equivocal were the literature findings on goal setting. Research on goal setting within physical education and sport environments has consistently produced positive results in relation to improving movement outcomes. As a consequence, goal-setting is used extensively in sporting environments.

However, despite its well-documented use and success in the sport domain, goal setting appears to still not be widely employed within the physical educator's armoury of teaching skills.

2.18.1 The merged position of mastery learning and goal setting

Within physical education research, more recent writing on mastery learning and goal setting has merged the functions of both methodologies. This newly evolved and exciting role for mastery learning and goal setting is documented in the literature as having the potential to provide classroom environments where students believe outcomes relate to effort and not innate ability (Ames, 1992). The literature clearly suggests that instruction in physical education that is mastery focused encourages students to establish individual goals in conjunction with those mastery outcomes. Those who are assessed against those goals and not against their peers will experience self-efficacy and a willingness to take up challenges and engage with the content to a more intensive degree.

The suggested merged function of mastery learning and goal setting within physical education can indeed probably be seen as cyclical, because it tends to capture again the original motivation of Bloom (1976), to potentially overcome inequality in outcomes within schooling and to provide equal opportunity in society. The approach now advocated is not based on making a case for a one or two sigma advantage over rival methodologies, but that the adoption of the methodology is likely to create a positive learning environment with equitable outcomes. It is suggested that a learning environment that encompasses mastery learning is likely to focus on students making an effort, being involved and displaying an intrinsic interest in learning.

2.18.2 Mastery learning, goal setting and a good citizen model

Within the literature, Papaioannou (1998) suggested that physical education programmes that concern themselves with issues of democracy and equity need to embrace mastery learning and goal setting. The implication is that physical education based on norm-referenced standards quickly gravitates to a sport performance model - a model that is concerned with producing 'top class' performers. It is suggested (Papaioannou, 1998), that using norm referenced standards within physical education is an anachronism, because for many students it encourages failure avoidance, and negative beliefs about their ability to achieve competence.

The literature suggests that for establishing basic competence and lifting as many people as possible to a standard of movement competence that allows them to participate in sports, recreation and leisure activities, then the merged position of mastery learning and goal setting as a teaching methodology has considerable merit. Its merit is very much focused on the potential it has in creating a positive learning environment that is task oriented and where student achievement is judged in a self- referenced way. Consequently, establishing some base levels of competence, teaching children to at least these standards, has the potential to have a markedly positive impact on their lives and the health of the nation.

CHAPTER THREE
Methodology

Within-subject experiments involve the repeated observation of the performance of individual learners over extended periods of time. Treatment effects are measured by comparing the changes in performance in the days following the introduction of the experimental treatment, against the same subjects' performance in the days prior to the treatment period (Church, 1994, p. 4).

3.1   Introduction

The purposes of this chapter are, firstly, to explain and justify why the researcher has adopted a within-subject experimental design as the preferred methodology. Secondly, it is to identify the subjects, tasks and procedures used, as well as the ethical issues considered by the researcher in the study. Thirdly, it restates the nature of the data analysis undertaken. Finally, it highlights the research questions, the development of instructional procedures, and the tools of assessment. [10]

3.1.1   The initial experimental design: a between subject design

Initially, the design developed for the study was a between-subject experimental design. Two separate cohorts of students from different schools were selected and both cohorts were to receive the same treatments but in reverse order. The class from one school was to have received Treatment A conditions followed by Treatment B, while students from the other school were

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[10] At this stage it is pertinent to refer the reader again to the comments made in the introductory chapter regarding the problems the author experienced immediately prior to and at the start of the data collection. The author again wishes to acknowledge the pertinent advice he received at that time that allowed the investigation to continue.

to receive Treatment B conditions followed by Treatment A. This design would enable the researcher to identify and compare any changes in player performances and rates of learning, relative to the methodology employed in each treatment period. However, immediately before the study began, the home teacher of one of the classes suffered a serious sporting injury requiring hospitalisation. As a result of the teacher's absence the students were not going to be available to participate in all sessions. This situation would severely compromise the results of the planned study, so another design was required if the study was to continue.

Consideration was given to replicating the original design with the one remaining class. However, several factors mitigated against being able to pursue that option. Firstly, previous studies involving goal setting variables with intact cohorts (Barnett & Stanicek, 1979; Howe & Poole, 1992) had demonstrated that, in such circumstances, both control and treatment groups are likely to employ goal setting procedures and this can contaminate results. Secondly, as the subjects were all from the same class, it was felt that it would be very difficult to keep knowledge of the instructional procedures one group was receiving (e.g., mastery levels of performance), separate from the other group. Finally, after discussion with the home teacher, it was felt that the additional time (double) required was too major an intrusion into the class timetable to allow an adaptation of the original design to be used. Therefore, in order to continue with the study, a within-subject experimental design had to be employed without scope for being able to vary the order of delivery.

3.2   Within subject experimental design

The within-subject experimental design is particularly pertinent to this investigation for four major reasons:
- its suitability for analysing data when subject availability is restricted to very small numbers;

- its suitability for data analysis of both an exploratory and confirmatory nature;
- the design allows for the same subjects' performances to be repeatedly measured;
- the nature of teaching physical education in New Zealand schools.

3.2.1 Subject availability for field-based research

Finding an authentic school-based context for this investigation was difficult. However, once identified, both the school community and individual students were supportive and enthusiastic about the project. Although the data from only 21 students could be analysed, the choice of a within-subject design allowed for analysis and discussion in relation to the posed questions.

3.2.2 Data analysis with a small critical mass of subjects

While the low numbers of available subjects restricted the role of confirmatory data analysis, the within-subject design allowed individual learning to be identified and this facilitated the use of exploratory data analysis. This type of analysis (Tukey, 1977) is pragmatic in nature and is likely to provide an element of realism and credibility for the reader with a physical education background. As such it is a method of analysis that is pertinent to the way physical education is taught in New Zealand schools.

3.2.3 Repeated measures of the same students as a measure of learning within an intact class field-based research paradigm

Being restricted to one intact class for the research required that the design had to allow for the repeated measure of subjects that could in some way measure learning. The within-subject design provides for that scenario. Church (1994) suggests that the research design also has a positive effect in that it limits

differences between the treatment outcomes from being attributed to pre-existing conditions in the different treatment groups.

3.2.4 The nature of teaching physical education in New Zealand schools

Instruction in physical education classes in New Zealand schools is traditionally delivered to randomly assigned intact classes without consideration being given to individual student differences of motor performance ability. Therefore, the use of a regular intact class would allow New Zealand teachers of physical education to readily identify with the conditions of class allocation typically faced in school contexts. Such a provision may encourage a teacher reading the work to identify with it, promoting a feeling that the class used in the investigation could just as easily have been theirs.

3.3   Subjects: introduction

Field-based investigations are fraught with difficulties not always encountered within a tightly controlled laboratory environment (Schmidt, 1988, 1992). This investigation was no exception. Firstly, there was the author's desire to test the hypothesis in an authentic environment. It was also considered desirable to have a sufficient critical mass of student participants in order for the statistical analysis to have some credibility. However, the desires and the outcomes proved to be difficult to achieve.

In the first instance it proved impossible to find a local secondary school physical education programme that had the flexibility to allow sufficient numbers of students to participate with the regularity required to conform to accepted levels of frequency of instruction required to promote changes in motor performance. The best the author could find would have allowed two contact times per week. There were problems also regarding other timetable

demands, use of tennis courts, and avoiding clashes with major school festivals in other sports (e.g., inter-school visits or swimming and athletics sports).

With primary schools, while there were not the issues associated with timetable flexibility, there were problems associated with facilities. Primary schools do not usually have enough tennis courts to allow the envisaged programme of instruction. In the end this was solved because the school that chose to participate in the programme was located within close walking distance to six public tennis courts of good quality.

3.3.1 The subjects

The subjects of the study were an intact composite Year 7 and 8 (Forms 1 & 2) class (N=29), at an Intermediate school. The chronological age range within the class was 10 - 13 years and the gender balance was 48% male and 52% female. The school had responded positively to a general letter of enquiry (see Appendix A) requesting expressions of interest from teachers who might be interested in their class being part of the study. The follow-up to that response took the form of an interview with the teacher who confirmed an interest and that they would like to have their class involved in the study. Permission was then sought to undertake the study through an application to the school's Board of Trustees (see Appendix B). The letter to the Board of Trustees outlined the programme and suggested measures to be taken to seek parental or guardian approval for the children in the class to be involved.

3.4 Ethics

The code of ethical conduct for research and teaching involving human subjects adopted by Massey University (1990) was followed in this study. The nature of the research did not pose any major moral questions given that the research consisted of collecting data from instruction in what became part of the class's normal physical education time allocation. It was a relatively straightforward task to keep student information confidential and there were no

actual safety risks for the students. In fact, the students all stood to gain from receiving professional tennis lessons within the normal allocation of physical education time without any disruption to their other teaching programmes.

3.4.1 Ethical procedures established by Massey University for research involving human subjects

In the first instance, the ethical considerations of the research were discussed with the author's supervisor. The request for permission sought from the school's Board of Trustees spelt out the ethical considerations of the research. In particular the letter stressed that no specific student would be identified by name in any subsequent publication. Also, that the programme of instruction would be accommodated within the normal allocation of time given to the class's physical education programme and that the instruction would be thoroughly supervised and carried out by a highly competent professional tennis coach. The letter also detailed procedures for an alternative programme of instruction should the parents or guardians object to their children participating in the programme or should any of the students themselves not wish to participate in the tennis instruction. The Board of Trustees gave its consent for the research to proceed to the stage of allowing for parents, guardians and students to be canvassed to provide informed consent to participate in the research programme.

Information was provided to the students and parents/guardians in the following ways. The class was visited and the basic outline of the study was explained to the students. The students were then given an explanatory letter and a permission slip to take home to their parents or guardians (see Appendix C). The explanation to the parents and guardians noted the purpose of the study, that the study would take place in the regular allocated physical education time and would for four weeks comprise the students' programme of physical education. Travel arrangements and supervision, which included the class teacher, were also explained. Parents not wishing to have their child

involved in the study or students not wishing to participate were offered an alternative programme of supervised work in another class or participation in a parallel physical education programme for the duration of the study. In this way the principles of the ethical code were adhered to in 'an open and informed way' (Massey University, Code of Ethical conduct for research and teaching involving Human subjects, 1990).

As a result of these procedures permission was received from all but one parent for the students to participate in the programme. On this basis the research was allowed to proceed and an alternative programme of instruction was provided for the student unable to participate. One week into the programme, however, the parents requested that the student be allowed to participate. This was agreed to although the student's results were not included in the statistical analysis.

3.5 The research question and observation

As previously indicated, the research investigated the following question and observation.

1.   Does adopting a personalised mastery system of instruction (PML) incorporating individualised goal setting (GS) result in a better rate of student improvement in motor skills than traditional skill based learning practices?

2.   Does adopting the stated system of instruction contribute to potentially providing all students with equal opportunities to participate in movement activities of their choice?

The answers to these questions were sought through a comparison of student levels of improvement in two tennis skills - serving and rallying. Data were collected when the students were taught in a traditional whole class format of

skill-based, coach paced instruction and, then, when taught using a personalised mastery-learning programme of instruction (PML) incorporating individualised goal setting (GS).

3.6   The design format

Lessons	Activity
-1	Discussion with the class. Familiarity with venue, instructions, timing, travel, format, playing history questionnaire.
0	**Pre-test:** Serve: Standardized 10-serve format repeated twice – (see Appendix D). Rally: Modified version of the Kemp-Vincent Rally Test (1968) – (see Appendix E).
1 - 5:	Treatment (A) phase. Traditional skill-based instruction, coach paced, whole class instruction format – (see Appendix F).
0	**Re test:** Serve: Standardized 10 serve format repeated twice. Rally: Modified version of the Kemp-Vincent Rally Test (1968).
0	Class meeting to demonstrate new methodology of instruction, to discuss goal setting and to set individual goals.
6 - 10:	Treatment (B) phase. Class taught using the personalised mastery learning (PML) methodology incorporating individual goal setting (GS). (see Appendix G).
0	**Post-test:** Serve: Standardized 10 serve format repeated twice. Rally: Modified version of the Kemp-Vincent Rally Test (1968).

3.7 Methodology of design

The question posed was to measure and compare rates of learning in two motor skills funadamental to the game of tennis. The measures of learning were performance scores on a rally and a serving test. Adopting these two measures of learning reflected both the nature of the game of tennis and simple, pragmatic outcomes associated with tennis instruction in physical education lessons in New Zealand schools.

The two tests were designed to measure learning as represented by a change in performance scores in serving and co-operative rallying. Scores on the tests do not represent a formal level of mastery of the tennis skills. Mastery learning strategies and goal setting were confined to the instructional components of the investigation. However, given the fact that students knew their previous scores on these tests one might anticipate, as noted in the Howe and Poole (1992) investigation into short and long term goal setting, that students would most likely set informal short-term goals of beating their previous scores on the mid- and post-tests.

3.7.1 Serving and rallying

Among numerous acceptable outcomes of a physical education programme of introductory level tennis instruction, two would be that students could start a game of tennis and perform the basic skills of the game well enough to sustain a co-operative rally. Given that starting a game requires players to successfully perform a serve, it is logical to measure student learning of this skill. Winning points in tennis requires a player to have the skill to return their opponent's serve and shots, in consecutive alternating order; that is, to rally. Therefore, the ability to rally, albeit co-operatively within this assessment structure, as another major component for assessment, is also a logical measure. These two components of the game thus represent a valid focus for assessing learning in tennis in a physical education environment.

The two tests employed to measure the motor skill development clearly define the behaviour required; namely, individual student scores in the performance of serving and rallying. They also provide observable measures of change in performance in the tests. With serving, the criterion was directed to accuracy and with the rally it was accuracy and fluency.

3.7.2 Individualised goal setting

The motivation for including individualised goal setting in the treatment phase came from several sources. One source was the evidence in motor skill research that suggests that when a research design employs a pre- and post-test format, there is a tendency for the participants, regardless of whether goal setting is part of the design or not, to establish performance goals. Typically, they hope to beat or improve on their first scores (Edwards, 1988). Weinberg, Bruya and Jackson (1985) noted that the sport skill assessment situation produces competitive and highly motivated performances by many people, often reducing the effect of an experimental control group and making it difficult to test the effect of goal setting.

The assessment tests proposed to measure learning in this programme and with the transparent environment (i.e., other students could easily observe your score and performance) would undoubtedly have encouraged students to try and improve on their previous scores and perhaps to beat their friends. This phenomenon became quite evident in the work undertaken to establish the protocols and criterion levels of mastery to be used in the investigation.[11] The students who undertook that work became competitive, both against each other and against the established standards, and set goals to beat their friends and achieve the standards. Howe and Poole (1992) noted this same experience in a

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[11] With respect to this phenomenon related to informal goal setting, the within subject design paradigm provided an additional research bonus. The bonus was that had a between group research paradigm been employed the results would have been susceptible to contamination in respect to any conclusions of the perceived values of the methodologies, because goal setting could not be contained to the mastery learning and goal setting group. Because the within subject design provides for intact treatment groups, whether or not students set goals after the pre-test and before the mid-test is not such a concern, because any contamination is contained to an individual's performance.

between-subject goal setting study involving goal shooting in basketball. A post-programme survey revealed that students in the non-goal setting control group did, in fact, informally set short-term goals aimed at improving their scores.

Another source of motivation for including individualised goal setting into the design was ascribed to the structure inherent in the personalised mastery system of learning (PML) methodology. PML, with its methodological requirement of clearly defined learning progressions, promotes itself as an appropriate methodology for the employment of individualised goal setting procedures.

In the tennis mastery segment, the hierarchical and sequential mastery levels were all made transparent to the learners. Within this context the author observed that goal setting came naturally and it was easy for the students to establish what level of mastery they would like to try and achieve. Management or motivation questions such as, 'What level are you up to?' and 'How are you going on this level?'; congratulating students on completing a level; encouraging them to master the next level and their striving for the ultimate level, would undoubtedly have encouraged the majority of the students to set goals within the mastery levels of the different skills. Given this almost inherent goal setting factor within the mastery learning instructional methodology, it appeared justified to formalise goal setting as a component of the Treatment B process. It was never intended that goal setting would be a primary objective of the research. Its inclusion was both for the reasons previously outlined and in recognition of its place in the mastery learning methodology. Its inclusion within Treatment B was also an opportunity to signal that other opportunities exist for the inclusion of goal setting as a teaching strategy within school physical education programmes.

3.7.3 When to introduce goal setting into the research model

Having decided to include goal setting within the research paradigm, the final question to be answered was at what stage of the design should goal setting be introduced so that the goals set by the students would be realistic and achievable? A pre-instruction questionnaire revealed that less than ten percent of the intact class had any experience of playing tennis in any formal sense (see Appendix H). Schmidt and Wrisberg (2000) note that predicting success in motor skill activities, when undertaken for the first time, is extremely difficult. Consequently, it was decided that goal setting would be introduced as a 'treatment' variable after the first five lessons of instruction. It was anticipated that at this stage of the instruction cycle, the students would have sufficient self-knowledge of their performance to set realistic but challenging goals for the next period of instruction.

3.8 Assessment tasks: serve and rally

3.8.1 Introduction: authentic assessment

As noted in the Introduction, motor skill assessment outside of a laboratory environment is fraught with difficulties. As Schmidt (1988) noted, getting a human to do the same thing twice in exactly the same way is difficult enough in a tightly controlled laboratory environment but it is almost impossible in an open skill one. However, in terms of ecological validity (Schmidt, 1992) and in the interests of authentic assessment it was considered important to include assessment items that were as authentic as possible. Certainly the mastery learning and goal setting literature search revealed that assessment involving motor skills in physical education and sport were generally confined to discrete skills: for example, Edwards (1988), or closed skill environments, for example, Barnett and Stanicek (1979). However, for the teacher of physical education these types of assessment lack a degree of authenticity because they do not always relate to the environment within which the skill needs to be performed

and the context in which they teach. Consequently, practitioners consider such results with some scepticism. In order to avoid that criticism the following tests were developed.

3.8.2 The serve test

Students were required to make ten consecutive serves using a 'standard' overarm serve action, to deliver the ball into the legal serving area on a tennis court. Students started by using the tennis convention of always serving to the opposite left service box first. They attempted to accurately serve twice to the left and then twice to the right service box until they had completed ten serves.

The test is easily standardised using international tennis rules of net height, serving position and the legal service ball placement area. Two serves to the left and then to the right represent the principle of specificity, in that in the game one serves to alternative sides of the court after each point is played. Two serves per-side also replicates the first serve / fault scenario in tennis that allows a player a second serve should the first one be illegal. Ten serves also links to the game in that, typically, in a match one might serve ten times before the completion of a game and a change of servers. Ten serves was also considered a manageable number for the developmental stage (age 10 - 13 years) of the students participating in the programme without inducing fatigue.

Students undertook the serve test twice (the second time after a rest) in each assessment period, with their scores being averaged. The 'twice' scenario allowed students to feel that they had a good opportunity to score well and overcome 'bad luck' or poor environmental conditions - perhaps it got windy. 'Let' serves: that is, where a serve hits the net but still lands in the legal zone, were retaken under the same rules that apply to serving in a tennis match.

3.8.3 The modified Kemp-Vincent (1968) Co-operative Rally Test

A co-operative rally is one where the players attempt to return the ball to each other in a manner that allows the optimum opportunity for their partner to return the ball. This is quite the opposite of a game of tennis where one attempts to return the ball in a manner that makes a return from the opponent as difficult as possible. The Kemp-Vincent Rally test (1968) provided the framework of a standardised test for a co-operative rally. The co-operative nature of the rally was explained and demonstrated to the students. A rally was to last for three minutes continuing despite errors that might occur. Scores were determined by subtracting the student's errors from the combined number of legitimate shots for both players; i.e., the student and the assessment coach.

3.8.3.1 Modifications to the Kemp-Vincent (1968) Co-operative Rally Test

Two modifications were made to the Kemp-Vincent (1968) Rally Test procedures, which was designed for United States College physical education students, to better reflect the developmental stages of the students in this programme. Firstly, in the Kemp-Vincent protocol, two players of similar ability are paired for the test. However, because the pre-programme tennis playing history questionnaire revealed an almost total lack of tennis playing background in the class, predicting within class performance compatibility with any reliability was not possible. Hence, the first modification was to employ semi-professional coaches to undertake the co-operative rally assessment with the students.

The coaches employed for the assessments had quite extensive experience of coaching students within this age range. They also had completed tennis coaching qualifications that required them to accurately 'feed / hit' balls to young players. As 'A' grade tennis players in the local premier tennis competition, they were all easily capable of sustaining a co-operative rally for three minutes. The use of the coaches in the assessment provided optimum

conditions for the students to receive shots that they could return. Students worked with the same coaches for the pre-, mid- and post-assessment periods.

