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MEASURES OF THE EFFICACY OF A DAILY FIFTEEN
MINUTE FITNESS PROGRAMME FOR INTERMEDIATE
SCHOOL CHILDREN

A thesis presented in partial fulfilment of
the requirements for the degree of Masterate
in Education at Massey University

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ABSTRACT

This study investigates the effects of a physical fitness training programme on the fitness, reading and mathematics performance of intermediate school pupils. The role of physical education in the primary school curriculum, theories of endurance and health-related fitness, as well as the possible relationship of physical fitness to academic achievement, are discussed and a review of previous studies is made.

An experimental group of 29 and a control group of 57 Form 2 boys and girls, aged from 11-13 years, were pre-tested on physical fitness, reading and mathematics performance. For the next six months the control group continued with the school's normal physical education programme while the experimental group underwent a daily, fifteen minute physical fitness programme in which the exercises were kept submaximal and as continuous as possible. Both groups worked on the same reading and mathematics programmes. At the end of six months both groups were post-tested and a Student t-test applied to assess the significance of the difference in progress between the two groups. Since this thesis is designed as a study for teachers, all tests, activities and equipment were drawn from resources that are currently available for use in classrooms.

The results of this study show a significant and generalized trend towards an increase in physical fitness on the part of the experimental group, but not on the part of the control group. In terms of academic achievement, the experimental group show generalized gains in relation to the control group, some of which are large enough to show up as significant on a t-test.

The major conclusions of this study are:

- (1) Physical fitness among intermediate school children does improve as a result of a daily fifteen minute fitness programme.

- (2) Children who are in a superior state of physical fitness perform better in some areas of their academic work.
- (3) Motivation, ideally of an intrinsic nature, is the key to success in physical fitness activities, or for that matter, in any activity.

The results of this study reinforce current theories regarding the importance of physical fitness and motivation and also provide some statistically significant confirmation of the correlation between physical fitness and academic performance.

The educational implications of this study are pointed out and suggestions are made for future studies.

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CHAPTER IINTRODUCTION

The purpose of this thesis is to measure the efficacy of a daily 15 minute fitness programme upon intermediate school pupils in relation to cardiac recovery, reading and mathematics. The interest springs from the traditional yet currently keen concern among educators as to: (a) the role of physical education within the school curriculum, (b) its relationship to other areas of the curriculum, and (c) the community's concern regarding obesity and cardiac disease.

This thesis will find its parameters in the syllabuses and standardized testing procedures currently utilized by our schools. Initial consideration will be given to the role of physical education in the primary school curriculum. The various notions and definitions of physical fitness will then be considered. This will be followed by a study of the influence of physical fitness on both reading and mathematics in primary schools.

In considering the role of physical education in the whole curriculum, Andrews (1976) states that

"physical education must satisfy three important criteria:

1. Is what is done relevant to the needs of individuals living in society now?
2. Is what is done worthwhile, i.e. is it one of those permanent, unchanging aspects of education? (to use Peters' (1966) terminology).
3. Can what is done be organised in such a manner that efficient teaching is possible?"

(p.47 - 49)

The most difficult of the above criteria to answer, because of its philosophic nature, is the second. However, the opening sentence of the 1933 British Syllabus of Physical Training does much to reinforce the status of physical education as a subject when it states:

"The place of the Physical in all true education is something which begins with infancy and goes until the last day of life." (p.1)

The above approach is similarly reflected in the Final Report of the U.N.Conference on "The Role of Physical Education in the Context of Life-Long Education" (1976). Over two decades earlier, a similar theme, the harmonious development of mind and body, had also been outlined in the 1953 New Zealand Primary School Syllabus of Physical Education which began

"All education should be carried on in accord with the essential nature of children, making use of their natural impulses and satisfying their basic needs in ways that will help them to grow well. One of the most outstanding characteristics of children is their delight in movement and it is now realized that, for their healthy growth, they need several hours of vigorous physical activity every day. One of the major purposes of physical education is to provide some of the opportunities necessary for children to satisfy this need; another is to help them to move easily, gracefully, and with economy of effort. But physical education is not limited to the merely physical. The whole trend of modern thought in this field of education is towards using movement as a medium for much wider educational purposes - as a means of social development and creative expression and as an opportunity for the exercise and education of the mind and the emotions as well as the muscles. These wider purposes are in some degree being achieved when, in the quickly-changing physical education period, each child matches his powers against those of others, learns both to lead and follow, to work with his group for a common end, and to admire the success of his competitors; and when, too, he comes to delight in the growing control of his body, to know the satisfaction of controlled and graceful movement, and to feel the joy of new and adventurous achievement." (p.1)

The application of Andrews' first criterion, re relevance to society's current needs, makes the New Zealand syllabus look somewhat outdated. Similarly, his third criterion, re organisation for efficient teaching, is largely ignored in the New Zealand syllabus. The Johnson Report (1977), New Zealand's most significant education document of the decade, supports the above two criticisms in its claim that physical education in New Zealand primary schools is spasmodic and lacking in unified direction.

The syllabus outline of 1953 mentions the contemporary trend of thought towards using movement as a medium for much wider educational purposes. However, the needs of present-day society, a quarter of a century later, appear to emphasize physical fitness as a major medium for optimal growth development, keenness of response to physical and mental stimuli, and avoidance of ill health, especially obesity and cardiac related diseases. This concern has been emphasized by educationalists and medical experts alike in such studies as the French Vanves Experiment (1950-1961), the Medford Boys' Growth Study in Oregon (1955-1965) and more recent studies by Clarke (1967), Blair's Eltham Primary School Study (1977), Fentem's and Basseley's authoritative British report (1978), and the New Zealand Council for Recreation and Sport (1978). Roydhouse, a leading Australasian Surgeon (1973), and Nye, Associate Professor of Medicine at Otago University (1978) provide supporting opinions from the medical profession regarding the critical importance of exercise and health awareness as part of our education system and lifestyle. Beverly Ross (1975), a physical education lecturer at Otago University, indicates that there is a New Zealand school of thought concerning physical fitness which is closely aligned with American, Canadian, British and Scandinavian thinking. In the case of Scandinavia, she makes particular reference to Astrand and Rodahl (1970), leading Swedish and Norwegian authorities in physiology.

While we may acknowledge physical fitness as relevant and worthwhile in terms of Andrews' first two criteria, i.e. relevance and worth, it would appear that we do little to satisfy them, since physical fitness is presently assigned no more than a brief six week block in the options suggested for primary and intermediate physical education yearly plans by the currently used N.Z. Physical Education Handbook entitled "Planning the Programme" (1973), (Ref. Appendices 1 and 2). Having acknowledged the need for physical fitness and having recognized its ongoing nature, subsequent provision for a six week "crash course" once a year appears to be a meagre allotment of time.

The above criticism is not, however, to deny the many other worthwhile aspects of our physical education curriculum, but is merely an attempt to give physical fitness the central, ongoing role in New Zealand schools, as suggested by the above quoted studies.

Stier (1976) considers Physical Education to be "a discipline composed of specific sub-components, each in turn being capable of playing significant and meaningful roles in the total educational process." He regards "knowledge - academic development" as the first of seven broad areas of objectives for physical education, saying "the needs of the mental are inextricably connected with activities of the physical." However Stier does not indicate how they are connected, but goes on to state that physical activities must be considered as "tools" to accomplish a variety of objectives, "must be selected on the basis of their benefits being able to transfer beyond the scope of the physical education programme," and "must be evaluable and judged as to their suitability in terms of their actual contribution to the total and complete development of the child." (pp23-27) Perhaps Stier's mention of a "fitness craze" as a result of the Kraus-Weber Fitness

Tests (1954) will, if given closer consideration, provide a more specific link between the mental and physical than Stier himself appears able to find in his generalizations.

The foregoing discussion provides a basis for this study, viz. to go beyond the broad generalisation of the "healthy body - healthy mind" concept by searching for a clearly identifiable link between academic achievement and one major area of physical education - physical fitness.