The second modification of Kemp-Vincent Rally Test (1968) concerned the number and placement of tennis balls used in the test. The Kemp-Vincent Rally Test starts with two tennis balls per player. A component of the original test score is reflected in the time taken by the players to retrieve misplaced shots once both sets of balls have been used in the rally. College-age students can retrieve balls relatively quickly but young students often take longer to retrieve them. In order to promote the hitting of the tennis balls rather than the retrieving of tennis balls and also mindful of the demoralising effect of chasing after balls when you know your score requires you to hit as many balls over the net as possible, the second modification was to start students with six (6) tennis balls on their side of the court placed on the base line.

3.8.4   Recording and recorders

The tests designed for the study incorporated diagnostic, ongoing and post-instruction assessment. All of the tests took place within an agreed sequence of lessons. The sequence ensured that at least twenty-four hours elapsed between instruction and assessment.

In motor skill learning a distinction is often made between performance and learning. This has been made largely due to research by Shea and Morgan (1979). In summary, Shea and Morgan found that tests taken during the acquisition phase of skill learning and almost immediately after the instruction produced higher scores than those with a longer delay. The immediate residue effect of very recent instruction appeared to produce higher scores than after a delay when, without the benefit of immediate instruction, subjects had to retrieve from long term memory movement patterns that had been taught and practiced.

The Shea and Morgan (1979) research led to the conclusion that immediate post- instruction tests are thought to be more of a measure of performance, while delayed post-instruction assessment is thought to be more of a measure of motor skill learning; i.e., a relatively permanent change in movement performance (Schmidt & Wrisberg, 2004). In order to ensure that learning and not performance was being measured in this research, assessment took place a minimum of twenty-four hours after the instruction.

3.8.5 Recorders

Once the protocols for the tests were established, several recorders were employed and trained in the recording procedures (see Appendix I). On the serve test, two recorders were employed. One organised the student servers and ensured the serves conformed to the serving style, placement on court and to the correct service sides. A second assistant recorded the serves as either successful or unsuccessful.

For the rally test, an assistant was provided with recording forms that noted the number of successful hits/shots and errors. The total combined number of shots of the student and coach was recorded. The student's errors were then subtracted from this score, to arrive at the final rally score. For example, if during the assessment period 80 shots were counted between the student and the coach, and the errors attributed to the student were 15, then the student's score was assessed as 80 - 15 = 65.

3.8.6 Monitoring the motor skill acquisition assessment

To make certain that assessment protocols were strictly observed and adhered to, the author attended the assessment sessions and undertook an active supervisory role. However, the instructional tennis coach was not involved in or observed the pre- or mid-lesson assessment sessions. The coach did not

know what the assessment format was, other than that the students' ability to rally and serve would be assessed.

3.9   Goal Setting

Pre-instruction in the mastery phase of instruction required the students to have the levels of progressions for the forehand and backhand ground strokes and the serve explained and demonstrated to them. The students were then asked, based on their judgement of their current level of tennis performance, what described level they thought they could achieve in the remaining lessons. Their responses were recorded on the summary result sheets as their goals for the backhand and forehand ground shots (see Appendix J). At the completion of the instruction period their 'actual levels' were recorded beside their goal levels.

In asking the students to set goals it was suggested to them that they should do so keeping in mind the following criteria, as summarised in work by Locke and Bryan, (1967) and Locke, Shaw, Saari, and Latham (1981). Their goals, they were told, should be at the described level they thought would be challenging, require hard work to achieve, but with that hard work they had to believe they could achieve their goals. They also knew that once chosen, their goals would be recorded next to their names on the class assessment sheets that all students would receive a copy of. In this way they knew that their goals would become, within their class, public knowledge.

3.9.1   Goal Setting and serving

While instruction for the forehand, backhand and serving skills in Treatment B followed a mastery format, goal setting was only employed with the forehand and backhand shots. Advice given to the author suggested that because students would only have one lesson on serving and, therefore, no opportunity to improve on the level they achieved in that lesson, that formal goal setting on

the serve was unlikely to provide reliable data in relation to the success of a goal setting strategy. The author acknowledges that this is not ideal in terms of the investigation, but is aware that this situation is sometimes part of the scenario of authentic field-based motor skill learning research.

3.10 Interpreting the data: confirmatory and exploratory data analysis

Once collected the data were to be analysed using both exploratory and confirmatory data analysis.

3.10.1 Exploratory data analysis

Raw data were collected and presented in simple bar graphs, with the objective being to provide simple pictures of trends in relation to the questions posed and data collected. Although the sample from which the data were collected was small, it was anticipated that this form of data presentation would provide, given the other components of the study, authentic observations of a learning/teaching environment consistent with those that teachers were likely to be familiar with.

3.10.2 Establishing an expert/novice standard for exploratory analysis of the rally test data

The Kemp / Vincent Rally test (1968), modified for this investigation, does not determine a mean score of competence that would indicate that a particular score on the test equates with the ability to rally proficiently in a game of tennis. In order to establish a measure of competence for this investigation, five elite-level tennis players, of the same age range as the students in the study, undertook the same modified rally test used in the study. These players were all club tennis players, receiving individual tuition from a professional coach

and had all played in New Zealand Tennis Association sanctioned junior tournaments. It was assumed that in any random assessment of tennis rallying ability of children of this age, these five players would all score in the high percentiles. The five players undertook the test and their mean score were established as 86 successful shots in three minutes.

3.10.3 Confirmatory data analysis

Confirmatory data analysis was undertaken to consider if anything identified with the sample group could be stated in relation to a wider population in terms of rates of learning between the two pedagogical methods of instruction. This analysis was completed using the t-Test for Mean Difference.

The t-Test for mean difference is typically employed for "analysing the difference between the means of two groups when the data is obtained from the same population" (Levine, Krehbiel & Berenson, 2000, p. 371).[12] The 'same population' means that the results of the first group are not independent of the second group. In this research, this dependency relationship occurred because there were repeated measurements, tennis serves and rally tests, obtained from the same set of individuals (a single class). As such, the variable of difference "becomes the difference between the values of the observations rather than the values of the observations themselves" (Levine et al., 2000, p. 371).

Levine et al. (2000), stated that this test is appropriate when one assumes that individuals will behave alike if treated alike. As such, any differences between the two measurements of the same individuals is due to different treatment conditions. The t-test is designed to give results that reduce the variability due to the individuals themselves.

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[12] Although the population is assumed to be normally distributed, in practice it has been found that as long as the sample size is not very small and the population is not very skewed, the t distribution gives a good approximation to the sampling distribution of the average difference (Levine et al., 2000, p. 373)

3.11   Designing the instructional programme

The instruction methodology employed in Treatment A had to conform to the standard prescribed motor skill instructional programme frequently referred to as command centred within the Mosston (1966) taxonomy of teaching methodologies. In Treatment B the methodology conformed to the Keller (1968) model of personalised system of mastery learning instruction in combination with goal setting.

Coach: The instructional coach employed was a full member of the New Zealand Professional Tennis Coaches' Association. A player with a national tennis ranking, he had worked as a professional coach, both in New Zealand and Europe, for approximately 10 years. He had extensive experience of working with players of the age of those in the investigation and his peers held him in high regard as a player and coach.

3.11.1   Treatment A lesson sequence: prescribed, group-based, coach-paced skill learning (see Appendix F)

In the non-mastery phase, the lesson plans developed required the coach to follow the following lesson sequence:
*   Warm up.
*   Introduction of the skill to be taught.
*   Skill demonstration and practice.
*   Minor game or games.
*   Warm down.

In a general sense the coach was required to provide instruction to meet the stated learning outcomes related to serving and playing forehand and backhand ground strokes in tennis. Within the allocated time, the coach dictated the pace of the lessons and the amount of time to be spent on each phase of instruction. Aspects of class management, such as student numbers to combine for any

group work, the numbers of students per court, the allocation of equipment and the use of racquets and tennis balls were also decided and acted on at the sole discretion of the coach. However, the amount of equipment and the number of courts available were held as constant variables in both treatment phases of the study.

The coach was directed that in Treatment A the instruction must include the whole class. For example, when demonstrating the forehand the whole class must be brought in to see the demonstration regardless of individual student tennis ability. When supervising practice it was acceptable to make individual player adjustments, but whenever a new skill or drill was to be taught, the whole class must receive the instruction.

3.11.2 Feedback

Feedback was largely at the discretion of the coach. In the Treatment A phase of the study, the coach was specifically asked not to encourage students to set individual performance goals. 'Do your best' comments were acceptable responses as were enjoiners for motivation, but not specific performance goals. In providing prescriptive feedback on the mechanics of the tennis strokes, the coach was encouraged to follow his normal feedback practice. It was also decided that should a student progress quickly, the coach could either set extension activities (e.g., volley), or encourage the student to work in a peer assistant role with fellow classmates.

3.11.3 Treatment B: Mastery learning lesson sequence and goal setting protocols (see Appendix G)

In establishing the mastery learning sequence, reference was made to the work of Ashy and Lee (1984). In a review of the literature on mastery learning in motor skill acquisition studies, they established the existence of several

conditions that conformed to the Keller (1968) model that they felt must be considered in a mastery learning design. These were that:

- content must be sequenced into small learning units
- performance objectives must be stated at varying levels of proficiency
- prerequisite competencies must be established
- movement content must be presented in note or similar form to students
- content must be sequenced in a logical, hierarchical fashion
- feedback must be provided by progress tests designed to determine if students have mastered each task
- remedial activities or alternative learning corrections must be provided
- summative tests must be employed.

The programme of instruction was designed to include all of these conditions. Design focused on the concept that mastery of a skill in the hierarchy was akin to a closure point. It then required a forward movement from the student to a more complex skill in the hierarchy. For a full explanation of the coach's' role, lesson plans and the skill hierarchies and sequences see Appendix K.

3.11.4 Tennis consultant

In developing the skill hierarchy, a full time professional tennis coach was consulted. The coach had 15 years of teaching experience and, at the time, held the position of President, of the New Zealand Professional Tennis Coaches' Association. In establishing the sequence of skill learning a task analysis of the concepts and motor skills to be taught was completed. Skills were identified and sequenced so that each built upon the previous one and, in turn, served as a prerequisite for the subsequent skill, thus reflecting the nature of mastery learning in motor skills.

The general outcome for the teaching segment of the study was established as being, that students would be able to start a game of tennis using a basic overhead serving action. Once started, the students would be able to sustain a

co-operative rally; i.e., using forehand and backhand ground strokes they would return the ball to their partner, in the expectation that the ball would, in turn, be hit back to them.

3.11.5 Lesson sequence

It was decided that in both the non-mastery (Treatment A) and mastery (Treatment B) periods of instruction the same sub-units of instruction would be taught. It was also decided that to fit into the experimental design structure, a sequence of ten lessons would follow, in both the Treatment A and B phases of instruction - two lessons on the forehand, two lessons on the backhand and one on the serve. In the introduction to the Treatment B segment of instruction, the students were also shown the progressions through the different levels. They were made familiar with the management of the lessons so that they would know what to do after they mastered a particular level. At Level 1, the coach assessed them. At Levels 2 - 5 peers in their group carried out assessments. The coach also undertook assessment at Levels 6 and 7.

3.11.6 Mastery levels

As almost all players in the study were in the beginner, verbal cognitive category (Schmidt & Wrisberg, 2004), the mastery level was established at 60%, i.e., 6/10 shots, with the requirement that advancement from one level to the next required a student to achieve that score twice in succession. This differs from the Bloom (1976) and Keller (1968) mastery learning models that respectively set mastery levels of 80% and 100%. The decision to establish 60% success as the benchmark for mastery was made for the following reasons.

Mastery learning studies have historically focused on a specific cognitive dimension of learning, such as mathematics or spelling (see Guskey & Gates, 1986a; Kulik, Kulik, & Bangert-Drowns, 1990). The learning environments for

those types of studies allows for a much tighter control of the learning variables than in the open skill learning environment of motor skill performance in a game like tennis. The very nature of tennis equipment, tightly strung racquets and balls with a very high bounce coefficient, makes tennis a very dynamic game. Small errors are greatly compounded over the length of a court and in the author's experience as a teacher, tennis is one of the most difficult games in which to instruct students in a physical education environment. The author and tennis consultant agreed that an 80% or 100% mastery level might have been very demotivating for the majority of the students. In support of this position it is worth noting that the Metzler (1986) tennis investigation incorporating personalised mastery learning criteria, also adopted a 60% mastery standard for progression between the mastery levels.

3.11.7 Feedback - diagnostic and summative tests

Diagnostic, ongoing and summative tests are part of the intrinsic structure of mastery learning (Bloom, 1976). The transparent hierarchical and incremental progressions of the design of this investigation provide this type of feedback. Working in groups of three, with two being the minimum number, each group received instructions from the coach. In addition, as per the Keller (1968) personalised mastery instruction model, students also received written documentation of the requirements for each level. These instructions, presented in diagrammatic form, were taken to the courts in clear-file, weatherproof, folders (see Appendix L). The illustrations presented both the whole skill and the progressions of the skill for each mastery level. Students also received sheets on which they were able to record their progress towards mastery of the sub-skills and, finally, the criterion version of the skill.

Independent of the coach, the material provided knowledge of results and feedback in relation to the assigned standards and the student's goals in relation to those standards. In addition, the coach also provided knowledge of performance and prescriptive feedback that, when necessary, included remedial instructions and extension programmes.

CHAPTER FOUR

Results of the Study

Restricting one's self to the planned analysis - failing to accompany it with exploration - loses sight of the most interesting results too frequently to be comfortable (Tukey, 1977, p. 3).

4.1   Introduction

Following the tennis instruction programmes, the Paired Samples t-Test was used to analyse data collected in relation to the students' tennis ability, reflected in terms of serving and rallying. Baseline data collected before the tennis instruction began provided student entry-level performance information. Next, data were collected following the first treatment period of instruction (Treatment A - traditional skill-based learning). These data were used to compare student achievement against their entry-level performances. Finally, following the second treatment period (Treatment B - individualised mastery learning incorporating goal setting), data were collected to compare student performance in contrast to both their entry-level base-line performance and performance following the initial treatment period.

In addition to this analysis, goal-setting data collected as part of the second treatment intervention were also analysed using the t-Test for mean difference. These data related to achievement goals students set in regard to the mastery levels employed for instructing the forehand and backhand tennis shots as part of the second treatment strategy. This analysis was to investigate the relationship between goals set and outcomes achieved.[13]

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[13] Descriptions of these progressive, hierarchical levels are found in Appendix L

4.2   Data Analysis: inclusion criteria

At the completion of the research programme, 21 students from the class roll of 29 students (i.e., 72%) were identified as having met the criteria of attending 80% of the classes and the three assessment sessions. Data from the eight students who did not meet the criteria were excluded.

4.3   Data Analysis

The data gathered from this investigation were analysed in relation to the research questions in two ways. Firstly, confirmatory data analysis was undertaken to establish if there were identifiable differences in terms of learning achievement between the base-line data and the two pedagogical methods of tennis instruction; namely, (1) traditional skill-based learning and (2) individualised mastery learning incorporating goal setting. Secondly, an exploratory analysis of the data was undertaken to identify if trends in the data might suggest potential for identifying a good citizen model of instruction in physical education.

4.3.1   Confirmatory data analysis: serving scores

Confirmatory data analysis was completed using the Paired Sample t-Test for mean difference. Student base-line data were established by undertaking the serving test prior to the treatment programmes of tennis instruction and then, from the data, calculating the individual scores and the mean serving score for the group as a whole. The serving test was repeated after the first treatment period and after the second treatment period. The results of these serving tests are shown in Table 4:1, with differences shown between Pre-test and Treatment A (Change 0-1), Pre-Test and Treatment B (Change 0-2) and between Treatment A and Treatment B (Change 1-2).

78

Table 4.1 - Serving scores:

Students	Pre-Test successful serves	Treatment A successful serves	Treatment B successful serves	Diffs. 0-1	Diffs. 0-2	Diffs. 1-2
Student 1	0	1	2	+1	+2	+1
Student 2	0	1	2	+1	+2	+1
Student 3	0	1	3	+1	+3	+2
Student 4	1	2	3	+1	+2	+1
Student 5	1	2	4	+1	+3	+2
Student 6	1	2	4	+1	+3	+2
Student 7	1	2	4	+1	+3	+2
Student 8	1	2	4	+1	+3	+2
Student 9	2	3	5	+1	+3	+2
Student 10	2	3	5	+1	+3	+2
Student 11	2	3	5	+1	+3	+2
Student 12	3	3	5	0	+2	+2
Student 13	3	3	6	0	+3	+3
Student 14	3	4	7	+1	+4	+3
Student 15	3	4	7	+1	+4	+3
Student 16	3	4	7	+1	+4	+3
Student 17	3	5	7	+2	+4	+2
Student 18	5	7	8	+2	+3	+1
Student 19	6	7	8	+1	+2	-1
Student 20	7	8	8	+1	+1	0
Student 21	8	10	9	+2	+1	-1
Mean Scores	**2.62**	**3.66**	**5.38**	Diff Σ 20	Diff Σ58	Diff Σ37
Standard Deviations	**2.25**	**2.46**	**2.09**			

The Paired Sample t-Test analysis revealed the following with regard to differences:

between Pre-Test (0) and Treatment A (1):

Difference	Sample Diff.	Std. Err.	DF	T-Stat	P-value
0-1	-1.05	0.11	20	-9.65	<0.0001

between Pre-Test (0) and Treatment B (2):

Difference	Sample Diff.	Std. Err.	DF	T-Stat	P-value
0-2	-2.76	0.19	20	-14.24	<0.0001

between Treatment A (1) and Treatment B (2):

Difference	Sample Diff.	Std. Err.	DF	T-Stat	P-value
1-2	-1.71	0.22	20	-7.80	<0.0001

The results indicate, therefore, that there was a significant level of improvement from the Pre-Test baseline scores for both Treatment A and B, as well as a significant level of improvement between Treatment A and B. The consistency of improvement with individuals in the programme following both treatment programmes led to changes at significant levels in both conditions. However, it must be remembered that the design constraints led to Treatment B effects being embedded within Treatment A intervention, so it is not possible to make any definitive claims about Treatment B, independent of Treatment A processes. However, given likely plateau effects, and the consistent and evident pattern of change, it is interesting to note that the skill improvement level seemed to be clear and maintained.

4.3.2 Rally scores

Using the Paired Sample t-Test, a similar analysis to the serving scores was done with rallying scores. Student base-line data were established by undertaking the serving test prior to the treatment programmes and then, from the data, individual rally scores and differences and mean rallying score for the group as a whole were calculated. The rallying test was repeated after the first treatment period and after the second treatment period. The results of these rally tests are shown in Table 4.2, with differences shown between Pre-test and Treatment A (Change 0-1), Pre-Test and Treatment B (Change 0-2) and between Treatment A and Treatment B (Change 1-2).

Table 4.2 - Rally scores:

Students	Pre-Test rally	Treatment A rally	Treatment B rally	Diffs. 0-1	Diffs. 0-2	Diffs. 1-2
Student 1	9	11	1	-2	-8	-10
Student 2	13	36	39	+23	+26	+3
Student 3	15	44	45	+29	+30	+1
Student 4	18	46	46	+28	+28	0
Student 5	20	47	58	+27	+38	+11
Student 6	22	48	58	+26	+36	+10
Student 7	27	49	58	+22	+31	+9
Student 8	31	49	64	+18	+33	+15
Student 9	35	56	64	+21	+29	+8
Student 10	40	56	64	+16	+24	+8
Student 11	40	56	71	+16	+31	+15
Student 12	43	59	74	+16	+31	+15
Student 13	45	61	75	+16	+30	+14
Student 14	46	61	78	+15	+32	+17
Student 15	53	62	79	+9	+26	+17
Student 16	57	63	80	+6	+23	+17
Student 17	59	74	83	+15	+24	-9
Student 18	60	75	83	+15	+23	+8
Student 19	69	78	102	+9	+33	+24
Student 20	83	81	112	-2	+29	+31
Student 21	84	92	134	+8	+50	+42
Mean Scores	41.38	57.33	70.04	Diff $\sum$ 325	Diff $\sum$ 589	Diff $\sum$ 263
Standard Deviations	21.46	17.06	26.68			

The Paired Sample t-Test analysis revealed the following with regard to differences:

between Pre-Test (0) and Treatment A (1):

Difference	Sample Diff.	Std. Err.	DF	T-Stat	P-value
0-1	-15.95	1.85	20	8.64	<0.0001

between Pre-Test (0) and Treatment B (2):

Difference	Sample Diff.	Std. Err.	DF	T-Stat	P-value
0-2	-28.66	2.24	20	12.78	<0.0001

between Treatment A (1) and Treatment B (2):

Difference	Sample Diff.	Std. Err.	DF	T-Stat	P-value
1-2	-12.71	2.38	20	5.33	<0.0001

Similar to the results involving serving scores, there is a consistency in both raw score changes and statistical analysis, such that significant improvements were identifiable between Pre-score rally scores and those following both Treatment A and Treatment B, as well as significant improvement between Treatment A and Treatment B scores. Again, though, the interaction of Treatment A and B initiatives means that definitive conclusions as to differences in Treatment effects are compromised.

4.3.3   Goal setting: forehand and backhand

As noted in the introduction to this Chapter, in addition to the motor-skill analysis of serving and rallying, a student self-selected goal-setting[14] variable was part of the Treatment B design. Goal setting data were collected to determine if setting challenging but achievable goals resulted in students outperforming those who set less challenging goals. The seven hierarchical mastery levels designed to teach the forehand and backhand tennis shots in Treatment B, were also utilized as seven performance goals. Students were asked, after having each mastery level explained and demonstrated to them, to choose an appropriate mastery level as their personal performance goal. It was explained to students that if they chose, for example, Level 4 as their performance goal, mastery of the criteria established for that level would be commensurate with their having achieved their goal.

The goal setting data collected compares the final forehand and backhand mastery levels achieved by the students against the mastery levels they set as performance goals. In the Figures (4.1 & 4.2) below, the Y-axis indicates the final mastery levels students achieved and the X-axis the mastery level they chose as a goal. For example, in Figure 4.1, five students chose Level four as a performance goal. One of those students achieved Level two, one Level four and three students achieved Level seven.

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[14] The inclusion of goal setting as part of this treatment is extensively explained in Chapter Three, *Methodology*, with particular reference to the work of Weinberg et al, (1985), Edwards, (1988) and Howe and Poole (1992).

The goal setting data were analysed using the t-Test for mean difference between the level set and the level achieved. For example, in Fig. 4.1 five students chose Level four as their goal. For those five students Level four represents the base level mean. Of the five students, one scored -2, one scored 0 and three-scored +3. The reader should note that other than the fact that players either employed a forehand or backhand shot, the task sequence and hierarchy of skill mastery progressions for both shots, were identical.

Individual student relationships between goal and achievement levels: forehand

(Fig. 4.1)

Individual student relationships between goal and achievement levels: backhand

(Fig. 4.2)

The estimated relationships are: Backhand: final = 0.74 - 0.89 x goal

Forehand: final   2.78 + 0.60 x goal

Comment

In both scenarios (backhand and forehand) the relationship between goal set and goal achieved is significant (p   < .05). However, the relationship could either be causal (i.e., setting a higher goal causes a higher final level) or not (better students tend to have higher goals and to achieve better).

4.3.3.1 Backhand shot:

To clarify the relationship for both backhand and forehand, account had to be taken of the mid-test rally score, which provided an indicator of actual

performance from which to consider differences. The result is: Backhand: final = - 0.22 + 0.0176 mid + 0.84 x goal.

The coefficient of 'goal' is still significantly different from zero (p = 0.026), so it does seem that setting a higher goal is associated with a better final backhand score even for students with the same mid-test rally score.

4.3.3.2 Forehand shot:

Following the same process for the forehand, the result is: Forehand: final = 2.55 + 0.011 mid + 0.52 x goal. The coefficient of 'goal' is not significantly different from zero (p = 0.13), so there is no evidence that a higher goal is associated with a better final forehand score even for students with the same mid-test rally score. The likely difference between these outcomes for forehand and backhand will be discussed more fully later.

4.4   Exploratory data analysis

Because the design of the study that was forced on the researcher meant that there would be limitations as to what conclusions could be drawn from statistical analysis (in that Treatment B also had Treatment A embedded in it), a more 'hands on' consideration of data was undertaken. Although invariably speculative, it was seen as worth undertaking for consideration of trends.

4.4.1   Serving competency

Prior to any teaching intervention in this study, serving competency was assessed in relation to a player's ability to start a game of tennis without penalty. In tennis, players receive two serves to start a game. If the first serve is a fault they receive a second serve or chance to start the game without the loss of a point. Therefore, players in this study who could consistently serve at 50% were deemed to be competent. On the serving test used in this study, following

interventions, this level required players to achieve a score of 5 out of 10 serves.[15]

Number of students who scored at or above the 50% competency serving level
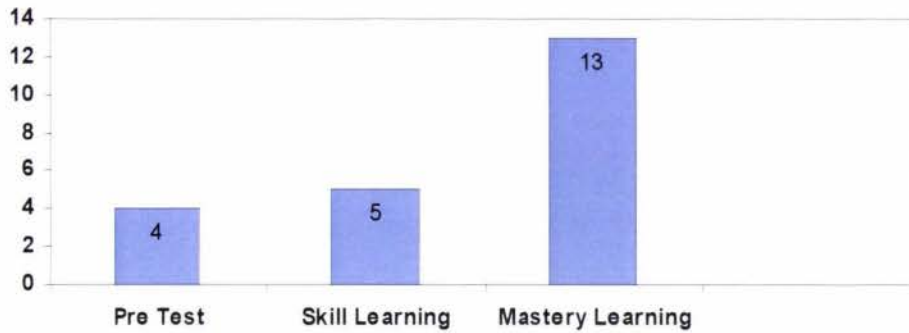
(Fig 4.3)

Comment

In the pre-test (see Fig 4.3) only four students (19%), achieved competency in relation to the stated measure. At the end of Treatment A (Change 0:1), five students (23%), achieved competency. At the completion of Treatment B (Change 1:2) 13 students (62%), achieved competency. However, because the same group was used in both treatments it is not possible to say if the Treatment B effects (Change 1:2) were caused exclusively by the personalised mastery learning / goal setting methodology or, had the Treatment A methodology, traditional skill based learning, been continued, it too might have produced the same degree of improvement.

However, the Change 1:2 score of 39% competent over the Change 0:1 score of only 3% competent works against both intuitive reasoning and an understanding of the plateau effect in motor skill development. Intuitively, having seen some improvement during Treatment A (Change 0:1) one would have anticipated that with continued practice students would probably continue

[15] The figure of 5/10 as an estimate of competency should not be confused with the 60% 6/10 mastery levels of stroke proficiency students were required to achieve in the mastery skill learning Treatment B phase of the investigation.

to improve, but not at the level recorded. This intuition would be supported by reference to the plateau effect frequently seen in motor skill learning where, following an initial improvement in performance, there usually follows a levelling off, a plateau, in the rate of change in improvement.

4.4.2 Rallying competency

The Kemp / Vincent Rally test (1968), modified for this investigation, does not determine a mean score of competence that would indicate that a particular score on the test equates with the ability to rally proficiently in a game of tennis. It can provide a comparative measure between pairs of students or, if used in a pre- and post-test scenario, as a measure of improvement over a course of instruction. Using the test as a measure of competence could also be achieved by the teacher or coach arbitrarily assigning a measure of competence score based on their coaching experience or through assessing performance against elite-level scores.

In order to establish a measure of competence for this investigation, five elite-level tennis players, of the same age range as the students in the study, undertook the same modified rally test used in the study. The five players undertook the test and their mean score was established as 86 successful shots in three minutes.

Using as a reference point Bloom's (1976) claims that mastery learning had the potential to lift student performances by one standard deviation over traditional group-based forms of instruction, the mean scores of students in the study were compared on levels of 50% - 80% of the elite-level players' mean score. Comparisons were made using the students' pre-instruction base-line data and data collected at the end of Treatments A and B.

**Percentage of class mastery as considered against elite player's
mean score on the Kemp-Vincent (1968) Rally Test**
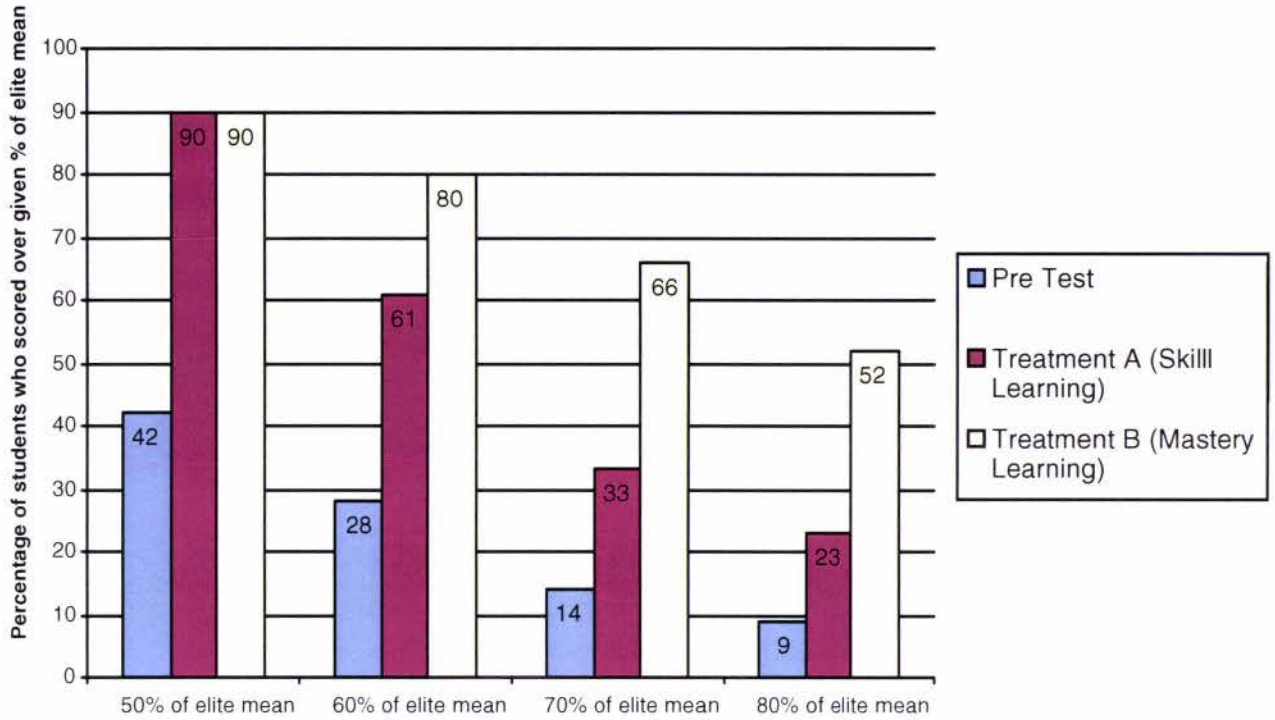
(Fig 4. 4)

Comment

Looking at whether the two treatments resulted in more students improving
against the pre-test scores, it is obvious that the treatments brought about
improvements, with 90% of the class reaching at least 50% of the elite players'
mean score at the end of each treatment intervention. Considered in terms of
60% and 70% of the elite players' mean score, one can observe differences that
suggest a trend. Both the Treatment A and B methodologies appeared to result
in a higher percentage of students improving their ability to rally in relation to
the elite players base-line mean, but the percentage was greater under
Treatment B conditions.

This trend is sustained when assessed against 80% of the elite level players' mean score. It is worth noting that, following Treatment B, over 50% of the class achieved at least 80% of the elite players' mean score. As previously stated, it is not possible to say if the Treatment B performance outcomes were brought about exclusively by the methodology employed. Nor is it possible to exclude the possibility that had the Treatment A methodology been continued it too might have achieved the same performance levels. However, for any teacher of Physical Education concerned with achieving movement competence for as many students as possible, this is an extremely interesting result.

4.4.3 Goal setting

As previously outlined, the forehand and backhand instruction variables built into Treatment B, besides including personalised mastery learning, also included individualised goal setting. It was explained to the students that goal setting was believed to enhance performance, especially if the individual set goals that they thought were challenging but achievable through hard work. The students received both a physical demonstration and a diagrammatic presentation of the seven different levels of mastery developed for the forehand and backhand ground-strokes. It was explained to the students that the seven mastery levels should also be seen as performance goals. Students were then asked to choose as a performance goal a level of mastery, between 1 and 7, for the backhand and forehand tennis shots based on their perception that the goal was challenging but achievable through hard work.

At the completion of Treatment B the goal setting data were analysed in order to establish the number of students who did or did not achieve their forehand and backhand mastery level goal. Figures 4.5 and 4.6 graph those results.

Raw score goal achievement rate for forehand shot

Achievement options
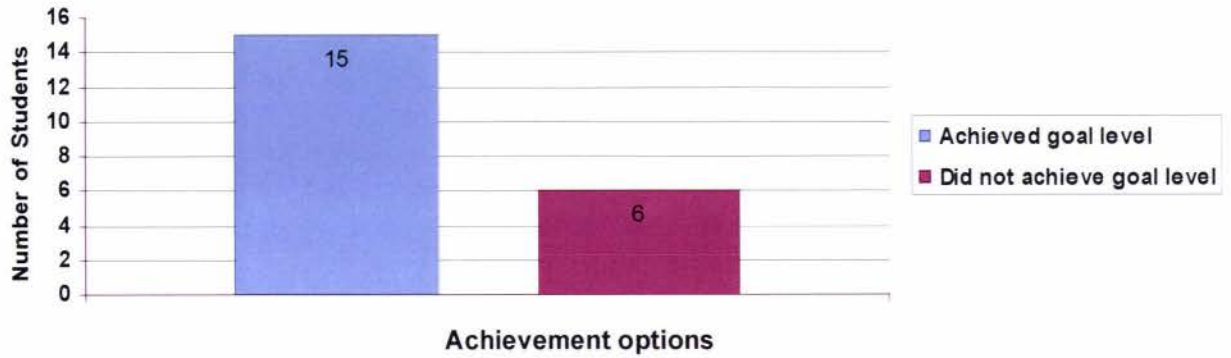
(Fig 4.5)

Raw score goal achievement rate for backhand shot

Achievement options
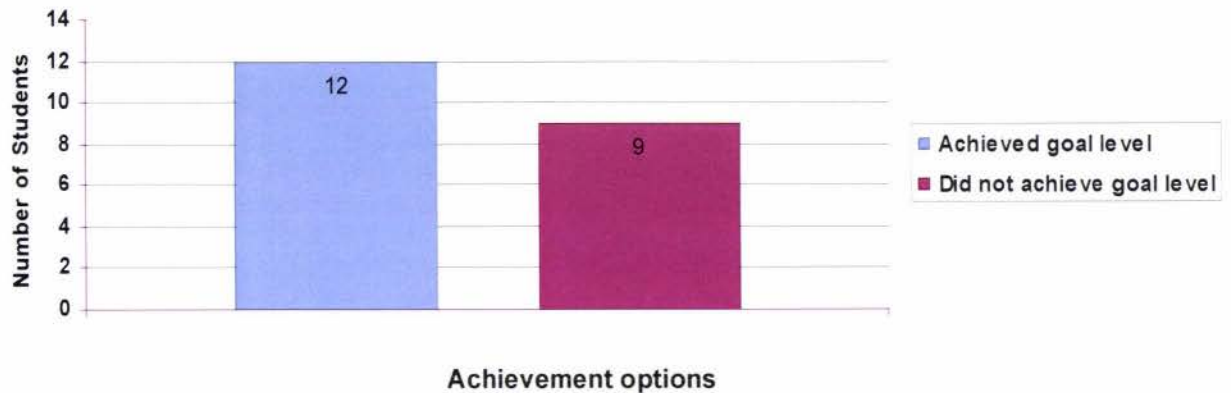
(Fig 4.6)

Comment

In relation to the goals set and the final mastery levels achieved, the results indicate that most students either achieved or bettered their goals (Figs 4.5 & 4.6). The data also reveals one exception to that outcome, namely those students who set as their goal, mastery level 5. Students with Level 5 as their goal were more likely than students who set any other level, not to achieve their goal (Figs 4.7 & 4.8 below).

Goal achievement rates for mastery Level 5: forehand
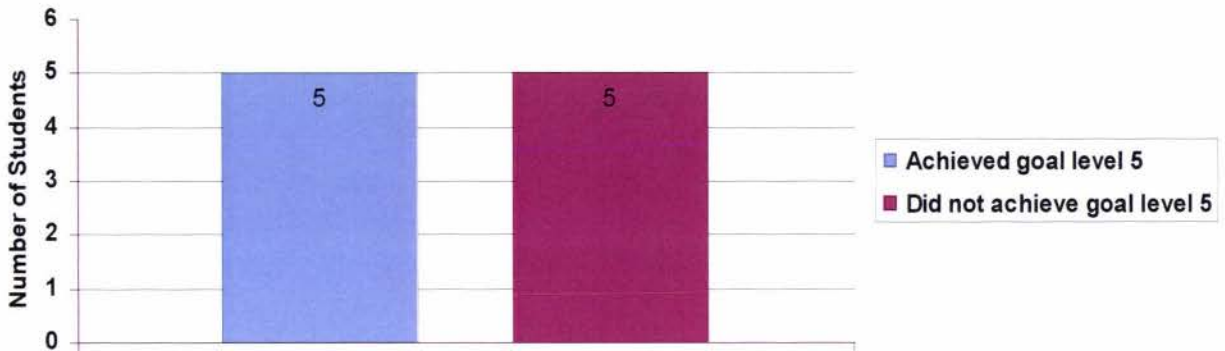
(Fig. 4.7)

Goal achievement rates for mastery Level 5: backhand
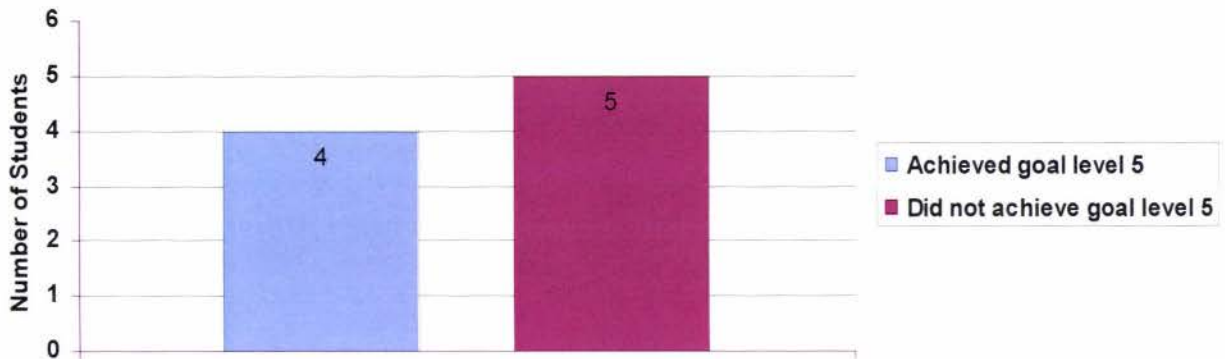
(Fig. 4.8)

This anomaly (Figs. 4.7 & 4.8) to the general trend observed in relation to goal setting and levels achieved, is suggestive of perhaps a flaw in the skill hierarchy design adopted by the author for this investigation. The Level 5 mastery skills described required competency with quite complex tennis skills and appeared to provide more of a barrier to progressing to the next level than any other progression within the hierarchy. The anomaly receives extensive discussion in the next Chapter (*Discussion and Conclusions*).

CHAPTER FIVE

Discussion and Conclusions

A mastery-oriented climate sustains equality, but a performance-oriented climate promotes inequality in education (Nicholls, 1989, as cited in Papaioannou, 1998, p. 267).

5.1   Introduction

The discussion is laid out in three sections. Section One focuses on the results from the data analysis presented in the *Results* chapter and qualifies and discusses the data principally in regard to the posed question: "Does a system of tennis instruction in a physical education environment utilising a personalised mastery learning methodology that also incorporates individualised goal setting (PML/GS), result in a better rate of student improvement in motor skills than traditional skill based learning?" In addressing this question, recognition is also given to the inherent problems associated with human motor skill research outside of a laboratory environment and the influence on motor performance of the plateau effect. Comment is also made in relation to the study's somewhat equivocal goal setting results, which differ from the overwhelming support in the literature for the positive effects of the addition of a goal setting variable to achievement in sport. Further discussion on goal setting relates to the aberration surrounding the achievement rate of those students who set mastery of the Level 5 performance criteria as their goal for learning the forehand and backhand tennis shots.

Section two focuses on observations in relation to the context of the instruction and student learning within the two treatment periods. These observations are referenced to the philosophical issues foreshadowed in the *Introduction* and

further examined in the *Literature Review*. Those issues relate to the role of physical education in a democracy and the evolving pedagogical practice associated with mastery learning and goal setting. In particular, the focus is on evident differences in student learning experiences related to the research of Duda (1996) and Papaioannoou (1995b, 1998), which suggested that a mastery-oriented classroom environment improved student motivation in physical education classes in areas such as effort and intrinsic interest in the activity.