Crucial to the above intention is an exploration of the notion of physical fitness and attempts at its definition. Westcott (1976) typifies current world thought in his consideration of physical fitness as being task specific. In doing so he distinguishes two types of fitness

- " 1. Strength fitness, which is a measure of the capacity of a muscle group to exert force against a resistance. This type of fitness can be measured by applying the overload principle.
2. Endurance fitness, also referred to as circulatory-respiratory fitness, which is a measure of the capacity of the heart, lungs, and circulatory system to deliver oxygen to the working cells of the body. In simplest terms, the efficiency of the circulatory-respiratory system determines how much oxygen can be supplied to the working muscles and thus determines how much these muscles can perform. The transporting capacity of the circulatory system can be increased through participation in endurance training programmes, and is largely the result of the following physiological changes:
 - i. Heart becomes more efficient
 - (a) Cardiac output increases
 - (b) Stroke volume increases
 - (c) Heart rate decreases
 - ii. Circulatory system becomes more efficient
 - (a) Vessel size increases
 - (b) Blood volume increases
 - (c) Amount of haemoglobin increases. "

(pp 15-17)

Westcott points out that

"although precise standards for endurance exercises have not been firmly established, most exercise physiologists agree that these beneficial physiological adaptations begin to occur when large muscle activities are performed in accordance with the following training criteria:

1. The intensity of the activity must be sufficient to increase one's heart rate to at least 70 per cent of maximum (approximately 150 heartbeats per minute for secondary school students).
2. The duration of the activity should approach a minimum of 20 minutes.
3. Participation in the activity should not be less than three times weekly."(pp18-19)

Westcott's criteria two and three i.e. duration and regularity, may appear a heavy demand upon teachers in our closely timetabled curriculum when one considered a recent investigation throughout 120 New Zealand state secondary schools by Jones (1977) which revealed that time allocations for physical education diminish increasingly from form three through to form seven. Jones concludes that examination pressure in our educational system may be a major contributing factor to the above state of affairs. Nevertheless, Westcott's second criterion regarding minimal duration of activity may be considerably curtailed yet still remain beneficial when one considers specific studies (refer Chapter II), along with playtime, school sports day and weekend sports activities.

In the past few decades educators, including New Zealanders such as Shaw (1972), have endorsed Clarke's (1967) separation of "fitness" into health-related (physical) fitness and skill-related (motor) fitness which is a similar approach to that taken by Westcott.

Clarke refers to those "motor" elements that underlie sports performance, such as power, speed, agility, balance and coordination. Most of the fitness tests that have appeared in the literature and in the N.Z. Primary School Physical Education Handbooks contain tests largely of this nature. A decade later we find a change of emphasis towards the health-related (physical) type of fitness test, well justified by Matthews (1978).

Health-related fitness is seen by Clarke as involving "those components that are deemed necessary for a robust life and which are instrumental in avoiding heart and circulatory disease". This statement provides support for Andrews' (1976) earlier mentioned first two philosophic criteria of physical education, and appears to outline a more educationally worthwhile concept for a school's physical education programme weightings than does motor fitness. It is thus clearly evident that cardio-respiratory fitness, muscular strength and endurance are agreed upon by researchers as being components of health related fitness. Some physical educators include flexibility in this category because of its importance to good health and the avoidance of injury e.g. Corbin (1974), Johnson (1974), Matthews (1973). Medical personnel often add absence of obesity, or weight control as an important component of health related fitness e.g. de Vries (1974), Cundiff (1975).

Cooper (1968), after carefully examining various sports and fitness programmes from a physician's perspective, has strongly encouraged participation in endurance (fitness) activities. He claims

"Endurance fitness should be your goal. It will assure all the benefits of the training effect, improving not just your muscles, but your lungs, your heart, and your blood vessels. It is the foundation on which all forms of fitness should be built." (p.13)

Cumming (1976), a cardiologist, completely endorses Cooper's point of view. He further points out however, that we will probably never be able to define optimal growth and development, either in generalities or in specifics, just as we cannot know with certainty what minimum of physical activity is required to attain that optimum. This difficulty in establishing absolute criteria and measures could account a great deal for the still nebulous role of physical fitness activities in our class programmes.

Westcott (1976) comments that

"for those of us who are sympathetic with Cooper's viewpoint, it is somewhat discouraging to note that those activities which are most useful for improving endurance fitness (i.e. jogging, bicycling, lap swimming, etc.) are seldom included in secondary school physical education programmes." (p.15)

The same appears to be the case in our primary and intermediate schools where few of the team sports, and even fewer of the calisthenics, which occupy so much of our programmes, have any value in terms of cardio-respiratory fitness. Furthermore, Westcott reports research indicating that one out of every two Americans discontinues sports activities altogether after leaving school. He also provides evidence suggesting that most people perform calisthenics only when they are compelled to. The implication here is that our physical fitness programmes do not provide sufficiently motivating exercises, nor do they inculcate positive attitudes among pupils concerning the intrinsic value of fitness activities. Westcott's views are supported by Crawford, a New Zealand lecturer in sports studies (1979), who argues that physical education is far too often dull, the result being alienation of the adolescent from

recreational sport. However, the New Zealand literature does not reveal empirical evidence to measure against Westcott's research findings. Nevertheless, as physical educators, perhaps we need to provide games with a higher interest level that require continuous routine exercise. These may serve as a pre-requisite for the more popular team sports such as rugby, soccer, hockey, netball, cricket and softball, which require fitness for optimum performance and avoidance of injury, yet have a negligible effect on cardio-respiratory fitness because they do not require high, continuous, energy expenditures.

The lack of emphasis previously placed upon cardio-respiratory fitness is further revealed in H. Harrison Clarke's (1976) discussion of the "Medford, Oregon, Boys' Growth Study", a longitudinal study begun in 1955, extending over a twelve year period, in which boys were tested annually within two months of their birthdays from the age of seven years until high school graduation. Clarke reports that a wide spectrum of human traits was tested, with the glaring exception, on the physical growth side, of those traits related to circulatory-respiratory endurance. Now, following the American experience of a decade ago, this aspect has become an important concern in New Zealand, a society which also has become characterised by automation, phases of large-scale unemployment, an increase in sedentary occupations, economic affluence and concomitant increase in mechanical transport.

A life-long approach to physical education in terms of physical fitness is strongly supported by Schendel (1976). He outlines his concept of physical fitness as

"one which includes factors or component parts which are related to the physical health and well-being of the individual and which can be modified by individual effort in following a carefully prescribed program of exercise. It

is based on the assumptions that the individual possesses normal organic functions, is free from disease, and has access to an adequate diet. When these assumptions hold true, the component parts of physical fitness which can be measured and then modified through prescribed exercise are as follows:

1. muscular strength
2. muscular endurance
3. circulo-respiratory endurance
4. flexibility
5. body fatness

While each of these components of physical fitness is important, the component about which the adult population needs to be most concerned is circulo-respiratory endurance because it is linked to the most critical physical health problem in the United States i.e. cardiovascular disease." (pp 75-90)

Although researchers have not conclusively determined evidence establishing a causal relationship between increased physical activity and reduction in coronary heart disease risk factors, Schendel does point out that

"most of the studies reported which deal with this topic indicate a decrease in the incidence, prevalence, severity and/or mortality from coronary heart disease among subjects who are more physically active." (p.76)

Included among the studies outlined by Schendel are those reported by Morris (1953, 1956, 1966), Zukel et al. (1959), Fox and Haskill (1966), Fox and Paul (1949), Brown et al.(1957), Kahn (1963), Keys (1970), and Skinner (1970). Thus, a broadly common view of the importance of physical activity has been held by researchers for nearly a quarter of a century.

On the basis of currently available evidence, Fox, Naughton and Gorman (1972) summarized the mechanisms by which physical activity may reduce the occurrence or severity of coronary heart disease:

PHYSICAL ACTIVITY MAY

<u>Increase</u>	<u>Decrease</u>
Coronary collateral vascularisation	Serum lipid levels
Vessel size	Triglycerides
Myocardial efficiency	Cholesterol
Efficiency of peripheral blood distribution and return	Glucose intolerance
Electron transport capacity	Obesity-adiposity
Fibrinolytic capability	Platelet stickiness
Arterial oxygen content	Arterial blood pressure
Red blood cell mass and blood volume	Heart rate
Thyroid function	Vulnerability to dysrhythmias
Growth hormone production	Neurohormonal over-reaction
Tolerance to stress	"Strain" associated with psychic stress
Prudent living habits	
Joie de vivre	

(p.20)

Fox, Naughton and Gorman's summary is an endorsement, not only of general Western medical and physiological thought, but also of leading Scandinavian Physiologists such as Astrand (Sweden) and Rodahl (Norway), (1970). Fentem's and Bassey's (1978) report, commissioned by the British Department of Health, reviewed over one hundred worldwide authorities in the fields of health and physical education and provided significant support for physical fitness as a prime promoter of longevity.

Such knowledge as the above demonstrates the importance of what Stamler (1973) terms, "the strategy of emphasizing primary prevention in the control of the major coronary risk factors." (p.6) Primary prevention simply means education - the function of our schools.