Section three briefly covers further research ideas and directions.

SECTION ONE

5.2   Background to discussion of results principally in relation to question one: rates of learning

In the *Introduction*, the author presented the Bloom (1968, 1976) view that one of the roles of a state education in a democracy was to try and overcome inequality between citizens that had been created by circumstances of birth or environment. According to Bloom, overcoming inequality through schooling would be achieved through everyone learning to the same degree. Bloom (1968, 1976) suggested that the group-based mastery learning model could provide 'all students with successful and rewarding experiences now allowed to only a few" (Bloom, 1968, as cited in Block, 1971, p. 3). He claimed that mastery learning would enable 75 - 90% of all students to achieve at the same level as the top 25% currently learning under typical traditional group-based instructional methods.

In respect of the role that physical education might play in relation to Bloom's philosophical position, the author hypothesized that a personalised mastery learning methodology based on the Keller (1968) model would best serve to achieve that end. Supporting this position was the Papaioannou (1998)

suggestion that physical education taught from a mastery or competency-based philosophical position was akin to teaching based on democratic principles - a good citizen model. With such a model, attention is not merely focused on the elite movement performer (Papaioannou, 1998) but also seeks to ensure that all students are taught to master fundamental movements, such as, running, dodging, catching, throwing, striking and jumping. Mastery of these fundamental movements allows students to overcome what Taggart and Keegan (1997) referred to as the 'movement proficiency barrier.' They suggested that failure to overcome the proficiency barrier frequently manifested itself in adolescents avoiding participation in sports and as adults not choosing pastimes that included physical recreation and leisure activities. The author's position, as stated in the *Introduction,* is that a physical education programme that does not teach for mastery is failing in its 'good citizen' perspective of schooling, because it inhibits its future adult citizens from exercising their democratic right of choosing to fully participate in society in terms of their ability to participate in physical recreation and leisure activities.

Hence, the purpose of this study, using instruction in tennis as the medium, was to investigate whether a personalised mastery learning system of instruction in combination with individualised goal setting (PML/GS) accelerated motor-skill learning towards achieving mastery or competency in movement at a rate faster and, therefore, more effectively than traditional motor-skill learning instruction. If it did, then a recommendation from this study would be that in order for teachers to fulfil their function within a 'good citizen' model of instruction in physical education that they adopt, where applicable, mastery learning strategies, to ensure that as many students as possible achieved mastery of fundamental movements.

In discussing the results of this study the first questions to address in this section are: (1) did the interventions used in the study improve the students' tennis performance as reflected in serving and cooperative rallying scores and (2) did one intervention make more of a difference than the other?

5.2.1 The effects of the interventions used in Treatment A and B on students' performance of a tennis serve and cooperative rally

The straightforward answer to the first question, did the interventions used in the study improve the students' tennis performance as reflected in serving and cooperative rallying, was 'yes'. The results shown in the previous chapter clearly show that there were significant levels of improvement identifiable between the base-line data and Treatment A and the base-line data and Treatment B scores in the tennis skills. The results are unequivocal. However, given the relatively novice tennis starting point of almost all subjects in the study, one would anticipate some indication of improvement from pre-instruction to post the instruction periods. This is because one generally assumes, in motor-skill instruction, that some form of practice is better than none. Indeed Schmidt (1988), noted that it is quite difficult to achieve a negative transfer from practice to performance.

As to the second question though; that is, is there a significant difference between the Treatment A and Treatment B improvement rates, the results, again clearly indicate that there was a significant level of improvement achieved between the two intervention periods. The key issue though is whether the results indicate that the Treatment B intervention of PML/GS was a superior instruction method for providing tennis instruction than traditional skill-based learning methods?

Despite there being significant improvements between the two interventions in both serving and rallying, one unfortunately cannot make that claim. That is because, as previously noted, the research methodology forced on the researcher which resulted in Treatment A variables being embedded in Treatment B, predicates against any claims about Treatment B being completely independent of Treatment A processes.

Is then the evident significant improvement between the two treatment periods merely a case of just more practise resulting in continued improvement? It might well be but what cannot be said is that the continued improvement was brought about by more of the same type of practice, because the two methodologies, traditional skill based instructions and PML/GS, are very different. However, further examination of the Treatment B conditions is required because despite the obvious differences in instructional methodologies, the embedded nature of Treatment A conditions in Treatment B still prevents one from attributing the sustained significant improvements in Treatment B, solely to the differences between the two methodologies.

To further examine the effect of Treatment B, another question would need to be posed related to the Schmidt's (1988) observation of motor skill rehearsal typically resulting in a positive transfer to performance. The question is, would we expect the rate of improvement measured as significant in the first treatment period to be sustained over the two treatment periods? If the answer to this question is 'yes' then there is little that can be said for the second treatment intervention other than that extended practice resulted in continued notable improvement between the two treatment periods. However, if the answer is 'no' or equivocal, then, despite the embedded nature of the Treatment A conditions in the Treatment B variables, some reasonable speculations might be made in respect of the Treatment B methodology. One way of answering this question is through reference to the plateau effect.

5.2.2 Treatment B interventions, serving and rallying and the plateau effect

The plateau effect (Schmidt, 1991) is a frequently observed phenomenon in motor-skill learning. It refers to the levelling-off in performance improvements following an initial burst or rapid improvement, usually in response to introductory instruction, practice or training. As instruction continues

improvement in performance tends to level off, or plateau, and improvements come in much smaller increments and often at irregular intervals.[16]

Before attempting to address the results with reference to the plateau effect it has to be established that the two treatment periods used in this study, in terms of physical education instruction, represent more than an introductory period of instruction. Some might argue that 10 lessons still represent initial instruction. Within a larger perspective on sport instruction that argument is well made. However, a teaching unit of tennis instruction in a physical education context in New Zealand schools is likely to be between five or six lessons. Hence, within the realm of what is rather typical in terms of length of tennis instruction in school physical education lessons, the time spent in Treatment A might well equate to the usual initial introductory learning period. In accepting that position one might then speculate that teachers could anticipate a plateau effect in an extended period – such as the next five tennis lessons undertaken in Treatment B.

5.2.3 Results post Treatment B: additional practise or Treatment B effect?

The results in terms of both the serving and rallying skills clearly indicate that a plateau effect did not occur. Skill improvement in serving and rallying was evident and maintained across the second treatment period at notable levels. In terms of confirmatory data analysis we might, therefore, cautiously speculate that the Treatment B, PML/GS methodology, did contribute to a distinct improvement in motor-skill learning.

Given the counter intuitive nature of sustained learning improvements over an anticipated plateau effect, one might cautiously speculate that the significant

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[16] The plateau effect is described by Schmidt (1991) as one of the most fundamental principles of practice. He cites Snoddy (1926), as referring to the 'effect' as the 'law of practice.' Snoddy's law, he states, says that "improvements in motor performance are rapid at first and much slower later-a nearly universal principle of practice" (Schmidt, 1991, p.157).

improvement between the Treatment periods A and B is dependent on more than just the effect of more practice. One might also cautiously presume that it is the nature of the Treatment B intervention, albeit with embedded Treatment A effects, that is the key factor in bringing about the significant learning improvement following the second five lessons.

5.3　Exploratory analysis: raw scores of serving and rallying

A further means of developing the preceding discussion examining the rates of learning from base-line data and Treatment A and B interventions and between the two treatments, is through exploratory analysis of the serving and rally raw scores. While the emphasis of this examination leans more towards the philosophical observation associated with developing mastery in movement and the perspective of a good citizen model of instruction, it provides potential insight into the confirmatory data and lends further support to the cautionary conclusions just made in reference to the Treatment B intervention.

5.3.1　Analysis of serving test results as a measure of competency and of the effects of Treatment A and B interventions

Data on serving competency/mastery were collected and assessed in terms of the ability to start a game of tennis without penalty. The findings provided a graphic picture of the number of students who scored above the competency/mastery level of 5/10 serves following Treatment B instruction. The scatter graph below (Fig 5.1) provides evidence of the individual rates of change in learning post Treatment A and B.

Number of legitimate serves		Pre-Test	Treatment A	Treatment B	(competency level)
10			X		
9				X	
8		X	X	XXX	
7		X	XX	XXXX	
6		X		X	
5		X	X	(mean) XXXX	←
4			XXX	XXX	
3		XXXXXX (mean)	XXXX (mean)	XX	
2		XX	XXXXX	XX	
1		XXXXX	XXX		
0		XXX	X	X	
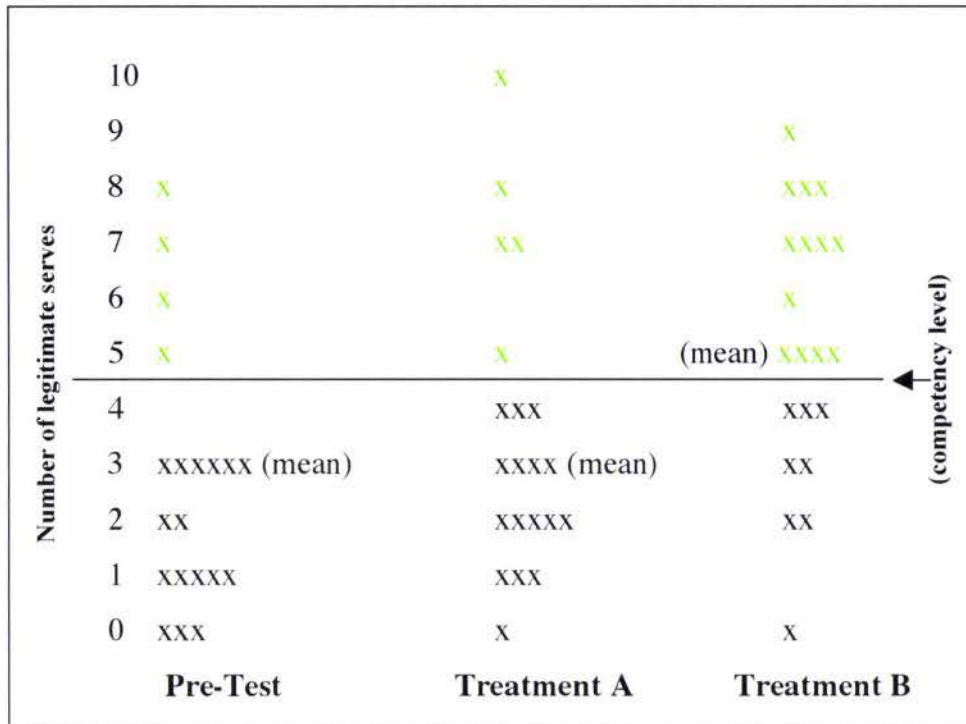
Fig. 5.1

5.3.2 Tennis Serve: results, analysis and discussion

Base-line data from the tennis serve pre-test, indicated a mean score of 2.62 or approximately three out of 10 legitimate serves. Only four students (19%) scored above the mean, although all of those who scored above the mean did so at the desirable 50% mastery/competency-serving ratio of 5/10 serves. However, at that point of assessment, approximately 17 students (80%) could not start a game of tennis without penalty. At the completion of the first treatment period (Treatment A), the mean had risen to 3.66; still a score of approximately three legitimate serves out of 10. At that point five students (23%) could serve at a 50% or better mastery/competency level but sixteen students (76%) still could not start a game of tennis without penalty. At the completion of the second treatment period (Treatment B), the mean serving score had risen to 5.38 successful serves out of ten. Thirteen students (62%)

were now scoring at five serves or better, an increase of eight students over those achieving a competence under Treatment A conditions. At the end of Treatment A, approximately 23% of the class could achieve the performance objective of five serves out of ten while after Treatment B, approximately 62% could - a 39% improvement.

5.3.3 Plateau effect, competency and Treatment B

Maintaining this discussion in a speculative form, any teacher of physical education would be pleased to see so many of the class achieving a learning outcome commensurate with what one would like to achieve in tennis lessons; i.e., the players being able to start a game of tennis without penalty. To have lifted the number of students considered competent from 19% (Pre-test), to 23% (end of Treatment A) and then to 62% (end of Treatment B) would be considered extremely satisfying. Part of this satisfaction would certainly come from the teacher observing the lack of anticipated levelling off or plateau in performance after the initial introductory period of instruction.

5.3.4 Treatment B serving intervention in regard to continued practice

It seems reasonable to speculate that despite the embedded nature of Treatment A experiences within the Treatment B intervention, the sustained and notably improved level of serving competency, that seems counter intuitive to the plateau effect in motor-skill learning, is likely to be a result based on more than just additional practice. Whilst unable to be conclusive, the results are promising in terms of the arguments about the PML/GS teaching methodology employed in the Treatment B intervention.

5.3.5 Discussion of rally test results as a measure of competency and the effects of Treatment A and Treatment B interventions

Exploratory analysis of the rally scores can be pursued in relation to two potential scenarios. The first concerns Bloom's (1984a, 1984b) claim that group-based mastery learning in combination with other good teaching practice procedures has the potential to improve student performance by one to two standard deviations over traditional group based methods of instruction. The second concerns Resnick's (1977) question, "Assuming that everyone can learn everything, will some learn less?" (p. 445)

5.3.5.1 The Bloom scenario

The literature review revealed that Bloom's (1984a, 1984b) claim that if taught correctly mastery learning could effect a one-sigma improvement over conventional group based methods of instruction. He also claimed that if that instruction was further enhanced with other forms of good teaching, for example, feedback, there was the potential for a 2-sigma improvement in performance.

In order to discuss the data in terms of this notion, attention needs to be given to the base rally scores and those of the two interventions against the standard score constructed for this study – the mean score of the elite young players.

5.3.5.2 Cooperative rally: developing the continuum measure

Their standardised mean score over the three-minute period was 86 shots. Eighty- percent of the mean scores of the experts rally test of 86 hits in three minutes was 68 hits. In the pre-instruction test, three players or 14% of the class achieved a score of 68 hits or better. At the completion of Treatment A, five players or 23% of the class achieved the 80% score or better. Adopting the rationale previously argued regarding an introductory period of instruction

being approximately five or six lessons in a typical physical education class context in New Zealand schools (Treatment A rallying practice), and with results indicating that at the completion of Treatment B, 11 students or 52% of the class were achieving 68 or more successful rally hits in three minutes, indications are that the same continuation of progress was evident

Observing the data from this perspective results in not trying to separate the effects of the two treatments but to combine them in the manner referred to by Bloom (1984a, 1984b). The combined effect of the two methodologies resulted in a shift from 14% to 52% of students being able to score 80% of the best scores. This is still short of the Bloom ideal of having 75 – 90% of all students achieving at the level of what the top 20 – 25% of learners can achieve. Despite this, as a teacher, having the majority of one's class (52%) performing at that level when initially only 14% could and then, after an introductory period only 23% could is promising and suggests that something quite distinctive is happening in terms of the rate of student learning. Again, part of that interest would come from the teacher not observing the anticipated levelling off or plateau in performance after the introductory period of instruction.

It is not author's intention to infer that these quite distinctive changes in performances in rallying scores are solely the result of the change in the instructional methodology of PML/GS used in the Treatment B intervention. As has already been stated, one cannot separate the effects from the preceding Treatment A to Treatment B interventions. However, from the perspective of a practitioner and the exploratory data analysis position based on Tukey's (1977) exhortation to take notice of results and not to lose "sight of the most interesting results" (p. 3), these results from the perspective of using a PML/GS methodology of instruction, are at least encouraging. From both a confirmatory and exploratory perspective they suggest sustained motor skill instruction of the type used in this study can bring about a notable change in performance or learning.

5.3.6 Summary comments: serving and rallying

In 1976, Bloom posed the question (paraphrased) of, why should not nearly everyone be able to achieve or learn what only a few currently appear to be capable of learning? He suggested that in order for all citizens to contribute to and share in the benefits of a democracy, it was the role of the school to teach in a way that provided the potential for citizens to overcome inequalities based on circumstances of birth or environment and ensure that most people learned what only a few appeared to be learning. His answer for achieving such an outcome through a state schooling system was the employment of group-based mastery learning methodologies. Mastery learning, he stated, in combination with other good teaching practice, for example, goal setting, had the potential to achieve this. From this perspective, the outcomes from this study provide some cautionary support for Bloom's (1984a, 1984b) suggestions regarding the potential of mastery learning when combined with other good teaching practices to achieve distinctive learning outcomes.

The cautionary support is based on the fact that following the programmes of instruction most students in the study (62%) could start a game of tennis without penalty and a majority of students (52%) could undertake a co-operative rally and achieve scores at 80 percent of an elite level players score under the same test conditions. The treatment period in which most students most rapidly improved to these levels was Treatment B, the personalised mastery learning and individualised goal setting conditions. The motor learning effect of a plateau in performance that one might have anticipated by the time the students were receiving instruction under Treatment B conditions, was not observed. Within the perspective of a good citizen model of instruction in physical education, the outcomes resulted in providing almost everyone in the study with the opportunity, should they wish, to play a game of tennis.

One might, therefore, imply that based on the observed counter intuitive sustained improvements in tennis performance achieved by the students in this

study in the Treatment B period of instruction, teachers of physical education might acknowledge that the PML/GS has some merit as a means of improving base level tennis performance. A further merit of the methodology also extends to providing outcomes associated with the philosophical position aligned with the 'good citizen model' of instruction in physical education discussed in the *Introduction* of this study. The development of competence as a means to potentially overcoming inequality of opportunity in society is at the philosophical heart of Bloom's (1976) mastery learning philosophy. In this light the results of this study are interesting and suggest a direction for motor skill instruction that is worth pursuing.

5.4 "Assuming that everyone can learn everything, will some learn less?" (Resnick, 1977, p. 445)

Resnick's question, stated above, was put in response to Bloom's (1976) claims for group based mastery learning. Bloom claimed that the correct implementation of group-based mastery learning would allow nearly everyone to learn what everyone else learned, but Resnick challenged whether group-based mastery learning would overcome individual differences in aptitude. Would the adoption of the methodology proposed perhaps change educator's notions of individual differences and would a form of educational utopia emerge that saw everyone capable of achieving what anyone else might achieve?

Based on the findings and observations of this study the answer to Resnick's (1977) questions would be a qualified 'yes' and 'no'! Yes, in that despite all students being exposed to the same mastery-learning environment, some students as measured by their performance on the serving and rallying tests, evidently learned less than others. Hence, despite some consistently positive learning outcomes, it would appear unlikely that most students would achieve what potentially all could achieve. A question is whether this is a flaw in the teaching methodology or just a case, as prescribed in the mastery learning

protocols, of recognising the need to provide more time to those who do not initially achieve the required standard? An answer to these questions appears to lie in what Schmidt (1988, 1992) observed in relation to the nature of humans and the consequent difficulties of authentic human motor-skill learning research.

5.4.1 Discussion

Motor skill literature (cf., Schmidt, 1992; Schmidt & Wrisberg, 2000, 2004) distinguishes between skill and ability in the following way. Skill is learned and subject to practice, whereas ability is inherited. Ability underlies skill, but is not subject to change through practice. The implication of this in terms of those students in the study who did not perform as well as others despite receiving the same instruction, is that they might not have the inherited ability that underlies skill in tennis - for example, multi-limb co-ordination (Schmidt & Wrisberg, 2004, p. 36). Hence, despite the same amount of practice, the results, as measured by a skill test, were not likely to be as good for all students. Mastery of the basics would require a longer period of instruction for those who may not have inherited, for example, high levels of multi-limb co-ordination abilities.

A further explanation in relation to differences in learning outcomes that counters the Bloom claim relates to what is called human nature and what Schmidt (1988) associated with the difficulty of undertaking human motor skill research outside of the laboratory. Maintaining individual motivation for a task and having the task performed in the same way when using human subjects is, according to Schmidt, fraught with difficulty. In this study some of the subjects struggled with the tennis activity in both treatment periods. By the time the assessment for post-Treatment B arrived, in the author's judgement, they had had enough of tennis. In the Treatment A conditions their lack of individual progress could be disguised. They could join in and have fun but without any of the accountability measures built into the protocols of the mastery learning

methodology, they were not confronted with the fact that they were not progressing. Again, in the author's opinion, in the final Treatment B assessment activity one or two of the students 'gave-up' in terms of any focused sustained effort, and did not work as hard as they had in earlier assessments. This might have been caused by the level of frustration they experienced once accountability measures were introduced to the programme. The author considered that further progress was possible with these students, but that the nature of instruction needed for this would have to be one-on-one instruction. Of course, one positive outcome in terms of PML/GS instruction, was that the accountability structures – the requirement to sequentially master the hierarchical movement criteria established for each performance level - associated with the methodology, identified these students and would have made them candidates for remedial work as prescribed by the methodology.

These observations also provide support for the view that there is not a one learning style that fits all learners and it is unlikely in the immediate future, if ever, that a 'silver-bullet' methodology will emerge that will result in the kind of educational utopia that underlay Bloom's claim.

5.5 Summary comments: implications in relation to movement competence and the good citizen model of physical education

The fundamental question that the author has been discussing and seeking to answer in this Section is, the benefits of a PML/GS method over traditional skill-based instruction or whether the results are merely achieved through additional practice? Basically, would another five lessons within the structure of the methodology used in Treatment A have produced similar or even superior results or were the outcomes based on a change in methodology?

Without a control group one can only speculate on those questions. Hence it is important to be careful when drawing conclusions, but the results achieved appear to suggest the following:

1.   The interventions under Treatments A and B conditions resulted in significant improvements in student tennis performance as measured on tennis serve and rally tests.

2.   The serving and rally tests indicated significant improvements between Treatment A, traditional skill based learning instructional methodology, and Treatment B, PML/GS, intervention.

      The latter finding meant that, counter to normal expectations, the rate of learning during the Treatment B conditions did not plateau. Consequently, following Treatment B conditions the number of students who could serve competently and rally to a level at 80% of an elite players score of the same age, was notable.

3.   Based on the post-Treatment B serving and rallying results, one could speculate that the nature of the PML/GS methodology appeared to provide motivation for most students to want to achieve well. In combination with other instructional methodologies, such as skill-based learning, it appears to enhance performance.

5.6   Goal Setting - introduction

The findings of the research in terms of goal setting established that there was a relationship between goal setting and the results players achieved in relation to their forehand and backhand stroke performance. It was suggested that the relationship could either be causal (i.e., setting a higher goal caused a higher final level) or incidental in that better students tend to set higher goals and also to achieve better. In order to clarify the relationship, it is suggested that

account has to be taken of the mid-test rally score. The data seemed to indicate that in terms of the backhand shot, a higher goal was associated with a better final score, even for students with the same mid-test rally score. For the forehand, there seemed to be no evidence that a higher goal was associated with a better final score, even for students with the same mid-test rally score.

The confirmatory data analysis consideration in terms of goal setting, therefore, provided conflicting results that require some comment. In relation to the Locke, Shaw, Sarri, and Latham (1981) claim, that students who set difficult goals outperform those who set easy goals, their claim was confirmed in this study in relation to goal setting and the backhand, but not with the forehand shot. The data obtained in this study also uncovered unusual results in respect to those students who set mastery of the performance criteria established for Level 5 as their performance goals for the backhand and forehand shots relative to students who chose other levels as their goals and brief comment also needs to be made in relation to the overall goal setting results achieved in this study. These have to be made in the knowledge of the extensive research that states that goal setting has very positive outcomes on movement performance and the results of this study, that suggest that while overall most students achieved their goals, a not insubstantial number did not.

5.6.1 Goal setting: equivocal results

In terms of the methodology of this study and the layout of the tennis programme, several conditions were manipulated to investigate whether goal setting would contribute to positive learning outcomes. With younger subjects the research (cf., Lee & Edwards, 1984) suggests that teacher-set goals encourage students to work hard based on trust in the teacher's judgement. In this study the researcher established the mastery performance levels, which the students could set as goals but did not assign specific goals to individuals. As such, the position was something of a compromise, in that the students self-selected goal levels but the author pre-set these levels. This was based on the

fact that participation in goal setting is likely to affect a person's cognitive, affective and behavioural responses by increasing understanding, satisfaction and effort to perform the task requirements. The intention sought was to encourage the students to accept their goals in more than a tacit way.

In a general sense, the results of the research tended to support the results of the Latham, Steele and Saari (1982) study, in that those students who chose harder tasks and consequently more difficult goals outperformed those who choose less difficult goals. However, where the results were more equivocal the following explanations are offered for discussion and reflection.

5.6.2   Player background and self-knowledge as a factor in goal setting

The student pre-programme playing experience questionnaire revealed that the group's tennis playing background was extremely limited. Most players did not have any previous experience to provide a reference point for what they may or may not achieve in the tennis activity. While students were not asked to set specific performance goals until they had received five lessons and perhaps would have started to form some sort of view of their ability in the game, they were possibly still too inexperienced to accurately choose a realistic goal. Support for this speculation is perhaps vindicated in the data collected on some of the students who set mastery level four as their performance goals for the forehand shot. Three of the students who set that relatively 'easy' goal were, in the author's opinion based on his observing them in the Treatment A instruction period, very good athletes. While those three students expressed surprise that they exceeded their goals and achieved a Level 7 final result, the author was not.

5.6.3 Conflicting forehand and backhand goal setting results: order of lessons and perception of difficulty

There seems to be no rationale explanation for the goal setting protocols that produced both positive (backhand) and negative (forehand) relationships for the two evidently similar tennis strokes. Essentially, the hierarchical protocols for the two shots were identical. There are two possible explanations, but they are both speculative and should be viewed from that perspective.

5.6.3.1 Order of lessons

In the sequence of lessons, the forehand was always instructed and practised first. Perhaps this provided some positive, near transfer of learning, in terms of developing a motor programme that included striking the tennis ball and footwork. The preparations for the two shots, forehand and backhand, are very similar and perhaps the familiarity with the structure the second time around may have also boosted the player's confidence. This confidence, if it existed, may have contributed to improved performance on the backhand shots and allowed students to better achieve their goals on that shot.

5.6.3.2 Perception of difficulty of the two shots

The second speculative explanation regarding the conflicting results obtained on goal setting and the backhand and forehand shots, is in relation to the perception that the backhand ground-stroke in tennis is often considered more difficult to perform than the forehand. While this often appears to be true in the open skill environment of a game of tennis, especially when one wants to hit the ball hard, within the practice environment it is not always the case. Some coaches, including the consultant coach, believe that the double-handed backhand used in this study forces students to move into a better striking position than is the case with the forehand. He stated, "they have to move their feet to get into position because two hands on the racquet effectively shortens

the length of the racquet relative to the single handed forehand. The additional footwork, perhaps coupled with the view that this stroke is the more difficult, makes the player concentrate harder and frequently leads to better shot production in practice for novices hitting backhands than initially achieved with their forehand shots" (John Salisbury, personal communication, 2003). If the players did view the backhand as the more difficult shot and did, as the consultant suggested, work harder at achieving the correct execution of the shot, then this could have contributed to a more positive relationship between the goals set for the backhand and achieved compared to the forehand shot.

5.6.4   Goal setting and Level 5 results: A programme design fault?

The goal setting data analysis also revealed, that those players who set Level 5 as their goal in the forehand or backhand performance tasks, experienced the most difficulty in achieving a successful learning outcome. The reason for this slight aberration in the goal setting results is perhaps explained by the nature of the movement activities associated with this level. In retrospect, the technical skill requirements associated with Level 5 mastery may well have been too difficult a step in the skill hierarchy and may have been better placed at a higher level.

Level 5 required the players to hit a ball that was thrown to them into the determined 'power-zone.' Mastery at this level, therefore, required students to strike the ball quite firmly and to also impart topspin on the ball in order that the ball would drop into the 'power zone' area. In effect, they had to be capable of hitting a genuine top spun forehand or backhand shot. It probably required the most precise technical skill of any of the seven mastery levels. On reflection, one could assume that if a player achieved Level 5 as described, then mastering the succeeding two levels would prove to be relatively straightforward.

5.6.5   Summary position: goal setting

The research on goal setting as a factor in achieving positive outcomes in sport is unequivocally positive (cf., Locke & Latham, 1985). The widespread acceptance and use of goal setting in sport is testimony to this practice. The results in this study tended to support the position that setting challenging but achievable goals and making them public resulted in better performance.

Where the results were slightly equivocal this may have been caused by a design fault in the skill hierarchy or sequence, the perception of difficulty associated with the two shots and the consequent amount of effort and concentration players may have brought to the two tasks related to the goal setting activity.

SECTION TWO

It is a crime against mankind to deprive children of successful learning when it is possible for virtually all to learn to a high level (Bloom, 1987, p. 508).

Discussion of results principally in relation to observations and perceptions of the changing context of the student-learning environment.

5.7   Introduction

As stated in the introduction to this chapter, this section focuses on observations in relation to the context of the instruction and student learning within the two treatment periods. In particular, it focuses on any observed differences in the student's learning experience in the manner of what Duda (1996) and Papaioannoou (1995b, 1998) suggested in relation to a mastery-

oriented classroom environment, namely, that it results in improved student motivation in dimensions such as effort and intrinsic interest in the activity.

Papaioannoou (1995b) also noted that in order for sport and physical education to promote values associated with democracy, then there is a need for those who teach and coach physical education and sport to become accountable for all student learning and not just for the elite. Further support for this conclusion has been referenced to Xing and Lee (1998) who stated that mastery learning and goal setting provided a vehicle for student participation in sport and physical education to be delivered at the individual's own level and in doing so PML/GS provided a vehicle for recognising individual student achievement.

It is the author's view that it is within the nature of the PML/GS methodology that one best finds accountability for the instruction of all. The context of physical education classes, thirty students in large outdoor spaces or in a gymnasium, makes accountability for all student learning a difficult task to master. However, as Siedentop and Tannehill (2000), who list accountability as one of their key qualities of an effective teacher, stated, master it one must if one wants to become an effective teacher of physical education.

The researcher's observations of the tennis lessons took place with these elements in mind, with a view to see if any differences could be perceived between the instructional periods of Treatment A and Treatment B. The important question that drove these observations was whether the two treatment interventions, traditional skill based instruction and personalised mastery learning incorporating individualised goal setting, resulted in any observable differences in the nature of the student learning experiences?

5.7.1   The nature of the learning experiences

Under the Treatment A conditions of prescribed instruction in the traditional format of command centred, skill-based and teacher-paced whole class

instruction, there were definite improvements in both performance and learning. These were recognized in both the confirmatory and exploratory analyses of the data. There continued to be clear improvements in Treatment B under the PML/GS period of instruction, sometimes at rates that would appear to be counter intuitive to normal expectations in motor learning instruction, especially in relation to the plateau effect. What is at the centre of this present discussion is what appeared to drive changes in student performances under the two treatment conditions?

In regard to this question, the acknowledged difficulties associated with the study that resulted in a forced change in the research design might also be seen as an advantage. The fact that "control" and treatment subjects were one and the same, from the perspective of this discussion, is useful. The value is that one can observe the same subjects reacting to different instructional variables. Because the instructor, physical environment, equipment and subjects were all the same in both treatments, any observed changes in teacher or student behaviour could fairly be attributed to other variables. The only substantive variables changed between the treatment periods in this study related to the instruction methodology. This discussion draws on the author's observations of the instructor's and subjects' behaviours and the learning context relative to the instructional methodologies employed.

5.7.2   Treatment A: traditional motor skill instruction

In observing the Treatment A period of tennis instruction, it was obvious that the students were excited by the programme. The novelty of the environment, real tennis courts, good equipment in the form of tennis racquets and more tennis balls than any of the students would have ever seen in one place, was motivating. So too was having a professional tennis coach who was a very good teacher, who managed the class well and ensured that the students had many opportunities to use the equipment and try and learn the skills. It could be speculated that with such wonderful resources there was no potential

inequality of opportunity to learn. It might also suggest that failure for everyone to achieve at a high level would be down to individual differences - aptitude - and not teaching methodology or any other conditions.

Certainly, the teaching in the first treatment phase was, in the author's judgement, of a very high standard. It was much more than a 'busy, happy, good' scenario of teaching. The data collected clearly indicated that learning took place. The lessons had good pace and momentum. The students did as they were told and they happily ran to the courts and practiced. On command they came in quickly and watched as techniques were demonstrated and discussed. They loved the fun games at the end. But, the driving force behind the student learning, the energy and momentum within the lessons appeared to come from the coach. The students worked off his cues but there appeared to be little in the way of a shared expectation of any finishing point to the programme. There was no goal or accountability in terms of a shared understanding of expectations of what they might achieve at the end of the programme. It could also be said that there was no tension, either for coach or students, if skills were not mastered. The lessons were just taking place and the students seemed to think they were great!

However, despite the 'good teaching' and the obvious enjoyment of the students, at the completion of the Treatment A period few students were performing at the desired level of competency as measured by the serving test of being able to start a game of tennis without penalty and being able to undertake a co-operative rally at 80% of the mean score established by the expert players of the same age.

5.7.3 Treatment B: personalised mastery learning incorporating individualised goal setting

Under the Treatment B learning conditions, PML/GS, the author observed significant changes within the context of the learning environment. The

structure of the mastery programme coupled with the goal setting appeared to provide a definite end point of acceptable performance. The atmosphere of the lessons centred on specific outcomes associated with; "this is what we are striving for. It is expected that you will achieve the following. If you are not progressing then you'll get help to master those stages and progressions!" Suddenly, what was taking place was no longer just a fun experience. It was still fun, because all of those previously mentioned variables associated with the venue and environment were still there, but now, in addition, what they were doing seemed important. There was learning to achieve and the expectations were that they, as students, would work towards achieving those learning outcomes.

5.7.4 Student ownership and responsibility for learning

In the researcher's assessment, the fundamental difference between these two treatments seemed to come down to ownership and responsibility. The transparency and involvement of the students in the learning experience provided a direction that was not previously apparent. The act of goal setting - the public declaration of writing down what level of mastery the individual student sought to achieve - placed some challenge of ownership of actually achieving the learning outcome onto the student. Now the pace of the lesson was not determined just by the energy of the coach, but also by the focus and commitment of the students.

The nature of the mastery learning organization, with its small hierarchical sequences, provided achievable outcomes for the students. They could see that if they achieved a level it moved them onto another mastery level, all of which was aimed at getting them to a stage of learning that was sensible and logical. The students could see what was required to enable them to do what they would really like to do in tennis, namely start and play a game with sufficient skill to enjoy the activity and not be frustrated by it. Observing the students working in groups of three, striving to master the levels, the shift in ownership

and responsibility for the learning was evident. It was clear to the author, and reflective of the Papaionannou (1998) position, that there was a fundamental shift in the learning ownership and responsibility between the interventions of Treatment A and Treatment B.

5.7.5   Teacher accountability

Another very important factor in the change of learning environment related to the level of accountability placed on the coach to affect the learning outcomes. A strength of the PML/GS methodology is in the good teaching practice it promotes. For example, the requirement to analyse what is going to be taught and present it in a skill-learning format that is sequential and hierarchical is a strength of the methodology. The requirement for learners to master each sequential stage of the skill ultimately leads to the person being able to participate, at least at an introductory level, in a game of tennis, which is also a strength of the model. These structural requirements of mastery learning place on the teacher and coach the responsibility of accountability to ensure detailed planning and built in assessment procedures that clearly indicate the rate of student learning. It places expectations on the teacher/coach to ensure students learn in their class and do not just participate; however enjoyable that experience might be.

5.7.6   Constructive tension?

One observation of the Treatment A intervention previously mentioned was that there appeared to be little tension for either the students or the coach regarding the level of achievement. This did appear to change under the Treatment B intervention. There was more tension evident. This tension perhaps relates to the expectations of the mastery format. There was a shift from some generally stated outcomes that were set by the teacher for the whole class, to specific outcomes that the students were invited to set as part of their goal for learning. In this sense, one sees the phenomenon of the norm-

referenced scenario. The teacher/coach states, "Here is the standard. Can you reach it?" Students look around and see some of their class mates getting there and because the goal is slightly obscure, they have no way of measuring their progress towards it, apart from by their own generalised comparison with other students. They might feel that they are 'doing okay' because they appear to be better than those on the court next to them but not as good as those on the other side. Without clearly defined outcomes there is no accountability for either the student or the coach.

Within the Treatment B phase, utilising the PML/GS model of instruction, one could see that students became absorbed with their own progress towards mastery. For a very few this did result in some frustration and tension as they struggled to complete the levels of mastery. However, for the vast majority the clearly stated and visually presented transparent outcomes resulted in them working with great focus within their own group with little attention to those around them. In addition, the 'built-in' components of mastery learning, such as the intrinsic feedback of knowing whether they achieved mastery of a level coupled with individual help from the coach, clearly appeared to be motivating for the students. One might also say that even for the students who experienced particular tension in this period of instruction, the measures of learning creating that tension were against standards that they had chosen, and not by how well they perceived they were doing by comparison with the players on the next court.

What was observed tended to reflect the research of Duda (1996) and Papaioannoou (1995b) that suggested that a mastery-oriented classroom environment improves student motivation in physical education classes in areas such as effort and intrinsic interest in the activity.

5.8 Conclusions

In observing the contextual changes in the learning environment under the two treatment interventions, the researcher came to several conclusions. The first was in relation to the evolving position of mastery learning and goal setting. Papaionannou (1998) stressed that physical education class environments that placed an emphasis on effort, task involvement and mastery, resulted in indexes that reflected positive student motivation and intrinsic interest. Conversely, where the class environment reflected a generalised performance focus, the student perception was not positive. Papaionannou (1998) felt that a mastery-learning environment could change both student and teacher perceptions of what was possible.

The Treatment A conditions produced positive responses from the students but seemingly not in the same manner as in Treatment B. The traditional skill-based methodology of Treatment A produced positive attitudes towards participating in the activity, but they were teacher driven. The PML/GS intervention of Treatment B also produced positive learning attitudes, but under these conditions the positivity appeared to come from the intrinsic motivation of the students.

A second conclusion relates to Resnick's (1977) response to Bloom's (1976) assertion that mastery learning had the potential to overcome inequalities in society by providing a means by which most people potentially could learn what previously only a few appeared to learn. In reply Resnick, sought qualification as to what was meant by 'what most people can learn?'

A response to the Resnick (1977) question and to the Bloom position in relation to sport and physical education might be that the mastery learning approach has the potential to provide almost everyone with mastery of many of the fundamental movements to allow them to at least participate in sports, recreation and leisure at a basic level. The literature on individual differences

and performance in sport already referred to (cf., Schmidt & Wrisberg, 2004), suggests that inherited ability does make a difference in performance outcomes at the highest levels of sport performance. In this sense, perhaps almost everyone can learn the basics but not everyone can perform at elite levels in movement activities. This is not a weakness of the teaching methodology as such, but a pragmatic and research-based observation that should not discourage the adoption of the teaching methodology in general.

5.8.1 The 'Robin Hood' effect: how much time to give to students who do not reach the desired level of mastery?

A criticism of the Bloom (1976) group-based mastery protocols was attributed in the literature to a phenomenon called the 'Robin Hood' effect. It was so named because of the effect of holding up the progress of all learners on a particular unit of work until 80% of the class had mastered the content. Critics suggested that this practice robbed from the faster learners (the rich) the time available for them to progress their learning while they waited for the slower learners (the poor) to be given the additional time to 'catch-up.'

In this study, the time variables between the two treatment periods were kept constant. However, to have ensured everyone achieved mastery at the levels defined within the study, considerably more time would have been required to instruct those individuals who had not met those levels.

In relation to the basics of tennis taught in this study, having 62% of the class achieve competency on the serve and 52% of the class perform a cooperative rally at 80% of elite players of the same age mean score is suggestive that mastery of basic skills is possible. The issue though, which remained unresolved from this study, is how much time one could realistically devote to a unit of work in a school situation to ensure everyone achieved mastery.

For the author, a pragmatic solution lies within the Keller (1968) protocols established for individualised mastery learning and the practice of goal setting. By adhering to the protocol of transparent outcomes and study guides, and displaying these as posters, for example, in the school gymnasium, the teacher would provide a reference point for students to undertake additional practice in their own time – what other subjects call homework! Students could be assisted in establishing realistic performance goals and be given opportunities to be reassessed post the formal completion of the unit of work.

5.8.2 To teach or not to teach for mastery?

Alan Launder (2003), in a discussion of new trends in teaching movement activities in physical education made reference to mastery learning in the following way. He suggested that in all motor learning methodologies or models there needed to be an expectation of skill mastery. He suggested that unless students/players were taught to the stage of mastery of the techniques associated with games or sports, then there was little chance that they would be motivated to participate, as the activity would never feel as it was intended or as it is experienced by those who do master the skills. Clearly, Launder (2003) believes that a lack of mastery of movement skills equates with little or no participation in sport or physical recreation activities. His position also supports the same view advocated and previously referenced to by Taggart and Keegan (1997) in relation to mastery of fundamental movements and participation by adolescents in sports. Without mastery there is little participation.

What is important, in the author's view at least, is that the focus in instruction should be on lifting the minimum standard of performance, as it is not possible, within the confines of state school physical education programmes as they currently operate, to take all students to the very highest levels of performance in all sports or physical activities. The author's observations of the PML/GS teaching method in action suggests that the employment of this model of

instruction in practical movement activities would provide the learning framework to provide the potential for most students in physical education classes to achieve mastery of basic movements.