Munroe (1976) stated that "top level performance in any physical activity is such a complex event that it defies evaluation by any singular measurement". (p.57) Yet he pointed out that, although total performance may be considered as a single entity, it must be "broken down" into major component parts for detailed analysis and measurement.

Hunsicker (1974) recognized the diverse nature of human performance in his attempt to identify human factors related to physical performance. His list, admittedly limited, included strength, muscular endurance, cardiovascular endurance, body type, flexibility, coordination, speed, agility, balance, intelligence, creativity, and motivation.

However, clear definition of these component parts, as Munroe (p.57) pointed out, has proved to be a difficult task and one almost certain to lead to some controversy. For instance, any model or attempted analysis of motor performance must consider the question of specificity versus generality of human skill. The concept of general motor ability was popular until Henry (1960) advanced his argument of neuromotor reaction. Fleishman (1964) referred to "abilities" as a more general trait of the individual, dependent on both genetic and learning factors, whereas a "skill" is task-oriented and related to the level of proficiency in a specific task. He argued that skills can be described in terms of the more basic abilities. (pp.8-15)

Despite such controversies as the above, any performance requiring total body involvement for long duration will tax the cardiovascular and respiratory systems, and thus stamina, or aerobic power, is dear to physiologists' hearts in terms of its prime importance to the definition and measurement of physical fitness. This viewpoint leads to the choice of cardio-vascular fitness testing, along with the motor fitness testing battery (comprising muscle strength, endurance and flexibility) still existent in our physical education curriculum, for the purposes of this study in the pre and post assessment of a daily fifteen minute fitness programme for intermediate school children.

Nelson (1976) points out, in relation to the above, that any fitness testing in schools is only meaningful if it is followed up by specific instruction and post-testing. (It is noteworthy that post-testing is seldom reported as a feature of New Zealand primary schools' physical education programmes.) Nelson also argues that the student should be informed as to why a particular test item or exercise is being given, the principles upon which the exercise is based, and whether different exercises may be substituted, thus averting the common impression among students that calisthenics are militaristic, robot-like punishments. (pp.65-72) The now popular Step-up Test, as outlined by Broekhoff (1976), is an excellent example of an opportunity for testing as an educational process. It provides scope for lessons on heart rate, pulse count, the overload principle, and the relevance of fitness to heart and circulatory disease.

Nelson (1976) quotes a high school English teacher who said she was afraid to undertake any kind of fitness programme because, whenever she walked upstairs, "her heart beat fast." This was a college graduate. What Nelson and other Physiologists are still saying therefore, even in the late 1970's, is that physical education, in order to be meaningful, should be taught in schools, not only as a testing and exercising process, but also as a total discipline, involving discussion, questioning, understanding and motivation of an intrinsic nature.

Unfortunately, it must be said that specific instruction, like post-testing, does not always follow up pre-testing in our core subjects, namely mathematics, reading and language. For instance, how many teachers

undertake item analyses on P.A.T.'s or physical fitness tests, then teach groups or individuals accordingly? Noticeable also, is the fact that teachers tend to isolate their curriculum subjects rather than consider pupils' gains in one subject relative to another. Too often they administer P.A.T. tests of achievement in Reading Comprehension, Reading Vocabulary, Listening Comprehension, and Mathematics, record them in their test register, use them too heavily as a guide to mid-year assessment, then forget about them. Consideration of the relative gain score from one test to the next could give as important information as does yearly attainment. What is more, the consideration of relative progress between subjects could give teachers heightened insight into both pupil learning mechanisms and the possible interrelatedness between physical fitness and other subject areas.

In summary, we have considered the role of physical education in the primary school curriculum as interpreted by various overseas and New Zealand authors. We see that a void has traditionally existed regarding physical fitness programmes both in theory and practice. However, studies quoted from the past decade clearly demonstrate a growing awareness of the importance of physical (health related) fitness and this has been reflected in modern redefinitions of physical fitness, with their stress on intensity, duration and regularity, followed by evaluation. The wide-ranging possibilities of the influence of physical fitness upon other curriculum areas will be further developed in the succeeding chapter.

CHAPTER IILITERATURE REVIEW

A great deal of research has been done in recent years revealing more about the effects of physical fitness training programmes on children's physical well-being but little of its effects on other developmental factors. For example, Gilliam (1977) reports that in Exblom's study of eleven year old boys, mean increase in VO_2 ⁽¹⁾ due to interval running, sprint distance and strength training reached 18% after six months and 58% after thirty two months among the experimental group, with figures of only 13% and 41% respectively among the control group. The resultant mean increase in heart volume for the experimental group was 7% then 48% while the control group's increase was 5% then 37%.

Eriksson is reported (Gilliam 1977) as achieving a 10% increase in heart volume among subjects in his experiments, as did Dubelin (1977). However, in their studies, neither had control groups for comparative purposes. From the above, and further supporting evidence concerning the important role that the growth hormone plays in hypertrophy of the heart and other organs after exercise, it appears that children beginning as early as age 10 can enhance their aerobic (endurance) capabilities through endurance type training. These notable endurance gains are evidence of the fact that, during the pre-pubertal and puberty years, children are particularly sensitive to the action of the growth hormone.

(1) Oxygen consumption.

Data by Eriksson (1977) show that boys of 11 years increased their anaerobic (short duration/high intensity) ability through training, but not to the same extent as their aerobic (long duration/relatively high intensity) ability. In fact, Eriksson showed that, aerobically, children have the same potential as adults when compensation is made for body size. Hence maximum VO_2 can be achieved for adulthood by involvement in strenuous activity during the growing years.

Relevant to the above is a list of conditions outlined by Gilliam (1977) who states that in physical training type programmes for children we must remember:

1. frequent rest period.
2. individual differences e.g. growth spurt - tires more easily.
3. avoid abusing fat child - involve, encourage.
4. be sensitive to environmental conditions - heat, humidity - need to provide children with proper liquids.
5. poor skills in a child could be due to late maturation, therefore be patient and await development.

In her 1976 study Murray reports that sport can be developmental experience in terms of an improving attitude towards achieving. She discusses a transfer of achievement desire from the physical to the cognitive domain. However, in an objectively structured study of 61 male and female 6-13 year old emotionally disturbed children, Gruber (1977) found that coordination, fitness and academic items were unrelated. However, Gruber, in previous studies (1975), did find correlates to support the hypothesis that an enriched activity environment stimulates more favourable structural, chemical, and circulatory

changes in the cerebral cortex. This is supported by physical education objectives authors, such as Cowell and France (1963) and Baley and Field (1976), who concluded that regular participation in physical activity programmes should, in most cases, enhance the interpretive cortical development of children.

Along the above lines are the " $\frac{1}{3}$ time" school experiments in Europe, the progress of which was fully reviewed by Bailey (1976). These indicated that academic learning progresses better if proportionately less time is spent behind the classroom desk. In the traditional French elementary schools only two hours per week were devoted to physical education plus three hours of recreation compared to over twenty-three hours per week of academic work with homework in addition.

The above became regarded by educationalists as imbalance in the programme. Many French headmasters and medical practitioners drew attention to the inefficiency of afternoon intellectual work for most of the children in elementary schools. As a result of these evaluations from the medical and teaching professions several experiments were set up by the Ministry of Education in various regions of France, beginning in Vanves, 1951. The experimental classes did the major part of their academic work in the mornings. Academic studies were reduced to about four hours per day with no written homework. The afternoons featured up to two hours of physical education, totalling seven to eight hours per week.

The following table indicates the 1969 time-table used in Vanves (actually used since 1961).

Table 2.1

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday		
8:30	ACADEMIC			N O S C H O O L	ACADEMIC			
9:30	10 MINUTE EXERCISE				BREAK			
10:30	ACADEMIC				ACADEMIC			
11:30	LUNCH				LUNCH			
12:30	GAMES & GYMNASTICS		GAMES & GYMNASTICS			N O S C H O O L		
1:30	SWIMMING							
2:30	FREE TIME		RECREATION		RECREATION			
3:30	SUPERVISED STUDY - ART - MUSIC				S.S. PROJECTS			
4:00	CONTINUATION FOR				OLDER PUPILS			
5:00	-----		-----		-----			
5:30	NO WRITTEN HOMEWORK IN EVENINGS							

By 1960 these experiments confirmed that the health, fitness, discipline, enthusiasm and, most important, academic results, in the experimental schools surpassed those in the control classes. Bailey (1976) reports that similar experiments were then repeated in Brussels and Japan with like results.