5.8.3 Mastery learning, goal setting and a good citizen model of instruction in physical education

It is the author's position that if we as physical education teachers do not provide most of our students with a minimum level of mastery in movement activities then we are not fulfilling our function within a good citizen model of physical education in relation to a participatory democracy. The mastery learning methodology coupled with goal setting provides both the checks and balances to ensure that this is achieved and, in doing so, provides a physical education classroom environment that is, according to Papaionannou (1998) and Ames (1992), inherently more democratic.

SECTION THREE
Future Research Ideas:

5.9 Discussion of future research ideas

Respected physical education researcher Michael Metzler suggests that one needs to consider models of teaching and not methodologies (Metzler, 2005b). In clarifying the differences between methodologies and models, Metzler (2005b) suggested that methodologies tended to be ideologically bound. Within a methodology there is a set method that does not allow for a flexible approach to instruction. He reflects that advocacy of a single method of instruction has promoted research that is comparative, i.e., methodology A verse methodology B. He suggests that when two methodologies are specifically designed to achieve different learning outcomes that such research is the empirical equivalent of "comparing apples with oranges" (Metzler, 2005b, p. 190).

By contrast, Metzler (2005b) states that models tend to embrace various methodologies in order to achieve effective teaching and learning outcomes. He suggests that in developing models of teaching one overcomes methodological tensions by including various methodologies within one model. In this sense new directions, such as Teaching Games for Understanding (TGfU), could be accommodated alongside mastery learning, goal setting and sport education. In this way research questions about improving student learning in physical education could focus on determining "how well a model can achieve the outcomes for which it is designed" (Metzler, 2005b, p. 190).

Currently, the research direction in learning in physical education is towards models that focus on constructivist theories of learning, e.g., TGfU. The author's perspective is that totally abandoning behaviourist skill-based perspectives is potentially limiting in the search for developing a truly catholic model of learning in physical education. Consequently, in terms of research that might measure the effectiveness of creating a good citizen model of teaching children and adolescents in physical education, research could focus on developing models that incorporate both constructivist and behaviourist theories of learning. Such models should also include outcomes associated with the affective domain, for example, enjoyment and the social capital associated with good citizenship or democratic outcomes. The research should then attempt to measure how effective the model is in achieving outcomes in physical education that are not just confined to the motor skill acquisition but also in the area of the affective domain.

Developing such models should not be undertaken in isolation from the school physical education teacher. The research should also focus on the willingness of school physical education practitioners to adopt the model in their daily teaching. It appears that unless a model has credibility with those doing the teaching, little will be achieved in terms of change at the point of real return in

physical education - in the classrooms and on the playing fields and, subsequently, in terms of citizen participation rates, in physical activity.

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Appendices

General letter seeking expressions of interest in the research programme

Date

Mr. X XXXXX
Principal
xxxxx School
Palmerston North

Dear xxxxxxx

As part of the thesis requirements for my Masters degree I am undertaking an investigation into the relative merits of two different motor skill teaching methodologies. This letter is by way of seeking a general expression of interest from teachers at your school who might be interested in having their class involved in the project.

The project involves instructing a composite class of Form1 and 2 students in tennis. The programme would involve a discussion with the class about the project and completion of a questionnaire to establish the students tennis playing background. The instruction format would involve, a pre test of the learning outcomes, 5 lessons, a mid programme retest, a further 5 lessons followed by a post programme test. In all 13 lessons would be required. It is anticipated that these lessons would take place over three to four weeks and would take the place of the time normally set aside for physical education.

The experimental design requires two classes from different schools to receive the same instruction but in reverse order. The two five lesson units of instruction outlined previously would represent the time each class would spend on each method of instruction. I am looking for a composite year 7 & 8 class with a reasonably even gender split.

I will follow up this letter in a few days with a phone call to ascertain if any staff at your school are interested and if there are, to establish a time where I might explain in more detail to them the programme.

Thank you for your consideration of this request.

Yours sincerely

Dennis Slade

Letter to Principal and to school Board of Trustees

Date

Mr
Principal
xxxxx Intermediate School
Palmerston North

Dear

Mrs xxxxx teacher at your school has agreed to having her class involved in the research project requiring her class to receive instruction in tennis.

The attached letter is a request to your school's Board of Trustees to give approval for the class to be involved. Note that the procedures outlined, even with your and the Board's approval, provide individual students an opportunity to not participate in the programme if that is there or their guardians desire.

Once again, I would like to express my appreciation for your co-operation in facilitating this activity.

Yours sincerely

Dennis Slade

Memorandum

To: Board of Trustees, xxxx Intermediate School

From: Dennis Slade, Master's student, Massey University

Date   xxxxxx

Topic: Request to undertake motor-skill instruction research with a class at your school.

Following an approach to your school principal and subsequently staff member Mrs xxxx, I am writing to request your permission to undertaken a methodological investigation based on tennis with her class.

The Investigation:

The investigation is to gauge the relative merits of two different instructional methodologies, mastery learning and traditional skill-based learning, at promoting learning in tennis. Two schools and classes will be involved. Each class will receive the same instruction but in reverse order, i.e., one class receiving Treatment A followed by Treatment B and the other class Treatment B followed by Treatment A. Including testing, 13 lessons are required, approximately thirteen hours spread over three to four weeks.

Venue:

We will use the tennis courts approximately five minutes walk from your school. The students would be accompanied on this walk by their class teacher and myself. The one road crossing can be completed opposite the courts using the pedestrian crossing.

Equipment:

Students who have and wish to use their own tennis racquets may do so, but all equipment, racquets and balls, will be supplied.

Coaching:

Coaching will be undertaken by a New Zealand Professional Tennis Coaches Association registered coach with ten years coaching experience. The class teacher and the researcher will also be in attendance

Assessment:

Pre, mid and post testing will be undertake by semi-professional tennis coaches under the researchers supervision.

Ethics:

Students will receive professional instruction at no cost. Individual details of student results will not be published. No student will be identified by name in any publication. It has been agreed with the class teacher that any student or parent / caregiver not wishing to have their child involved in the programme will have their child accommodated in a parallel physical education programme. My supervisor suggests that such an investigation will not exploit the students in any unethical way. They suggest the students can only stand to benefit from the expert instruction.

Thank you for your consideration of this request.

Signed

Dennis Slade
█████████████
█████████████

Permission letter to parents and guardians

Memorandum

To:	Parents / Guardians of students: Room xx, xxxx Intermediate School
From:	Dennis Slade: Master's Student, Massey University, Palmerston North
Date:	xxxxx
Topic:	Tennis Instruction as part of research project

Dear Parent / Caregiver

Your school's Board of Trustees, School Principal and class teacher Mrs xxxx have given permission for me to approach you to request that your child participate in a series of tennis lessons as part of a research project gauging the relative merits of two different instructional methodologies for teaching tennis.

If you give consent your child will receive ten tennis lessons from a New Zealand Professional Tennis Coaches Association registered coach who has ten years of tennis coaching experience. The class teacher and the researcher will also be in attendance for all lessons.

All equipment will be supplied, though students wishing to use their own tennis racquets may do so. The tennis coaching will replace the regular physical education lessons undertaken by the class. The instruction including pre, mid and post tests of student skills will require thirteen lessons over three to four weeks. The lessons will take place on public courts approximately five minutes walk from the school. Students will walk to the venue and will be accompanied by the class teacher and the researcher.

The results of the study will be used in a thesis presentation on the relative merits of the two instructional methodologies. However, no individual will be identified by name in any publication and no individual results will be published.

If you do not wish to have your child involved in the programme they will take part in a parallel programme of physical education instruction at their school.

Would you please return the tear off section below and indicate whether you do, or do not give permission for your child to be involved in the programme.

Thank you for your consideration of this request.

Signed

Dennis Slade

I / We give / do not give, permission for_____to participate in the tennis

<div align="center">Students name</div>

programme as described in above memorandum.
Signed

Parent / Caregiver

Skill assessment: serve test

A serving and a rally test will be used to measure rates of learning in these tennis skills.

Serving test:

The serving test requires that each student undertake 10 serves, two in succession, into alternating sides of the court. The standard tennis rules of serving will apply.

Recorder X

Assistant
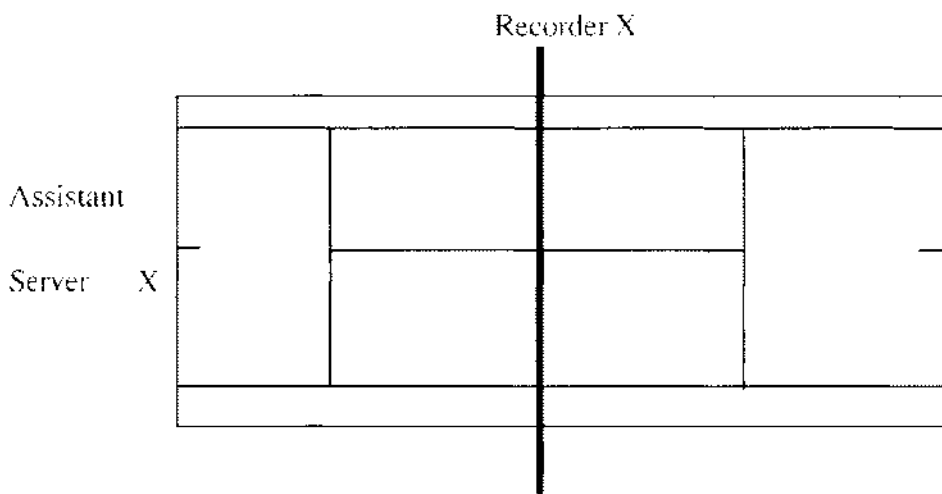
Server   X

Management

1   Divide students into groups of four.
2   One bucket of ten tennis balls per group.
3   One student serves. One student hands the server the tennis balls. Two students collect balls.
4   Assessors: One ensures serves are competed from the legal area with the correct action. One records serves as either successful or unsuccessful.

Skill assessment: rally test

The Modified Kemp-Vincent Rally Test

A modified version of the Kemp-Vincent Rally test, 1968, (cited in Strand & Wilson, 1992) will be used to test student's rally competence. The test is modified to better suit the developmental stage of the players. The modifications are that instead of having two balls at each end of the court the students will start with 6 balls at their end of the court. Secondly, the students undertake the rally test with a semi-professional tennis instructor and thirdly, the ball must be played by the players standing behind the service line. When repeating the test the students will work with the same rally coach.

Management:

In groups of 4

1   Six balls are paced on the end of the court.
2   One minute warm-up of hitting with the coach.
3   Rally for three minutes.
4   Student calls number of shots. Scorer records number of shots and student errors.
NB.   See next page for other test protocols
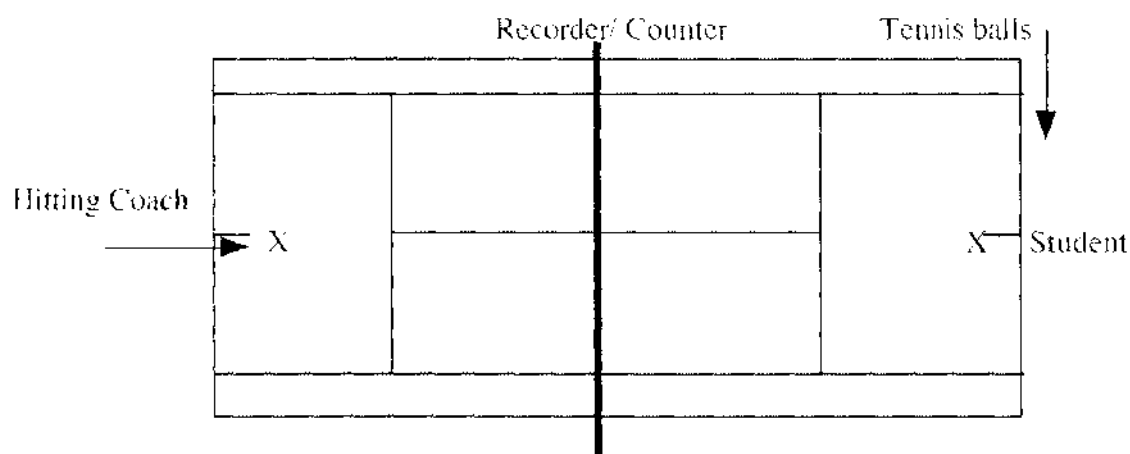
Kemp - Vincent Rally test

Note the modifications related to the number of balls used in the test, the use of a hitting coach and that the ball had to be played from behind the service line.

Kemp-Vincent Rally Test (Kemp & Vincent, 1968)

Purpose. To evaluate rallying ability in tennis under game conditions.

Validity and Reliability. Concurrent validity coefficients of .84 and .93 for beginners and intermediate players, respectively, were computed by comparing the rank difference between this test and the rank in a round-robin tournament. The test-retest approach reported reliability coefficients of .86 and .90 for beginners and intermediate players, respectively.

Age Level and Sex. Originally conducted with college students. Appropriate for junior high school and senior high school students.

Personnel. One person is needed to count the total number of strokes and two are needed to count each player's errors.

Equipment. Tennis racquets, tennis balls, a stop watch, score cards or recording sheets, and pencils.

Space. Regulation-sized tennis courts.

Test Item. Rallying a tennis ball.

Preparation. The only preparation involves score cards.

Directions. Two students of similar ability assume ready positions on opposite sides of the net on a singles tennis court. Each player has two tennis balls on his or her side of the court. On the "go" signal, one student bounces a ball behind the baseline and with a courtesy stroke puts the ball into play. The two students rally the ball as long as possible. When a ball is hit into the net or out of bounds, either player starts another ball into play with a courtesy stroke from behind the baseline. Any type of stroke may be used during a rally. If all four balls are hit out of play, the testing students are responsible for retrieving them to continue the test. One 3-minute timed trial is allowed.

Errors are recorded if a student fails to get the ball over the net on a courtesy stroke from behind the baseline; fails to get the ball over the net during a rally; fails to start a new ball from behind the baseline; fails to keep the ball within the singles court area; or fails to hit the ball before a second bounce.

Balls landing on boundary lines on a first bounce are good. Balls hitting the top of the net and going over into the opposite court are good and in play. Players may play a ball on which their test partner has committed an error if it is believed advantageous to keep the ball in play. A 1-minute warm-up period is permitted before the test.

Scoring. For a 3-minute rally, the combined number of hits for the two players are counted, including any erroneous hits. The courtesy stroke to put a ball in play counts as a hit. Errors committed by each player are counted. From the combined number of hits for both players, each individual player subtracts the number of his or her errors to arrive at a final rally score.

Norms. Not available.

Strand, B.N., & Wilson, R. (1993). *Assessing Sport Skills*. Human Kinetics, Champaign Il.

Treatment A: Tennis lesson instructions using a traditional skills based format.

Tennis instruction:

Lesson plans for the traditional skills based lessons.

Learning intentions:

At the completion of the instructional period students will have:

1.   Received introductory instruction and started to achieve basic competence in the tennis forehand, backhand and serve.

2.   Sufficient basic competence to sustain a co-operative rally in tennis.

3.   Sufficient basic competence in tennis to enable them to enjoy playing tennis.

Specific learning outcomes:

At the completion of the lessons it is hoped that students will be-able to:

1.   Play a tennis forehand.
2.   Play a tennis backhand.
3.   Perform a tennis serve using the overhead tennis serving action.

Equipment:

1.   Six tennis courts
2.   One tennis racquet per student
3.   100 tennis balls.

Lesson Sequence

Lessons 1 & 2   Forehand
Lessons 3 & 4   Backhand
Lesson 5   Serving

Lesson format:

Introduction: Following a discussion with the coaches it was decided with the traditional skills

based approach the following guidelines would be used. The set lesson sequence would be followed but there would not be specific time breakdowns per component within a lesson. Instead, the coaches, based on their experience, would decide when to introduce different activities into the programme.

Lesson structure: 50 minutes approximately for each lesson

The basic format to cover:

1. Warm up - tennis related activities.
2. Introduction to the days lesson.
3. First skill demonstration and instruction.
4. Practice.

Aspects of this basic format would be repeated during the lesson

5. Minor tennis game.
6. Warm down and debrief.

Notes:

1. Time allocation: The amount of time in Treatment A on any phase of instruction is at the discretion of the coach. However instruction must always involve the whole class. For example, when demonstrating the forehand the whole class must be brought in to see the demonstration, regardless of their progress or ability. The whole class would then be sent off to practice after the demonstration.

The coach would then supervise practice and, where applicable, make individual adjustments to student technique. However, whenever a new aspect of the skill was to be taught the whole class must receive the instruction as a group. The coach also decides on warm-up and down activities and any minor games. The coach monitors the pace of the lessons, number of students per court and distribution of equipment.

2. Feedback. The coach may provide whatever feedback they feel is appropriate.

3. Goal Setting. The coach **MUST NOT** encourage students to set individual goals. They may tell students to 'do their best' but not to set goals.

4. Tennis stroke mechanics. These should conform to what is acceptable practice as sanctioned by the New Zealand Professional Tennis Coaches Association.

5. Lesson sequence. This is to follow two lessons on the forehand, two on the back hand and one on the serve.

6. Extension Activities. Should a student progress very rapidly the coach may assign extension activities or encourage the student to work in a co-operative reciprocal learning manner with other students in the class.

7. Ultimate Outcome: The objective for the students, through the development of technically sound shots, is to be-able to start a game of tennis without penalty, 50% serving ratio, and sustain a co-operative rally.

Treatment B: Tennis lesson instructions using a personalised mastery learning programme, incorporating individualised goal setting.

Tennis Instruction

Lesson plans for personalised mastery learning instruction incorporating individual goal setting.

Learning intentions:

At the completion of the instructional period students will have:

1.   Received introductory instruction and started to achieve basic competence in the forehand, backhand tennis strokes and the tennis serve.

2.   Sufficient basic competence to sustain a co-operative rally in tennis.

3.   Sufficient basic competence in tennis to enable them to enjoy playing tennis.

Specific learning outcomes:

At the completion of the lessons it is hoped that students will be-able to:

1.   Play a tennis forehand
2.   Play a tennis backhand
3.   Perform a tennis serve using the overhead tennis serving action.

Equipment:

1.   Six tennis courts
2.   One tennis racquet per student
3.   100 tennis balls.

Lesson Sequence

Lessons 1 & 2   Forehand
Lessons 3 & 4   Backhand
Lesson 5   Serving

Lesson format and structure

Format: Introduction:

Students receive instruction in the concept and structure of mastery learning and how they need to mastery one Level before they move to the next. It will then be explained to them that the successful completion of one mastery Level will provide them with the basic competence to progress to the next. The various mastery levels will be explained and demonstrated to them. Next, the students will have the concept of goal setting explained. They will be told that setting challenging but achievable goals generally helps improve performance. A challenging goal is one that they think would be difficult to achieve but one they thought with hard work was achievable. They will be told that the seven different mastery levels for the forehand and backhand should be seen as goal levels. They will be shown the column on the class role that will indicate their goal level. They will then be asked to set a goals for the achievement of levels 1 - 7 in the forehand and backhand tennis strokes.

Lesson structure: approximately 50 minutes for each lesson.

1. Students will work in threes and be allocated half a court per three students.

2. Administration sheets: The students will be shown the administration sheets that they will take with them to the courts. These have instructions and diagrams of the skill requirements for each level of mastery. They will be told that the coach will assess Level 1 and Levels 6 and 7. Levels 2 - 5 they will assess. When a student passes a Level the other student should tick and sign the Level on the administration sheet. For serving, the coach assess Levels 1 and 6 and the students Levels 2 - 5 (Note only 6 levels on the serve.)

3. Instruction: The coach teaches everyone Level 1 which is completed without a ball. The coach shows the stroke in its whole format. The students replicate the stroke. If the coach is satisfied with the basic mechanics of grip etc. the students then move to the courts in 3's and commence their work. They all work at their own pace.

It is the coaches responsibility to ensure that the grip and stroke mechanics are correct. Students may receive instruction individually or in small groups if re-teaching is required.

4 Mastery levels and individual time on task. The mastery levels are set at 60%. A student must score 6/10 twice at a Level before moving to the next Level in the sequence. Students always receive 10 'balls' to try and achieve the mastery level. Because one is required to reach the standard twice before progressing, players can either receive their 10 feeds of tennis balls in succession or by rotating through after the other partners have had their turns.(The researcher favours the rotation method as it provides for a more effortful distributed practice format and it keeps the partners involved in the activity.)

5. Number of levels operating in a group. Up until Levels 6 and 7 a full range of levels can be accommodated with a single group. As long as partners can deliver a ball by throwing it to the correct position then all students should be-able to progress at their own speed. However, should the coach feel it appropriate, groups could be adjusted along mastery-levels e.g., all the students on Level 4 working together in groups of three. Players at Levels 6 & 7 should be grouped together.