In 1969, after extensive research in these "½ time" schools, which grew to involve up to 1500 classes throughout the 1960's, Dr.H.Perie, Chief of the Medical Services in the Ministry of Youth and Sports in Paris, gave them a full endorsement on behalf of medical experts. He confirmed physical education as an integral part of education in that it led to the improvement of growth, health and motor development. Further, "½ time" pupils performed better academically and were less susceptible to

stress. Intelligence did not actually improve but the "tools of intelligence" became much keener. Improved maturity, social adjustment and control of aggression were reported features of these pupils.

Mme Boes, the principal of Vanves School, when outlining the benefits of " $\frac{1}{3}$ time" physical education in her school, substantiated Dr. Perie's endorsement and added that pupils were keener, better disciplined, well prepared for secondary school, and the "esprit de corps" among teachers was improved. (Bailey, 1976)

Bailey further reports that, on the basis of these findings, a dramatic development came in 1969 when the government specified " $\frac{1}{3}$ time" physical education for elementary schools in France, amounting to about six hours per week. At the same time five hours of physical education per week were inserted into secondary schools, dependent upon personnel and equipment. Canada was very quick to follow France's lead in reassessing the suitability of its classroom programmes in the light of the " $\frac{1}{3}$ time" study.

Typical among the many physical fitness research programmes carried out in recent years is that of Stewart and Gutin (1976) who reported on the cardio-respiratory fitness of normal 10-12 year old males after an eight week running programme. In studying changes in submaximal and maximal heartrate and VO_2 they found that the heart rates of the training group averaged approximately 90% of the control group and VO_2 max. did not change significantly with training. This led the authors to point out that the apparently high threshold for a training effect on the VO_2 max. in children is probably related to their naturally active lives, that is to say, the stresses induced by short-term training are probably small when compared with the overall activities of children.

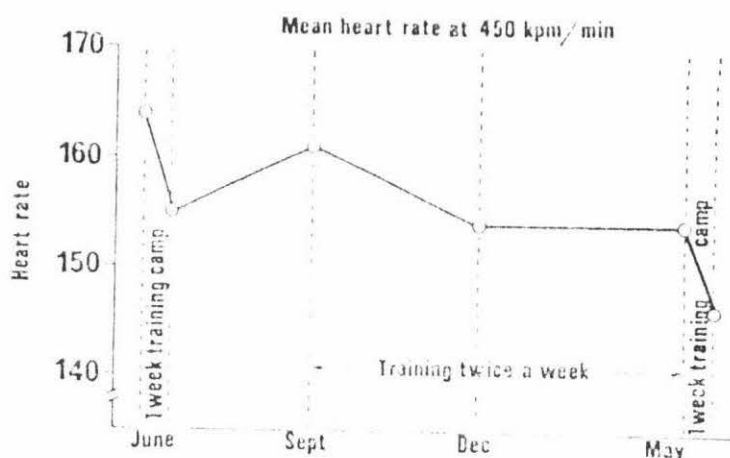
On the other hand, Stewart and Gutin found that submaximal heart rate during bicycle and treadmill exercise decreased significantly with training. The O_2 cost of these submaximal tasks remained unchanged. These findings suggest that the use of VO_2 max. as the only criterion for cardio-respiratory fitness may be misleading. Since most work tasks proceed at a submaximal rate, and since a training-induced improvement in submaximal response was demonstrated without improvement at maximal effort, perhaps submaximal physiological and performance measures are more important than maximal ones in the assessment of cardio-respiratory fitness. Step-up tests with pulse counts would be a good example of such a means of assessment.

Van Handel et al. (1976) gained significant reductions in HR⁽¹⁾ during all submaximal work tasks, consequent upon a preceding training period of cycling and treadmill running, when they studied 13 middle-aged sedentary men and women. Their data indicates that a moderate, progressive running programme of short duration can produce significant changes in cardiovascular function. These alterations were reflected in a reduced HR at a given submaximal workload and suggest a reduction in cardiac stress. Also improved was Recovery HR after submaximal stress.

Thoren (1971) ran a study on 15 boys, 11-12 years of age, all obese, who participated in a physical activity programme twice a week in addition to their regular physical training classes in school.

(1) Heart rate.

The boys decreased their degree of overweight significantly and at the same time their physical work capacity increased (see Table 2.2).



Changes in mean heart rate at unchanged submaximal work load during on year with different degrees of training in obese prepubertal boys.

This approach to treating obesity, one of the largely untreated health problems among our children, was found to be a more economical method than traditional medical and dietary régimes.

Gettman et al. (1976) initiated control, 1 day, 3 day and 5 day per week training groups. Training sessions were 30 mins. for 20 weeks at approximately 85-90% max.HR. Subjects were 55 volunteer prison inmates, age 20-35 years. Significant improvements occurred in direct proportion to frequency of training, in resting and recovery heart rates, treadmill performance time, VO_2 max., max. O_2 pulse⁽¹⁾ and V_E max.⁽²⁾ Skinfold fat was reduced only in the 5 day group. The authors concluded that frequency of training is an important determinant in eliciting changes in cardiovascular and performance variables in body composition.

(1) Pulse rate at maximum effort

(2) Maximum ventilation

A similar study to the above by Miles et al. (1976) gave closer attention to actual workout duration than to number of training times per week. The authors' purpose was to determine the effects of 15, 30 and 45 minute training sessions on maximum performance and cardio-respiratory fitness variables, body composition, pulmonary function, and serum lipids. Subjects included 59 prison inmates aged 20-35 years. Training included running and walking 3 days per week at approximately 85-90% max.HR for 20 weeks. Distance covered per exercise session was 1.75, 3.25 and 5.1 miles for the 15, 30 and 45 min. groups respectively. Improvements in the above variables were proportional to the duration of the training sessions i.e. the subjects training in the longer duration sessions showed the greatest improvements.

In an extensive study Jackson (1976) reports that 9 and 12 minute distance runs proved to be significantly correlated with VO_2 max. in children and that such runs provided a suitable means for fitness training as well as a basis for fitness testing in elementary school boys and girls. Jackson's work, along with that reviewed in the foregoing studies, provides a rationale for a class fitness programme aimed at increasing VO_2 max., thereby reducing HR, as well as averting obesity.

On the question of the correlation of physical education with academic achievement the Florida State Department of Education's 1975 report outlines very extensively the relationship of physical skills to reading readiness and ability. Their emphasis however, is upon motor skills as well as use of sports literature as a medium in language and reading programmes, rather than upon fitness activities. The essence of the Florida report lies in the perceptual motor approach, as demonstrated in the

Marianne Frostig Programme (1964) and later by Robert E. Vallett (1974) and Marie Clay (1972).

The perceptual-motor approach, which refers to the relationship between physical maturation and the ability to learn, provided a basis for Blair's (1977) Eltham study which looked at the relationship between motor development and achievement among five and six year old pupils. Dealing with such a young age group unfortunately made it impossible for the results of Blair's programme to be measured in concrete terms. Nevertheless, his observations reflect a similar success to that earlier reported in the Vanves " $\frac{1}{3}$ time" experiment.

Two other New Zealand studies on the relationship of physical fitness to academic achievement were undertaken by Small (1966) and Lewis (1971). Although they dealt with University students, an older and therefore more objectively measurable age group, neither study pointed to a significant relationship. In fact Lewis, in his conclusion, warned that, only with caution, should any attempt be made to justify a physical education programme along the lines of its relationship to academic achievement until the relationship is more fully investigated.

Despite the paucity of studies on older pupils and the difficulty of gaining objective measurement on younger ones, Plack (1968) found fairly substantial correlations ranging from .64 to .87 between reading evaluations and motor coordination skills for children in grades 1, 3, and 5. Ismail and Gruber (1967) found that items involving intricate hopping patterns were moderately related to scholastic achievement in upper elementary boys and girls. Kirkendall and Ismail (1970) added coordinated arm swing patterns to the hopping items and found that both sets of items discriminated among three discrete intellectual groups of elementary children.

Thomas and Chissom (1972) also found significant correlations between perceptual motor and academic achievement items in kindergarten, first and second grade children, but not in third grade children. The relationships decreased as age increased, indicating that abilities between the two domains become more specific as age increases. Nevertheless, motor skills having been inculcated, it does appear on the basis of earlier reported research that physical fitness remains a prerequisite for that keen edge on pupils' "tools of intelligence", to borrow a phrase from Dr.H.Perie (1969).