For example: *"I would like all students working on Levels 2 and 3 to come to me on this court. Could all students on Levels four and five move to these courts and get into groups of three and continue with the programme."*

6. Sequence of lessons. The sequence will be two lesson on the forehand, two on the backhand and one on the serve.

7. Coach assistance to reach the top levels of mastery. If the coach notices that a student appears not to be mastering level 6 or 7 because their partner cannot yet return the ball, the coach can act as the rally partner.

8. Extension Activities. Should a student move through the criteria for mastery of each level quickly the coach can set extension activities e.g. the volley, encourage more vigourous shots or enhanced technique. The student could also undertake reciprocal teaching with other students in a peer assistant role.

8. Ultimate Outcome. The object is for all students to achieve a level of mastery that will enable them to start a game of tennis without penalty, serve at a 50% success ratio, and then sustain a co-operative rally.

Mastery Standards for Tennis																	Goal	Final
Forehand																	Level	Level
Tennis Professionals																		
Name	L 1	Sign	L 2	Sign	L 3	Sign	L 4	Sign	L 5	Sign	L 6	Coach	L 7	Coach		

Mastery Goal Setting Standards for Tennis Activity

Mastery Sequence for Foreband (FH)

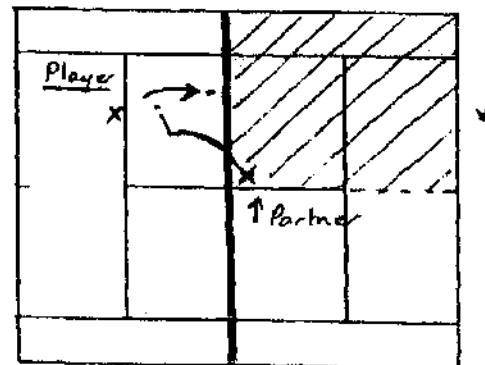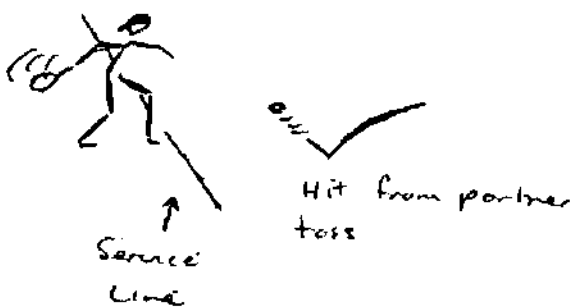| Task #	Task	Goal	Criterion
0	Lect./Demo from Coach	The ready position The Forehand (FH) Drive	None
1.	FH ready position FH Grip FH Footwork From ready / mirror shot	On call from the coach On call from the coach On call from the coach On call from coach	Correct Correct Correct Correct
2.	Stand on service line Own bounce. Hit FH	Over net into legal area	6/10 2x Sets in a row

Collecting balls
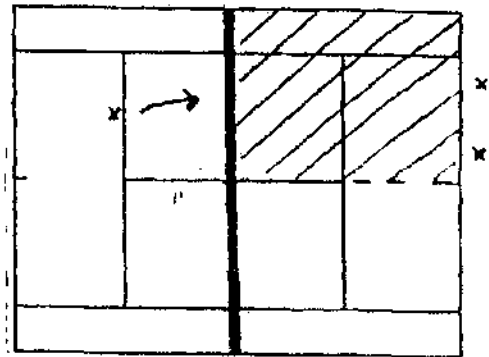
Service line

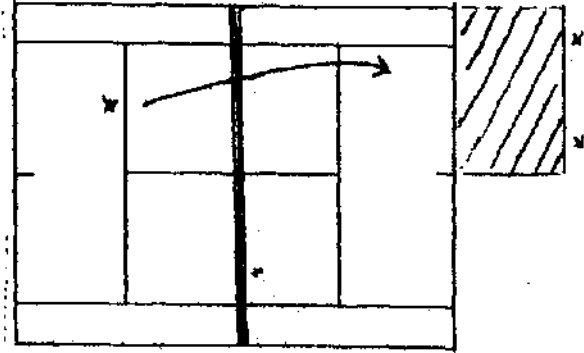| 3. | Stand on service line
Partner toss - Hit FH | Over net into legal area | 6/10
2x Sets in a row |

Hit from partner toss

Service Line

Collecting balls

Player

↑ Partner

152

4.   Stand on service line   Over net into legal area   6/10
          Own bounce. Hit FH   behind base line but not   2x Sets in a row   Fence
                                         into boundary fence

Service Line

5.   Stand on service line   Over net into legal area   6/10
          Partner toss. Hit FH   behind base line but not   2x Sets in a row   Fence
                                         into boundary fence

Hit from partner toss

Service Line

6.   Forehand cooperative   All shots into the legal area   2x 6 consecutive
          rally with partner. 1 or   hits in a row
          2 bounces of the ball
          between hits is
          acceptable

Net

1 or 2 bounces is okay

Hit to help each other

7. Forehand cooperative   All shots into the legal area   2x 6 consecutive
    rally with partner. Only   Players stand behind   hits in a row
    1 bounce of the ball   service area
    allowed

Stand here   Stand here

Hit to help
each other

Only one
bounce

Mastery Standards for Tennis															Goal	Final
Backhand															Level	Level
Tennis Professionals																
Name	L 1	Sign	L 2	Sign	L 3	Sign	L 4	Sign	L 5	Sign	L 6	Coach	L 7	Coach		

Mastery Goal Setting Standards for Tennis Activity

Mastery Sequence for Backhand (BH)

Task #	Task	Goal	Criterion
0	Lect./Demo from Coach	The ready position The Backhand (BH) Drive	None
1.	BH ready position BH Grip BH Footwork From ready / mirror shot	On call from the coach On call from the coach On call from the coach On call from coach	Correct Correct Correct Correct
2.	Stand on service line On bounce. Partner drops ball. Hit BH	Over net into legal area	6/10 2x Sets in a row

Partner drop   Collecting
                                balls

| 3. | Stand on service line
Partner toss - Hit BH | Over net into legal area | 6/10
2x Sets in a row |

Partner
Toss

156

4. Stand on service line   Over net into legal area   6/10
   On bounce. Partner   over the base line   2x Sets in a row
   drops the ball. Hit BH   but not into boundary fence

Partner
Drops ball

Service Line

5. Stand on service line   Over net into legal area   6/10
   Partner toss. Hit BH   over the base line but   2x Sets in a row
                    not into the boundary fence

Partner
Toss

Service Line

6. Forehand & Backhand   All shots into the legal area   2x 6 consecutive
   cooperative rally with   hits in a row. Each
   partner. One or two   player must hit one
   bounces acceptable   backhand in their
                                              3 hits

1 or 2 bounces
Okay

Hit to help
each other

Must hit a backhand.

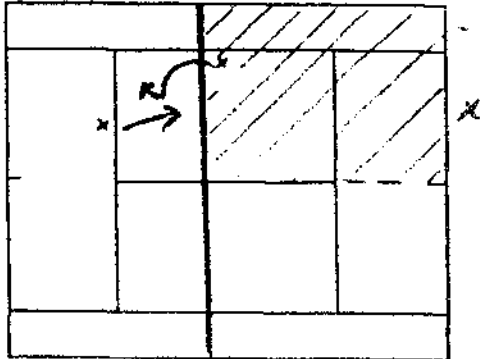| 7 | Forehand & backhand cooperative rally with partner. Only 1 bounce of the ball allowed | All shots into the legal area Players stand behind service area | 2x 6 consecutive hits in a row. each player must hit one backhand in their 3 hits |
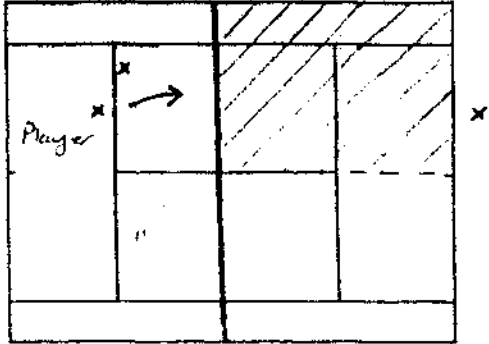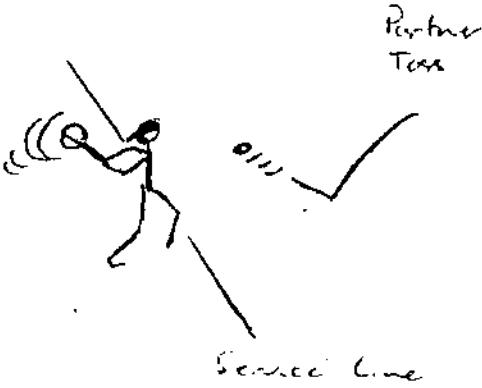
Hit from here

Hit to help each other

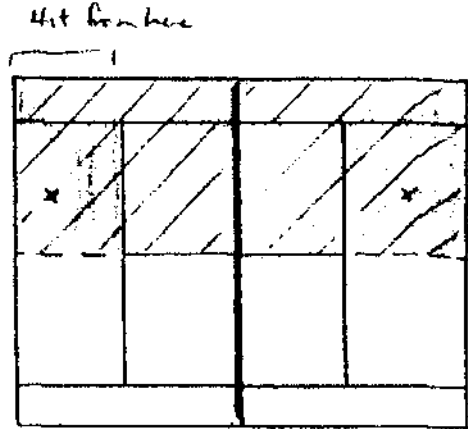|	A	B	C	D	E	F	G	H	I	J	K	L
1	Mastery Standards for Tennis											
2	Serve										Sign	Final
3	Name	L1	Sign	L2	Sign	L3	Sign	L4	Sign	L5	Coach	Level
4												
5												
6												
7												
8												
9												
10												
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12												
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Mastery Goal Setting Standards for Tennis Activity

Mastery Sequence for Serve (S)

Task #	Task	Goal	Criterion
0	Lect./Demo from Coach	The ready position The Serve	None
1.	S ready position S Grip S Toss From ready / mirror shot From ready hit a ball using the service action	On call from the coach On call from the coach On call from the coach On call from the coach On call from the coach	Correct Correct Correct Correct Successful
2.	Stand on service line Toss and serve	Over net into designated area	6/10 2x Sets in a row
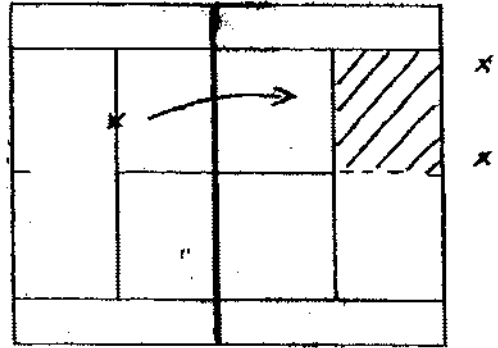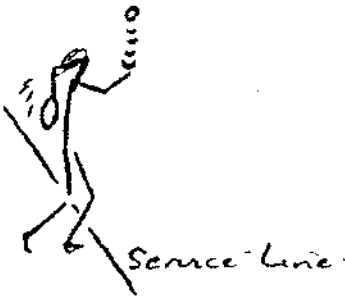
Service Line

| 3. | Stand two steps
back from service line
Toss and serve | Over net into back
designated area | 6/10
2x Sets in a row |
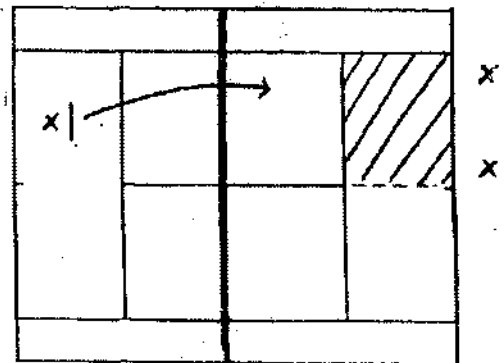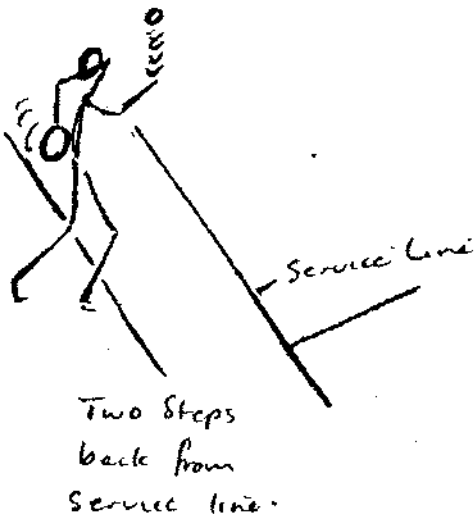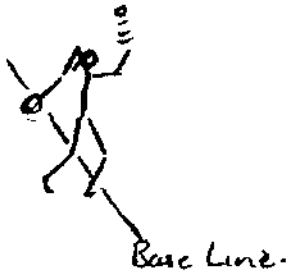
Service Line

Two Steps
back from
Service line.

160

4. Stand on base line
Toss and serve

Over net into legal service area

6/10
2x Sets in a row

Calls shots
in or out

X

X
Collect
balls.

Base Line.

---

5. Stand on base line
Toss and serve on
diagonal

Over net into legal service area

6/10
2x Sets in a row

Calls shots
in or out

X
Collect
Balls

Centre
Mark.

Base line

---
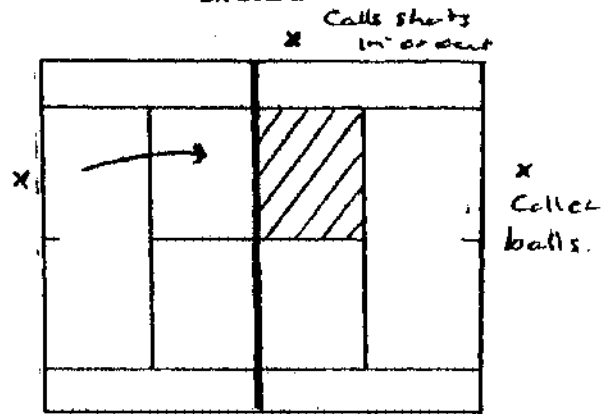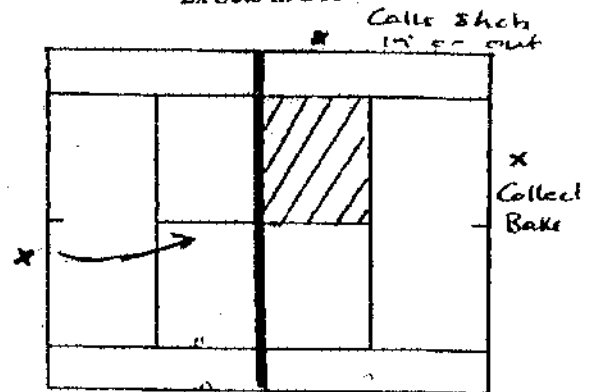
6. Stand on base line
Toss and serve on
diagonal

Over net into legal service area
serving to alternative service boxes

5/10
2x Sets in a row

Collect
balls

X

X

Change
sides after
two serves

X

X
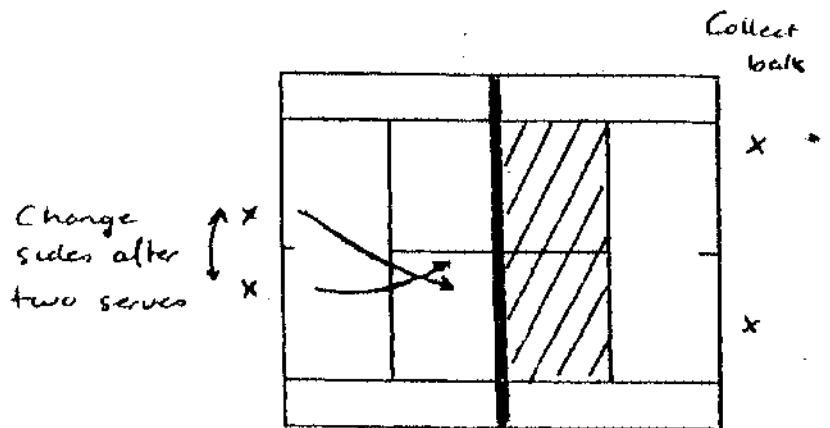
Student pre-programme questionnaire.

Name _____

School _____

Year group   7 / 8

Answer each question by putting a circle around either **Yes or No**

1. Do you play tennis at a club as either a social or competitive player?   Yes / No

    If **Yes** state what level of tennis you play: social, competitive or age
    group representative.

2. Has any one in your family played tennis for a tennis club at a   Yes / No
    regular competitive or social level? For example parents, brother,
    sisters?

3. Have you ever had a tennis lesson?   Yes / No

4. Have you ever played tennis on a full size tennis court?   Yes / No

5. Do you play padder-tennis at school?   Yes / No

6. Do you know the rules of tennis?   Yes / No

7. Have you seen tennis played in real life?   Yes / No

8. Have you seen tennis played on television?   Yes / No

9. Do you play any other net or racquet game e.g. badminton or squash?   Yes / No

Assessment recording sheet for the serve and rally tests.

Assessment Sheet

Name _____

School _____

Date _____

Serving:

Two sets of ten serves. Serve two balls to the left service court followed by two to the right. Continue until you have served 10 balls. A let serve does not count and should be retaken

Serves: Circle serves. A cross in the circle indicates an unsuccessful serve.   0 = successful

x = unsuccessful

Trial #1

1   2   3   4   5   6   7   8   9   10   **/10**

Trial # 2

1   2   3   4   5   6   7   8   9   10   **/10**

Co-operative Rally

1. Undertake a 1 minute hitting warm-up with the rally coach

2. Place 6 balls on the base line at your end of the court.

3. Rally for three minutes.

4. Student and coach retrieve balls after 6 are used.

5. The student always starts the rally regardless of who makes an error.

6. The total number of hits over the net into the legal area defined by the full court and played behind the service box line count as legitimate hits.

7. The student's score equals the total number of shots minus their errors. Successful shots are noted as a tick and errors as a cross.

1	2	3	4	5	6	7	8	9	10	11	12	13
14	15	16	17	18	19	20	21	22	23	24	25	26
27	28	29	30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49	50	51	52
53	54	55	56	57	58	59	60	61	62	63	64	65
66	67	68	69	70	71	72	73	74	75	76	77	78
79	80	81	82	83	84	85	86	87	88	89	90	91
92	93	94	95	96	97	98	99	100	101	102	103	104
105	106	107	108	109	110	111	112	113	114	115	116	117
118	119	120	121	122	123	124	125	126	127	128	129	130

# of hits   minus # of errors   =   Score

Serving:

1 Divide students into groups of four.
2 One bucket of 10 tennis balls
3. One student serves. One student hands students the balls
4 Two other students collect balls.
5. Assessors: One assessor ensures serves are completed from legal area. The other student records the scores.

Rally

In groups of 4

1. 6 balls placed at one end of the court
2. Warm up
3. Rally for three minutes
4. Student calls number of shots. Scorer records shots and notes errors

Mastery Standards for Tennis																Goal	Final
Forehand																	
Tennis Professionals																Level	Level
Name	L 1	Sign	L 2	Sign	L 3	Sign	L 4	Sign	L 5	Sign	L 6	Coach	L 7	Coach			

Designing the instructional programme

The instructional programme was designed by the author and the consultant coach Mr. John Salisbury.

1. Lesson sequence

Although the two teaching interventions are quite different it was decided to try and wherever possible to keep the sequence of the lessons the same. In both the traditional skills based intervention, (Treatment A) and the personalised mastery incorporating individualised goal setting, (PML/GS) - (Treatment B) period of instruction, the same sub-routines of instruction would be taught.

For the serve these consisted of:

1. Stance: Ready position.[166]

2. Racquet grip

3. Ball toss and back swing

4. Overhead strike of the ball and follow through.

For the forehand and backhand shots the sequence of sub-routines would be:

1. Stance: 'Ready position.'

2. Racquet grip: Single handed forehand and double handed backhand.

3. Racquet swing and footwork.

4. Forward swing sequence, striking the ball and follow through to the recovery (ready) position.

To fit the experimental design structure, the ten lessons followed, in both Treatment A and B interventions, a sequence of two lessons on the forehand, two lessons on the backhand and one on the serve.

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[166] The ready position is a generic position recognised by tennis coaches as being that the player, through their stance and posture, demonstrates that they are ready to play tennis.

Treatment A Phase: Traditional skill based learning

1. Introduction

The students were introduced to the coach. It was explained that they would have two tennis lessons on the forehand shot, two on the backhand and one on the serve. They were made familiar with the management and routines for the lessons.