In respect of physical fitness, Huey (1968) makes the point that psychophysiological correlates of the reading process have been investigated for about a century. He states that, while the literature is replete with studies of eye movements, subvocalization, and electrical activity of the brain during reading, a paucity of research exists on the role the heart plays in the processing of printed text.

One such study was undertaken by Campbell (1977), which measured increase in heart rate during reading caused by anticipation of comprehension questions to follow. More important to this review was Campbell's further investigation of the correlation between heart rate, reading speed and comprehension. Campbell found no significant correlations, therefore the conclusion of his study, overturning previous research, was that heart rate is not directly linked to cognitive activity.

The above, along with two similar studies by Wark et al. (1972) and Reichurdt (1977), constitute the only three studies reported that have required

subjects to read a continuous text while heart rate is measured. However, these studies use heart rate merely as a recording measure, whereas by manipulating heart rate as a variable this study may be able to demonstrate that physical fitness, in terms of a cardio-respiratory definition, does indeed affect cognitive performance.

The above notion can best be illustrated by beginning with an outline of Gabbard's (1978) investigation of the relationship between physical exertion and mental performance in elementary school children. Gabbard found that 95 second graders performed significantly better on mathematical problems 5 minutes after a period of 50 minutes physical exertion than after no induced exertion. Testing also revealed no significant difference between male and female mean difference scores. Durations 20, 30 and 40 minutes physical exertion did not give as significant correlations as 50 minutes. This last time revealed a .05 level of significance on the one-way ANOVA and a Dunnett Test value of 2.28

The above findings support those of Davey (1957), Duffy (1962) and Marteniuk (1976), all of whom put increase in mental performance down to an arousal function on an inverted U basis, whereby induced physical exercise for 40 or 50 minutes may exert students to the point of relaxation rather than arousal, thus enabling students to concentrate on mental functions.

Three approaches to the relationship between physical and mental activity have been considered in this review:

- (a) Cortical development - Cowell and France (1963), Gruber (1975), Baley and Field (1976)
- (b) Enriched physical activity - Vanves (1951), Frostig (1964), Clay (1972), Vallett (1974), Blair (1977)
- (c) Arousal function - Davey (1957), Duffy (1962), Marteniuk (1976), Gabbard (1978).

All three approaches appear to give a basis for hypothesizing a link between physical fitness and cognitive performance. This is especially so when we consider the proven cardio-respiratory efficiency of the short runs advocated by Jackson (1976) and his contemporary researchers. Training for cardio-respiratory fitness by means of short bursts of sub-maximal physical activity may therefore be just as effective as the 40 or 50 minutes advocated by Gabbard (1978), if we accept the findings of Jackson and related researchers on the development of quicker recovery rate of pulse following brief periods of sub-maximal exercise.

The above research findings provide a basis for the hypotheses and experimental design which follow. An attempt will be made to confirm or refute the observations of New Zealand and overseas researchers in the light of findings from the New Zealand environment.

CHAPTER IIIEXPERIMENTAL DESIGN

Aims of Study: This experiment is an attempt to measure the efficacy of a daily 15 minute fitness programme for intermediate school children to test the theory that children who are in a superior state of physical fitness will perform better in their school work. If this is so they will be expected to gain better marks than a control group of pupils on tests of the following nature:

1. Physical Fitness
2. Reading Comprehension
3. Reading Vocabulary
4. Listening Comprehension
5. Mathematics Problems and Basic Facts

Hypotheses:

- 1(a) Experimental pupils will have improved their Shuttle Run times by comparison with the control pupils.
- (b) Experimental pupils will have improved their Sit Up scores by comparison with the control pupils.
- (c) Experimental pupils will have increased their Softball Throw distances by comparison with the control pupils.
- (d) Experimental pupils will have improved their 550 metre Run times by comparison with the control pupils.
- (e) Experimental pupils will have improved their 5 minute Run distances by comparison with the control pupils.
2. The experimental pupils' pulses will have decreased by comparison with those of the control pupils in the following instances:
 - (a) at rest
 - (b) during the period 0 - 1 minute immediately after a 5 minute exercising period.

- (c) during the period 1 - 2 minutes after a 5 minute exercising period.
 - (d) during the period 2 - 3 minutes after a 5 minute exercising period
 - (e) during the period 3 - 4 minutes after a 5 minute exercising period.
3. The experimental pupils' Basic Multiplication Facts recall will have improved by comparison with that of the control pupils.
 4. The experimental pupils' Basic Addition Facts recall will have improved by comparison with that of the control pupils.
 5. The experimental pupils' Multiplication Tables at speed will have improved by comparison with those of the control pupils.
 6. The experimental pupils' Addition Tables at speed will have improved by comparison with those of the control pupils.
 7. The experimental pupils' P.A.T.Mathematics raw scores will have improved by comparison with those of the control pupils.
 8. The experimental pupils' P.A.T.Reading Comprehension raw scores will have improved by comparison with those of the control pupils.
 9. The experimental pupils' P.A.T.Reading Vocabulary raw scores will have improved by comparison with those of the control pupils.
 10. The experimental pupils' P.A.T.Listening Comprehension raw scores will have improved by comparison with those of the control pupils.

Method:

Two groups of children will be set up in order to compare the effects of a normal, two period per week physical education programme with an experimental programme comprised solely of daily periods of physical fitness exercises. The exercises in the experimental programme will take the form of callisthenics and fitness circuits, as recommended in the

New Zealand Department of Education's (1973) Physical Education Handbook, together with obstacle courses and jogging. The physical motor activity involved will be kept as constant as possible, yet at a submaximal rate, lasting for a duration of 15 minutes.

The experimental programme will observe, as closely as possible, the weekly timetable outlined in Table 3.1.

Table 3.1
Experimental Timetable

Monday	-	callisthenics (3 min.), run (12 min.)
Tuesday	-	fitness circuit and 400m. run
Wednesday	-	callisthenics (3 min.), run (12 min.)
Thursday	-	callisthenics (7 min.), obstacle course (8 min.), (School Sports p.m.)
Friday	-	callisthenics (3 min.), run (12 min.)

The experimental programme will necessarily be flexible, especially on Thursdays, due to timetable interferences, school sports fixtures, weather factors and pupils' motivation.

The control programme will follow the school's normal, yearly, physical education plan of two periods weekly, each of 35 minutes duration, together with school sports afternoon. (Ref. Table 3.2)

Table 3.2
Control Timetable

Term One

Week:	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Swimming						Fitness			Small Ball		Large Ball		

Term Two

Week:	1	2	3	4	5	6	7	8	9	10	11	12	13
	Large Ball			Dance						Gymnastics			

Term Three

Week:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Gymnastics				Fitness			Athletics				Swimming and Water Safety			

The control group will undergo 70 minutes of physical education lessons per week, while the experimental group will undergo 75 minutes of physical fitness activities. The experimental group will thus be excluded from the school's normal yearly plan, however both controls and experimentals will participate in normal recesses and school sports.

The duration of the experimental programme will be six months, from March to August inclusive, i.e. Term One, Week 5 to Term Two, Week 13. This will minimize interruptions to the experiment in terms of holidays, consisting of Easter and two weeks in May, and will correspond with the March annual achievement testing undertaken nationally in New Zealand schools from Standard Two to Form Four in both reading and mathematics.

The mathematics and reading programmes will be planned identically for the experimental and control classes, depending upon the availability of resources.

Subjects: The subjects will be eighty-six Form 2 boys and girls, aged from 11.8 to 13.2 years as at 1st March 1979, all of lower to middle class socio-economic backgrounds. They will be organised into a syndicate of three classes, one of which will be the experimental group, the others being control groups "one" and "two". The classes, or groups, will be equivalent numerically and in sex distribution, but diverse and unstreamed i.e. randomly assigned, on mental and physical motor abilities. A check on randomness will be made by inspection of pre-test results to ascertain if major differences between the experimental and control groups exist.

Cross grouping, based on ability, will be undertaken across the three classes in mathematics and

reading. This should eliminate, to a large extent, the variable of teacher ability. For example, one class might perform better at mathematics or reading because of its teacher's particular ability or interest in the subject. However, by cross grouping the classes three ways, so that one third of the experimentals are in each class, the problem should be minimized.

Sport and academic interest among pupils will not be taken into account for selection of the experimental group. Rather, these factors will be left, especially the former, to be cultivated by the inherent motivational aspect of the experimental programme, an integral part of the study, which must be considered for its possible "Hawthorne Effect".

Instrumentation: The following table outlines the testing battery to be initiated for both experimental and control classes:

Table 3.3
Testing Battery

FEB.	MARCH-----	EXPERIMENT-----	AUGUST	DEC.
		1.Motor Fitness Performance Items		
P		2.Cardiac Recovery Rate		P
R		3.Maths: 36 Basic Multiplication		O
E		Facts		S
T		4.Maths:45 Basic Addition Facts		T
E		5.144 Times Tables		T
S		6.144 Addition Tables		E
T		7.Maths P.A.T.		S
		8.Reading Comprehension P.A.T.		T
		9.Reading Vocabulary P.A.T.		
		10.Listening Comprehension P.A.T.		

1. Motor fitness performance items will consist of four tests normed and prescribed in the New Zealand Department of Education's Physical Education Handbook (1973), for use by classroom

teachers. The items will be Shuttle Run, Bent Knee Sit Ups, Softball Throw and 550 Metre Run. A fifth item will be included for the purpose of broadening the motor fitness testing battery, namely, a 5 Minute Run. (refer appendices 3 - 6).

2. Cardiac recovery rate will be measured by means of the Harvard Step Test which was developed by Brouha and associates in the Harvard Fatigue Laboratories during World War II. (Brouha et al. 1943, 1944) The test was constructed for the purposes of measuring the ability of the body to adapt itself to hard work and then recover. Original evidence of validity for the Harvard test was based upon endurance in treadmill running, maximum heart rate per minute, and blood lactate level. Studies on Harvard undergraduates showed that athletes scored higher with less variable scores than did non athletes, and increased their scores with more training, while termination of training resulted in lower scores.

There are two forms of this test - the long form and the short form - the only difference being in the number of times pulse counts are recorded. In the long form of the Harvard Step Test the subject exercises on a twenty inch bench for as long as possible with a maximum of five minutes. The cadence is thirty steps per minute, which is quite strenuous - the most common criticism of this test. The pulse is counted from one to one and one-half, from two to two and one-half, and from three to three and one-half minutes after cessation of the step-up exercises.

Modifications have been made to the Harvard Step Test for various purposes by Jung (1951) then

Skubic and Hodgkins (1955). In view of the fact that this experiment will not be requiring the Harvard norms but will operate on relative improvement in performance, one modification is able to be made, namely reduction of bench height from twenty inches for adults to fourteen inches for intermediate school pupils. A further necessity for assessment of performance will be the extra recording of pulse count one minute prior to testing and immediately afterwards. (Ref.Appendix 7)

3. and 4. All thirty-six basic multiplication facts and forty-five basic addition facts will be administered to the three groups of pupils by their mathematics teachers. Items will be read orally by the teacher at three second intervals and pupils will record answers only. The purpose will be to assess control versus experimental pupils' relative improvement on basic facts computation under the requirements of time and listening factors. (Ref.Appendix 8)

5. and 6. Tables testing will take the form of two scrambled table grids in both multiplication and addition, totalling 288 items, each test to be completed within four minutes. The purpose will be to assess control versus experimental pupils' relative improvement in speed of computation. (Ref.Appendix 9)

7,8,9,10. Progressive Achievement Tests (P.A.T.'s) will be administered in Mathematics, Reading Comprehension, Reading Vocabulary and Listening Comprehension. These tests, designed to measure pupils' achievement in specific curriculum areas, are normed for use annually at the end of February or early March in classes from Standard Two to Form Four. The P.A.T.'s have parallel forms, A and B,

in order to avoid a practice effect. Once again, the relative improvement of the experimental versus the control group will be considered. Because of the experimental design, post-testing will necessarily be undertaken after six months, rather than on the usual annual basis for which the tests were normed. (Refer Appendices 10-13)

All the above tests are objective tests of performance and can therefore be expected to be more reliable than subjective observations of progress. This is not to deny the place of the latter in daily classroom evaluation. However, observational tools, such as progress card ratings in Stability, Cooperation, Independence and Perseverance, or teacher, pupil and parent questionnaires, will not be employed in this study.

Assessment of progress in relation to the experimental hypotheses will be based upon pupils' comparative improvements in post-tests. The average scores of the experimental class and control classes will then be considered in relation to one another by means of a one-tailed t-test, since the hypotheses are directional. Specifically, control and experimental group pre and post-test scores will be subject to t-tests. Ideally there will be no significant difference between the two groups' pre-test scores. However if the experimental programme proceeds in the hypothesized manner, the post-test results should show a significant difference in favour of the experimental group. Particular notice will be taken of pupils with unusually high or low differences between their pre-test and post-test scores and retrospective comments will be made.

CHAPTER IVRESULTS (1)

Hypothesis 1(a): Experimental pupils will have improved their Shuttle Run times by comparison with the control pupils.

Table 4.1(a)
Motor Fitness Performance Test
Shuttle Run (seconds)

		Pre-Test	Post-Test
Expt.	M	8.44	8.17
N=29	S.D.	0.59	0.64
Control	M	8.79	9.85
N=57	S.D.	0.98	0.89
	t =	1.76*	t = 9.03**

Table 4.1(a) indicates that the experimental group achieved a slight improvement in its Shuttle Run times, while the control group's times fell away considerably. The t-test shows that a significant and substantial difference on this test has developed over the experimental period, lending strong support to the research hypothesis.

(1) In reporting the findings in this Chapter, the following indications will be used:

* significant at the 5% level of probability.

** " " " 1% " " "

Hypothesis 1(b): Experimental pupils will have improved their sit up scores by comparison with the control pupils.

Table 4.1(b)
Motor Fitness Performance Test
Sit Ups (no.in 1min.)

		Pre-Test	Post-Test
Expt.	M	28.10	33.24
N=29	S.D.	10.62	9.84
Control	M	28.42	29.70
N=57	S.D.	9.47	8.81
		t = -0.14N.S.	t = 1.69*

Table 4.1(b) indicates that the experimental group increased its number of Sit-ups to a significant extent by comparison with the control group. Hypothesis 1(b) is supported.

Hypothesis 1(c): Experimental pupils will have increased Softball Throw distances by comparison with the control pupils.

Table 4.1(c)
Motor Fitness Performance Test
Softball Throw (metres)

		Pre-Test	Post-Test
Expt.	M.	22.62	28.59
N=29	S.D.	7.40	7.26
Control	M.	21.98	21.84
N=57	S.D.	8.77	9.74
		t = 0.34 N.S.	t = 3.29**

Table 4.1(c) indicates that the experimental group improved its Softball Throw distances significantly by comparison with the control group. Hypothesis 1(c) is therefore strongly supported.

Hypothesis 1(d): Experimental pupils will have improved their 550 metre Run times by comparison with the control pupils.

Table 4.1(d)
Motor Fitness Performance Test
550 metre Run

		Pre-Test	Post-Test
Expt.	M.	2.25	2.18
N=29	S.D.	0.32	0.37
Control	M.	2.20	2.63
N=57	S.D.	0.30	0.54
		t = -0.71 N.S.	t = 4.03**

Table 4.1(d) indicates an improvement in 550 metre Run time on the part of the experimental group as opposed to a decline by the control group. The significance of the t-test strongly supports Hypothesis 1(d).

Hypothesis 1(e): Experimental pupils will have improved their 5 min.Run distances by comparison with the control pupils.

Table 4.1(e)
Motor Fitness Performance Test
5 minute Run (metres)

		Pre-Test	Post-test
Expt. N=29	M.	887.59	958.62
	S.D.	178.86	245.70
Control N=57	M.	930.53	928.95
	S.D.	159.58	203.93
		t = 1.13 N.S.	t = -0.59 N.S.

Table 4.1(e) indicates that the experimental group improved its 5 minute Run distances while the control group remained virtually the same. Specifically, from an initially lower pre-test average the experiment group improved to outperform the control group, which is in line with the findings of previous hypotheses. However, the method of analysis employed in this study does not allow this particular hypothesis to be supported at a statistically significant level.

Hypothesis 2(a): The experimental pupils' pulses at rest will have decreased by comparison with those of the control pupils.

Table 4.2(a)
Harvard Step Test
Pulse Rates at Rest

		Pre-Test	Post-Test
Expt. N=29	M.	88.83	86.03
	S.D.	8.19	6.25
Control N=57	M.	86.74	86.58
	S.D.	15.53	9.69
		t = -0.68 N.S.	t = 0.28 N.S.

Table 4.2(a) indicates that the experimental group's mean resting pulse rate decreased slightly as a result of the experimental programme, while that of the control group remained the same. The experimental group's gain was not significant on a t-test, therefore Hypothesis 2(a) was not supported.