2 Lesson sequence

In the non-mastery phase the lesson plans developed required the coach to follow the following lesson sequence:

1. Warm up.
2. Introduction of the skill to be taught.
3. Skill demonstration and practice.
4. Minor game or games.
5. Warm down.

In a general sense, the coach was required to provide instruction to meet the stated learning outcomes related to serving and playing forehand and backhand ground strokes in tennis. Within the allocated time, the pace of the lessons and the amount of time to be spent on each phase of instruction was dictated by the coach. Aspects of class management, for example, student numbers to combine for any group work, the numbers of students per court, the allocation of equipment and, the use of racquets and tennis balls, were also decided by the coach. However, the amount of equipment and the number of courts available, were held as constant variables in both treatment phases of the study.

The coach was directed that instruction must include the whole class. For example, when demonstrating the forehand the whole class must be brought in to see the demonstration regardless of individual student tennis ability. When supervising practice it was acceptable to make individual player adjustments but, whenever a new skill or drill was to be taught, the whole class must receive the instruction.

3 Feedback

Feedback was largely at the discretion of the coach. In the Treatment A phase of the study, the coach was specifically asked not to encourage students to set individual performance goals. 'Do your best' comments were acceptable responses and enjoiners for motivation, but not specific performance goals. The forehand and backhand techniques, service grip and stroke action conformed to what was examinable by the New Zealand Professional Tennis Coaches Association standards. In providing prescriptive feedback on the mechanics of these strokes, the coach was encouraged to follow their normal feedback practice. It was also decided that should a student progress quickly, the coach could either set extension activities, e.g., volley, or encourage the student to work in a peer assistant role with fellow class mates.

4 Mastery Learning protocols

Ashy & Lee (1984) established the following conditions as necessary criteria for motor-skill instruction to conform to mastery learning protocols namely:

- movement content identified, must be sequenced into small learning units;
- performance objectives at varying levels of proficiency must be stated;
- prerequisite competencies must be established;
- content must be sequenced in a logical, hierarchical fashion;
- feedback must be provided by progress tests designed to determine if students have mastered each task;
- remedial activities or alternative learning corrections must be provided;
- summative tests must be employed.

With reference to an earlier work by Metzler (1986), the researcher and tennis consultant undertook a task analysis of the concepts and motor-skills to be taught, identifying and sequencing the skills so that each movement built upon the previous one and, in turn, served as a prerequisite for the subsequent skill. Design focused on the concept that mastery of a skill in the hierarchy was akin to a closure point. It then required a forward movement from the student to a more complex skill in the hierarchy.

5   Treatment B phase: PML/GS

As previously stated, the lessons in the Treatment B mastery phase were to follow the same sequence of two forehand, two backhand and one service lesson, as delivered in Treatment A. The nature of the mastery learning format required tightly structured lessons. It also required that the pace of the lessons would be student and not coach driven.

5.1   Introduction to instruction[167]

In the introduction to the Treatment B segment of instruction, the students were shown the performance criteria for each mastery level (See Appendix G). In addition to verbal instruction, students received diagrams of each level's activity. They were made familiar with the management of the lessons so that they would know what to do after they mastered a particular level. At Level 1, they were assessed by the coach. At Levels 2 - 5 assessment was carried out by their peers in their group. Assessment at levels 6 and 7 were also undertaken by the coach.
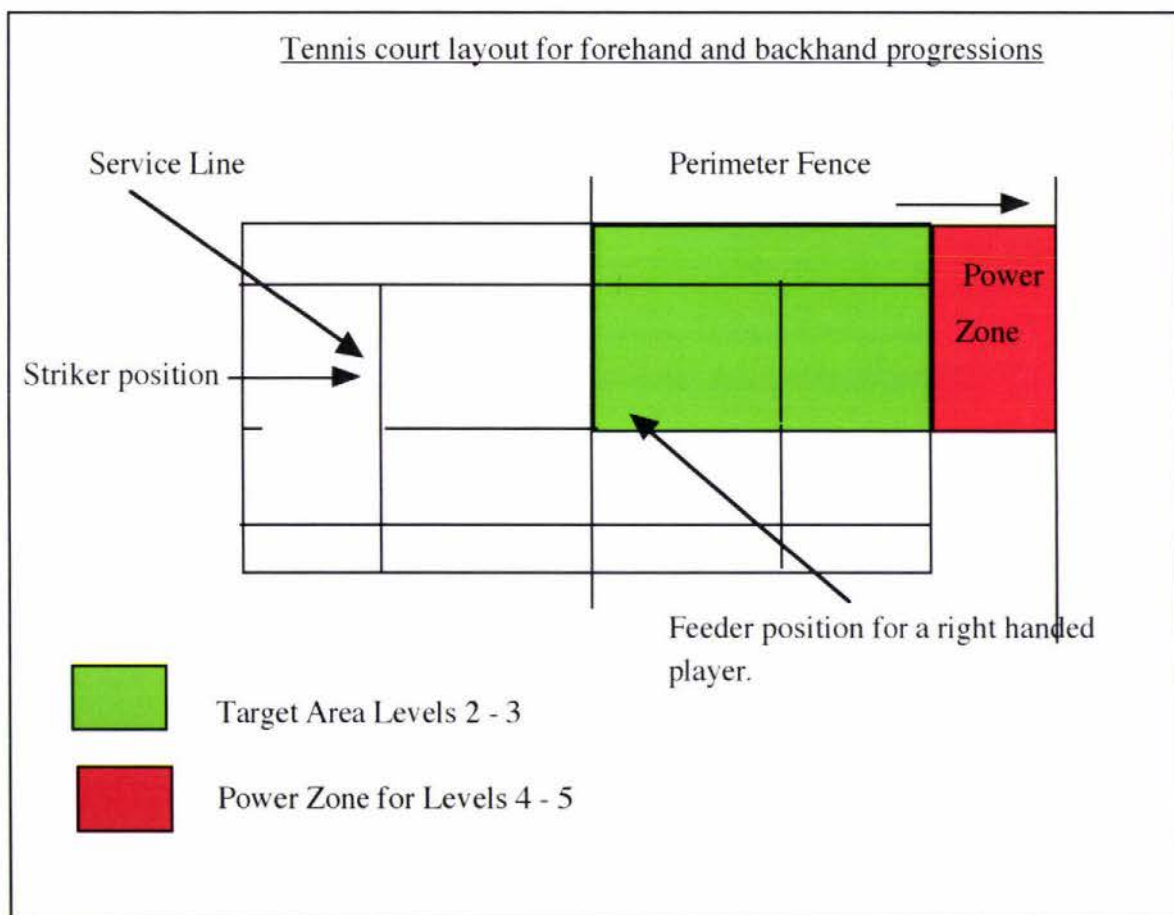
5.2   Forehand

The sequence started with a demonstration from the coach of the forehand ground stroke in a whole-skill format. Students were then shown the sub-routines of the movement, starting with the basic stance - taught as the ready position, then the grip, footwork, racquet swing, towards the ball and follow through to recovery position i.e. back to the basic stance. Level 1 mastery required students to demonstrate this sequence, without the use of a ball, on call from the coach. Only at this level was instruction taught, practised and assessed as a whole class activity. Individual students who did not demonstrate correct technique (mastery), received further remedial instruction.

Mastery levels 2 - 5, working from closed to open skill environments required variations of an own bounce and hit routine, through to a hit, after a partner feed i.e., the partner tossed / threw

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[167] The use of an introductory lesson to the whole class to establish a starting point or for motivation purposes conforms to the structure outlined in the Keller (1968) model of personalised mastery learning. Keller suggested that such practices should be used to motivate or act as rewards for reaching a standard of competence. But that it should not be the regular form of instruction. Keller stated that students required their own instructions and a teaching structure that allowed them to progress at their own rate. The structure adopted within this treatment phase accurately reflected those protocols.

the ball to them over the tennis net and into a designated area. In order to get some accuracy from the partner throws/feeds students were given targets to throw the ball at so that the resulting bounce would be reasonably consistent for the striker. Students received 10 consecutive feeds of tennis balls. Given the novice status of the students in this programme, this blocked and constant practice structure is considered appropriate (cf., Schmidt & Wrisberg, 2000). Schmidt and Wrisberg contend that this behaviourist type practice structure is likely to build new, basic motor programmes, quicker with learners classified at the verbal-cognitive stage (beginners), than more constructivist structures, for example, random learning, which they suggest are better suited to learners at the associative or autonomous stages of learning.

Tennis court layout for forehand and backhand progressions

Service Line

Perimeter Fence

Power Zone

Striker position

Feeder position for a right handed player.

Target Area Levels 2 - 3

Power Zone for Levels 4 - 5

At mastery levels 2 - 5, the on court hitting position was also modified from 'normal' tennis in that the players attempted to hit the ball over the net from a position on the service line (see striker position above). This closeness to the net was designed to have the effect of reducing the effort required to hit a ball over the net compared with a shot struck from the baseline. It also reduced the requirement for a top spun shot, a tennis technique which imparts downward force

on a ball and enables a firm shot to still drop into the legal playing area. In addition, the closeness to the net also allowed students to throw/feed the ball reasonably accurately and with little effort to the striker, so the player experienced the sensation of hitting a ball delivered from behind the net. In adopting the modified receiving position it was also thought that students might find it motivational to reasonably consistently see the results of their hits clear the net, which is not usually the case for beginners in tennis if they have to hit from the baseline. It was also noted that coaches of tennis usually brought players closer to the net when feeding them balls in beginner tennis instruction.

5.3   Double-handed backhand

In the pilot stages of the task development it was discovered that it was very difficult for a beginner player to hit a double-handed backhand using the correct grip off an own bounce. In order to keep the practice and mastery of the early levels at the closed end of the skill environment, the own bounce was modified to have a partner stand on the backhand side of the player about to hit the ball and, from a fully extended arm position above the head, release/drop the ball to a bounce. The striker, already with two hands on the racquet, could then hit the ball off the first or second bounce.

5.4   Mastery Levels 4 and 5: the power-zone

At mastery Levels 4 and 5, in both the forehand and backhand shots, to encourage a full and fast racquet swing, while maintaining students hitting from the service line with the inherent advantages just outlined, a 'power zone' was introduced. The power-zone (see diagram previous page) was the area immediately beyond the opposite baseline. The ball now had to be land in this zone while also not hitting the perimeter fence of the courts on the full. The distance from service line to base line equates, in tennis terms, to a 'good length' ball hit from the base line of a tennis court. As such it requires speed and accuracy in the stroke and some top spin because simply slogging or swiping at the ball merely sends it crashing into the perimeter fence and it is not then counted as a legal shot. In this way the power-zone also served as a check point on technique. The use of the term power-zone was also thought to provide a phrase which might prove motivational to young students i.e., to play in the 'power-zone,' as well as conjuring up images of a powerful shot and consequently encouraging a forceful swing.

Mastery Levels 6 and 7

At mastery levels 6 and 7 players moved to a co-operative rally. Players were encouraged to hit to each other from the base line but, as a minimum requirement, from beyond the service line. At Level 6, in an effort to encourage players to stay near their baseline, a legal hit was allowed to include a double bounce. At Level 7 the usual single bounce of the ball on one's side of the net was required.

6 Enrichment and Remedial activities

6.1 Enrichment

As soon as players completed mastery of Level 7 they were asked to play co-operative or competitive rally games and to set goals for non-stop rallies from the baseline.

6.2 Remedial [168]

Players not achieving the mastery level received additional help from the coach.
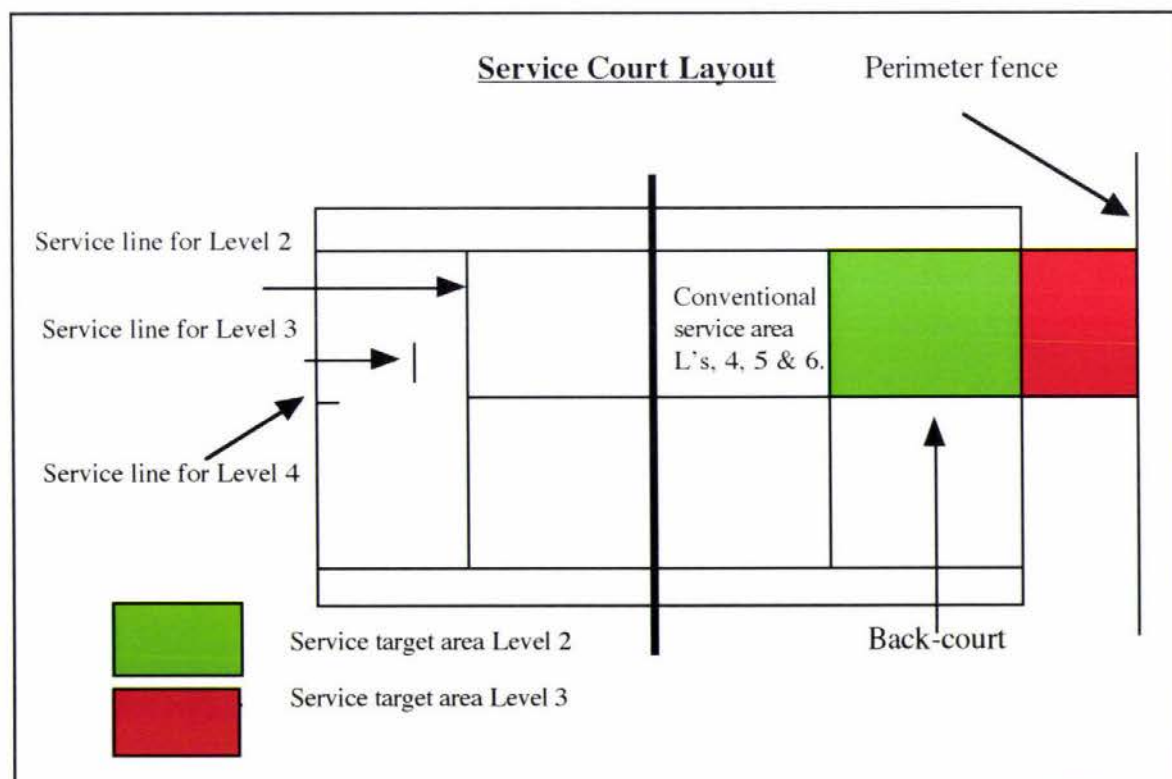
7 The Serve

7.1 Lesson Sequence

In the introduction to this segment of Treatment B the students were shown the progressions through all the levels. They were made familiar with the management of the lesson so that they would know what to do after they mastered a particular level. At Level 1, they were assessed by the coach. At Levels 2 - 4 assessment was carried out by their peers in their group. Assessment at Levels 5 and 6 was also undertaken by the coach.

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[168] The use of remedial activities and consequent additional time allocated to the experimental over control groups was a major criticism of Slavin's (1987, 1990) regarding the mastery learning studies carried out by students of Bloom (1984a, 1984b). Remedial activities are almost a natural consequence of mastery learning and as such needed to be included in the design of this study. To avoid the criticisms made by Slavin, no additional time was allocated to the mastery treatment intervention for remedial instruction.

For the serve, six levels of mastery progressions were developed. As with the forehand and backhand shots, the sequences started with a demonstration of the whole skill from the coach. Students were then shown the subroutines of the movement, starting from the basic stance, (ready position - to reinforce terminology), grip, ball toss and back-swing in unison, the forward motion of the stroke to hit the ball, including follow through to recovery position. At Level 1, students had to demonstrate mastery of this sequence of movements on call from the coach. At this level they did not have to hit the ball to any particular target area. For Level 1, and only at this stage, this instruction was delivered, then practised and assessed as a whole class activity. Individual students who did not demonstrate the correct sequence of strokes, received further remedial instruction.

At Levels 2 and 3, the on-court serving position was modified from the normal tennis serving position. At Level 2, the serve was delivered from the service line, over the net, to the area beyond the opposite service line, known, in tennis, as the back-court. At level 3, it was delivered, two steps back from the service line from a mark taped onto the court. The target area was outside of the court, already known to the students as the power-zone.

Service Court Layout

Perimeter fence

Service line for Level 2

Service line for Level 3

Conventional service area L's, 4, 5 & 6.

Service line for Level 4

Service target area Level 2

Back-court

Service target area Level 3

The Level 3 adjustment was calculated to require a successful serve to be of sufficient force to equate to a 'good-length' serve if hit from the conventional serving position. As with the forehand and backhand shots, these modifications were done to reduce the effective height of the net. Similarly, it was thought that students might find it motivational to reasonably consistently see their serves clear the net. At Level 4, players moved back and served from behind the baseline into the conventional service areas.

7.2   Principle of Specificity of Learning

At Levels 2 - 4 players served straight ahead rather than the conventional diagonal across court serve. They were also exposed to a constant practice format of repetitive serves at the same variable. Of course this is not the nature of serving in a tennis match and is contrary to the principle of specificity of learning. However, at this stage of the students' learning, it was felt that the development of a smooth and accurate motor programme, that saw the student consistently strike the ball accurately into a designated area should be the main learning outcome. Consultant advice suggested that the straight serve was easier than the diagonal serve hence, another reason for the adoption of the practice format at his progression of the skill hierarchy.

Practice, as with the forehand and backhand structure, took the form of 10 consecutive trials (serves). Research (c.f., Schmidt & Wrisberg, 2000), that suggests this type of constant, blocked practice produces high levels of initial in-practice success would, it was hoped, prove motivational to the students thus encouraging them to keep practising the activity. One also had to keep in mind the relative amount of time a student would spend at these initial stages of mastery. It was anticipated (correctly) that it would be so short that the benefits of this structure outweighed a strict adherence to replicating the specifics of the tennis serve conditions found in a match.

At mastery Level 5, students served diagonally from the baseline but still only into one side of the court. This was done to further reinforce the underlying focus for students learning to serve of developing a kinaesthetic awareness of both the serving action and distance the ball had to be sent to achieve a legal serve. The final level, Level 6, required alternating serves to both sides of the court in the manner witnessed in a tennis match.

8   Mastery Levels

As almost all players in the study were in the beginner, verbal cognitive category, the mastery level was established at 60%, 6/10 shots, with the requirement that advancement from one level to the next required a student to achieve that score twice in succession. This differs from the Bloom (1976) and other mastery learning models, that have generally set mastery levels at 80% or higher. The decision to establish 60% success as the benchmark for mastery was made for the following reasons.

Mastery learning studies have historically focused on a specific cognitive dimension to learning, e.g., mathematics or spelling (Guskey & Gates, 1986; Kulik,, Kulik, & Bangert-Drowns, 1990). The learning environments for those types of studies allows for a much tighter control of the learning variables than in the open skill learning environment of motor skill performance in a game like tennis. The very nature of tennis equipment, tightly strung racquets and balls with a very high bounce coefficient, makes tennis a very dynamic game. Small errors are greatly compounded over the length of a court and, in the author's experience as a teacher, tennis has been one of the most difficult games in which to instruct students in a physical education context. The researcher and tennis consultant agreed that an 80% mastery level would have been very demotivating for the majority of the students. In support of this position it is worth noting that the Metzler (1986) investigation also adopted a 60% mastery standard for progression between tennis mastery levels.

9   Co-operative Rally

The learning outcomes of being able to serve and upon receiving serve successfully participate in (sustain) a co-operative rally, was based on the nature of the learners, that is, they were beginners or novices to the game of tennis. The co-operative rally, which encourages frequent successive hits, was chosen for beginners because the repetition helps develop a stroke pattern or motor-programme that will eventually improve the novices performance. The practice environment for the sub-skills agreed to in the development phase, are not part of the criterion skill - people don't throw you a ball in tennis, it doesn't always land in the same place and you have to hit the ball inside of the court, but these progressions were designed to move students to the criterion version of the skill i.e., a rally, in a quick, but systematic way. It was felt that once they had got to

mastery Levels 6 & 7 they would be, by definition, associate level learners and ready for the more variable and random practice structures that are the nature of a tennis rally.

10   Feedback - Diagnostic and summative tests

Diagnostic, ongoing and summative tests are part of the intrinsic structure of mastery learning. The transparent hierarchical and incremental progressions of the design of this investigation provided this type of feedback. Working in groups of three, with two being the minimum number, each group, in addition to verbal instructions from the coach, received written documentation of the requirements for each level. These instructions, presented in diagrammatic form, were taken to the courts in clear-file, weatherproof, folders (see Appendix G). The illustrations presented both the whole skill and the progressions of the skill for each mastery level. Students also received sheets on which they were able to record their progress towards mastery of the sub skills and finally, the criterion version of the skill.

Independent of the coach, the material provided knowledge of results and feedback in relation to the assigned standards and the students goals in relation to those standards. In addition, the coach also provided knowledge of performance and prescriptive feedback which, when necessary, included remedial instructions and extension programmes.