Hypothesis 2(b): The experimental pupils' pulses during the period 0-1 minute immediately after a 5 min. exercising period will have decreased by comparison with those of the control pupils.

Table 4.2(b)
Harvard Step Test
Pulse Rates—immediate post exercise

		Pre-Test	Post-Test
Expt.	M.	145.48	129.79
N=29	S.D.	12.94	12.47
Control	M.	143.65	146.63
N=57	S.D.	12.34	13.85
t =		-0.64 N.S.	t = 5.51**

Table 4.2(b) indicates that the experimental group's mean pulse rate decreased by comparison with the control group whose results in fact showed a slight increase. The significant t-test result provides strong support for Hypothesis 2(b).

Hypothesis 2(c): The experimental pupils' pulses during the period 1-2 min. after a 5 min. exercising period will have decreased by comparison with those of the control pupils.

Table 4.2(c)
Harvard Step Test
Pulse Rate at 1 min. post exercise

		Pre-Test	Post-Test
Expt.	M.	118.21	108.55
N=29	S.D.	11.15	10.34
Control	M.	121.23	122.67
N=57	S.D.	9.72	10.21
		t = 1.29 N.S.	t = 6.04**

Table 4.2(c) indicates a decrease in mean pulse rate and standard deviation on the part of the experimental group. The control group showed a slight increase. The significant t-test result provides strong support for Hypothesis 2(c).

Hypothesis 2(d): The experimental pupils' pulses during the period 2-3 min. after a 5 min. exercising period will have decreased by comparison with those of the control pupils.

Table 4.2(d)
Harvard Step Test
Pulse Rates at 2 min. post exercise

		Pre-Test	Post-Test
Expt. N=29	M.	108.21	98.62
	S.D.	10.87	7.98
Control N=57	M.	107.54	108.42
	S.D.	10.72	9.51
		t = -0.27 N.S.	t = 4.76**

Table 4.2(d) indicates a decreased mean pulse rate and standard deviation on the part of the experimental group, while the control group's post-test results show a slight mean increase in pulse rate and a lesser improvement in standard deviation. These data lend strong support to Hypothesis 2(d).

Hypothesis 2(e): The experimental pupils' pulses during the period 3-4 min. after a 5 min. exercising period will have decreased by comparison with those of the control pupils.

Table 4.2(e)
Harvard Step Test
Pulse Rates at 3 min. post exercise

		Pre-Test	Post-Test
Expt. N=29	M.	100.76	88.97
	S.D.	10.88	6.57
Control N=57	M.	97.42	97.45
	S.D.	11.81	10.93
		t = -1.27 N.S.	t = 3.83**

Table 4.2(e) indicates that the experimental group's mean pulse rate and standard deviation have decreased significantly, while the control group's post-test results remain relatively constant. Hypothesis 2(e) is therefore strongly supported.

Table 4.2(f) Summary
Physical Fitness Test Results

	N.Expt. = 29	Expt.	Control	t-test	Expt.	Control	t-test
	N.Control = 57	PreTest	Pretest		Posttest	Posttest	
1. Motor Fitness							
(a) Shuttle Run	\bar{x}	8.44	8.79		8.17	9.85	
	σ	0.59	0.98	1.76	0.64	0.89	9.03**
(b) Sit Ups	\bar{x}	28.10	28.42		33.24	29.70	
	σ	10.62	9.47	0.14	9.84	8.81	1.69*
(c) Softball Throw	\bar{x}	22.62	21.98		28.59	21.84	
	σ	7.40	8.77	-0.34	7.26	9.74	-3.29**
(d) 550 metre Run	\bar{x}	2.25	2.20		2.18	2.63	
	σ	0.32	0.30	-0.71	0.37	0.54	4.03**
(e) 5 min. Run	\bar{x}	887.59	930.53		958.62	928.95	
	σ	178.86	159.58	1.13	245.70	203.93	-0.59
2. Harvard Step Test/Pulse							
(a) Rest	\bar{x}	88.83	86.74		86.03	86.58	
	σ	8.19	15.53	-0.68	6.25	9.69	0.28
(b) Immediate Post Exercise	\bar{x}	145.48	143.65		129.79	146.63	
	σ	12.94	12.34	-0.64	12.47	13.85	5.51**
(c) 1min. Post Exercise	\bar{x}	118.21	121.23		108.55	122.67	
	σ	11.15	9.72	1.29	10.34	10.21	6.04**
(d) 2min. Post Exercise	\bar{x}	108.21	107.54		98.62	108.42	
	σ	10.87	10.72	-0.27	7.98	9.51	4.76**
(e) 3min. Post Exercise	\bar{x}	100.76	97.42		88.97	97.45	
	σ	10.88	11.81	-1.27	6.57	10.93	3.83**

* Significant at 5% level of probability.
** " " " 1% " " "

The asterisked t-test results in Table 4.2(f) Summary indicate that all the physical fitness hypotheses were substantiated, with the exception of two, namely 5 min.Run and Harvard Step Test/Pulse at Rest.

In the case of the 5 min.Run test (Table 4.1e) the experimental group improved its distances noticeably. However, it was accompanied by an increase in standard deviation and no conclusive decision could be made by the analytic method used in this study.

Similarly, in the case of the Harvard Step Test/Pulse at Rest (Table 4.2a), the experimental group actually decreased its resting pulse rates as hypothesized, however the decrease was of insufficient magnitude to rule out chance factors.

Examination of the test data reveals further important information in the case of the Step Test pulse rates, namely that the experimental group's post-test standard deviations at rest (ref.Test 2a) and at 3 min.post exercise (ref.Test 2e) have drawn closer together than have those of the control group. This indicates that, as the experimental group has become more physically fit in terms of cardio-respiratory endurance, it has also become more homogeneous in terms of degree of recovery rate i.e. the pupils in the experimental group have improved their recovery rate as a whole, while the pupils in the control group have performed in a more spasmodic and diverse way.

It can therefore be deduced from the above physical fitness test results and discussion that the experimental group showed a significant and generalized trend towards an increase in physical fitness. The same cannot be said however for the control group whose performances remained much the same and in some cases decreased, which casts

considerable doubt upon the efficacy of the intermediate school's normal Physical Education programme in terms of physical fitness. It is also of interest to note (ref. Appendix 14) that in the physical fitness post-tests the boys' and girls' relative gains and losses differed markedly at times although no noticeable pattern emerged.

Hypothesis 3: The experimental pupils' Basic Multiplication Facts recall will have improved by comparison with that of the control pupils.

Table 4.3
Mathematics Basic Facts
Multiplication

		Pre-Test	Post-Test
Expt.	M	30.72	33.72
N=29	S.D.	5.81	3.33
Control	M.	30.96	32.63
N=57	S.D.	5.90	4.81
		t = 0.18 N.S.	t = 1.09 N.S.

Table 4.3 indicates that the experimental group's improvement in Basic Multiplication Facts was slightly greater than that of the control group. The experimental group's decrease in standard deviation was also greater, but neither of these factors was of sufficient magnitude and therefore Hypothesis 3 must be rejected.

Hypothesis 4: The experimental pupils' Basic Addition Facts recall will have improved by comparison with that of the control pupils.

Table 4.4
Mathematics Basic Facts
Addition

		Pre-Test	Post-Test
Expt. N=29	M.	40.62	43.34
	S.D.	5.23	3.53
Control N=57	M.	42.86	43.67
	S.D.	5.34	2.86
		t = 1.85*	t = 0.47 N.S.

Table 4.4 indicates that the significant difference in favour of the control group on Basic Addition Facts pre-test results decreased to a non-significant difference in the post-test results, which provides some measure of support for Hypothesis 4.

Hypothesis 5: The experimental pupils' Multiplication Tables at speed will have improved by comparison with those of the control pupils.

Table 4.5
Mathematics
Times Tables

		Pre-Test	Post-Test
Expt. N=29	M.	65.66	96.55
	S.D.	23.70	33.54
Control N=57	M.	69.75	87.75
	S.D.	26.03	27.89
		t = 0.71 N.S.	t = 1.29 N.S.

Table 4.5 indicates a greater increase in the experimental group's Times Tables results by comparison with the control group's increase. The increase in standard deviation for the experimental group should also be noted. However, the improvement is insufficient to rule out chance factors and Hypothesis 5 must therefore be rejected.

Hypothesis 6: The experimental pupils' Addition Tables at speed will have improved by comparison with those of the control pupils.

Table 4.6
Mathematics
Addition Tables

		Pre-Test	Post-Test
Expt. N=29	M.	71.34	103.83
	S.D.	20.01	25.49
Control N=57	M.	80.58	106.65
	S.D.	26.84	27.14
		t = 1.63 N.S.	t = 0.46 N.S.

Table 4.6 indicates a slightly larger increase in the experimental group's Addition Tables results than in the control group's. However, the control group performed better than the experimental group on this test and Hypothesis 6 must be rejected.

Hypothesis 7: The experimental pupils' P.A.T. Mathematics raw scores will have improved by comparison with those of the control pupils.

Table 4.7
Mathematics
Progressive Achievement Test

		Pre-Test	Post-Test
Expt.	M.	21.62	26.52
N =29	S.D.	7.65	9.42
Control	M.	24.18	26.40
N=57	S.D.	8.18	9.03
t =		-1.40 N.S.	t=0.06 N.S.

Table 4.7 indicates a slightly higher increase in the experimental group's Mathematics P.A.T. post-test results than in the control group's. However, the data show that Hypothesis 7 must be rejected.

Hypothesis 8: The experimental pupils' P.A.T. Reading Comprehension raw scores will have improved by comparison with those of the control pupils.

Table 4.8
Reading Comprehension
Progressive Achievement Test

		Pre-Test	Post-Test
Expt. N=29	M.	22.07	28.38
	S.D.	9.78	9.70
Control N=57	M.	27.49	29.00
	S.D.	7.36	7.71
		t = 2.88**	t = 0.32 N.S.

Table 4.8 indicates that the significant difference between the experimental and control groups' Reading Comprehension P.A.T. pre-test results (a difference in favour of the control group) decreased to a non-significant difference in the post-test results. This provides a measure of support for Hypothesis 8.

Hypothesis 9: The experimental pupils' P.A.T. Reading Vocabulary raw scores will have improved by comparison with those of the control group.

Table 4.9
Reading Vocabulary
Progressive Achievement Test

		Pre-Test	Post-Test
Expt. N=29	M.	35.52	39.76
	S.D.	19.99	12.99
Control N=57	M.	41.14	43.46
	S.D.	10.41	10.48
		t = 1.72*	t = 1.42 N.S.

Table 4.9 indicates that the significant difference between the experimental and control groups' Reading Vocabulary P.A.T. pre-test results (again in favour of the control group) decreased to a non-significant difference in the post-test results. The experimental group also showed a decreased standard deviation in its post-test. A slight measure of support can therefore be found for Hypothesis 9.

Hypothesis 10: The experimental pupils' P.A.T. Listening Comprehension raw scores will have improved by comparison with those of the control pupils.

Table 4.10
Listening Comprehension
Progressive Achievement Test

		Pre-Test	Post-Test
Expt. N=29	M.	27.31	31.14
	S.D.	6.07	4.94
Control N=57	M.	28.05	29.35
	S.D.	5.71	6.35
t =		0.56 N.S.	t= -1.33 N.S.

Table 4.10 indicates a relatively higher increase in the Listening Comprehension P.A.T. post-test result of the experimental group than that of the control group. The experimental group's post-test standard deviation also decreased while the control group's increased. Neither of these factors was, however, sufficient to provide significant confirmation for Hypothesis 10, which must be rejected.

Table 4.11 Summary
Academic Test Results

	N.Expt.=29 N.Control=57		Expt. Pre-test	Control Pre-test	t-test	Expt. Post-test	Control Post-test	t-test
3. Basic X facts	\bar{x}	30.72	30.96			33.72	32.63	
	σ	5.81	5.90		0.18	3.33	4.81	-1.09
4. Basic + facts	\bar{x}	40.62	42.86			43.34	43.67	
	σ	5.23	5.34		1.85*	3.53	2.86	0.47
5. X Tables	\bar{x}	65.66	69.75			96.55	87.75	
	σ	23.70	26.03		0.71	33.54	27.89	-1.29
6. + Tables	\bar{x}	71.34	80.58			103.83	106.65	
	σ	20.01	26.84		1.63	25.49	27.14	0.46
7. Maths P.A.T.	\bar{x}	21.62	24.18			26.52	26.4	
	σ	7.65	8.18		1.4	9.42	9.03	-0.06
8. Comprehension P.A.T.	\bar{x}	22.07	27.49			28.38	29.00	
	σ	9.78	7.36		2.88**	9.70	7.71	0.32
9. Vocabulary P.A.T.	\bar{x}	35.52	41.14			39.76	43.46	
	σ	19.99	10.41		1.72*	12.99	10.48	1.42
10. Listening P.A.T.	\bar{x}	27.31	28.05			31.14	29.35	
	σ	6.07	5.71		0.56	4.94	6.35	-1.33

* Significant at 5% level of probability
** " " 1% " " "

The asterisked t-test results in Table 4.11 Summary indicate that three of the academic achievement hypotheses were substantiated to a significant degree. Slight overall positive trends are shown in the tests of the remaining hypotheses. While not definitive, the test results certainly suggest a relationship between physical fitness and academic achievement. This is especially so when one considers that the earlier discussed possibility (ref.p.30) of a significant difference occurring between the pre-tests of the experimental and control groups did actually occur in the case of some of the pretests which thereby affected the intended random assignment of pupils. Hence the criteria for supporting the hypotheses must be altered to take account of the fact that while the experimental group may have shown little improvement on the control group in a comparison of post-tests, the fact that the experimental group began significantly behind the control group in many of the pre-tests makes for a noteworthy difference. Therefore, the criterion becomes not "who has achieved higher?" but "who has come further?" Table 4.4 provides an example of the above point.

It can therefore be deduced from the above academic test results and discussion that the experimental group showed a slight, generalized trend towards an improvement in mathematics and reading performance. Although the control group's performances improved less by comparison, the experimental group's relative overall increase was not sufficient to substantiate the theory that children who are in a superior state of physical fitness will perform better in their school work.

It is of interest to note (ref. Appendix 15) that, in the academic post-tests, the boys' and girls' relative gains and losses differed markedly. However, no noticeable pattern emerged. The only noticeable relative gains or losses in either academic or physical fitness post-test results were made by some pupils at the extremes of the health continuum i.e. the obese and the very fit.

Of interest are the results of a small sub-group of obese pupils in the experimental class (ref. Table 4.12). This Sub-group consists of three pupils out of the five obese pupils in the experimental group whose attitude to physical fitness was observed as being the most negative. These three pupils (numbers 1, 2, and 3 in Table 4.12) showed the least improvement in terms of decrease of pulse rate as a result of the physical fitness experimental programme - in fact, their pulse rates were the only three in the experimental group that exhibited an increase at rest and at 3 min. post exercise, rather than the hypothesized decrease. At the same time there emerged a sub-group of experimental pupils with the highest intrinsic motivation towards physical fitness (ref. numbers 6-11 in Table 4.12) who exhibited the greatest improvements in the hypothesized decrease in pulse rate following participation in the experimental programme.

The above observations indicate that, although both the very fit and the obese increased their personal performances on the motor fitness skills test battery, the very fit became fitter but the obese became less fit in terms of cardio-respiratory endurance. In order to explain further this point it is worth noting that an increase in cardio-respiratory endurance requires a relatively long duration of repeated, continuous, sub-maximal fitness training.

Table 4.12

Selected Sub-group of Eleven Experimental Pupils
Harvard Step-test Results

Obese/Low Motivation Pupil	Rest Pulse		Immed. Post		1-2 min. Post		2-3 Min. Post		3-4 Min. Post	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	88	92	164	146	132	128	116	116	102	108
2	72	80	130	120	116	110	110	106	92	96
3	96	100	160	150	132	126	116	118	100	108
Obese/Well Motivated										
4	78	78	140	128	118	116	116	112	108	78
5	82	84	148	130	118	106	94	96	92	90
Fit/High Motivation										
6	92	80	144	126	108	102	112	104	106	94
7	88	80	142	128	120	96	104	92	106	90
8	92	85	152	120	128	190	116	86	106	85
9	96	86	144	112	102	100	106	94	96	86
10	90	90	144	140	120	120	120	106	116	94
11	76	78	128	96	106	80	100	78	96	78

Neither of these experimental sub-groups exhibited any noticeable differences in academic post-test results, due possibly to the fact that both the obese and the very fit pupils mentioned above already exhibited relatively high intrinsic motivation towards academic success. This makes it rather difficult to make any comparison with the findings of Murray (1976) who studied transfer of achievement desire from the physical to the cognitive domain.

CHAPTER VCONCLUSIONSFindings Summary:

The important findings resulting from this study appear to be:

- 1(a) Shuttle run times do improve as a result of a daily 15 minute physical fitness programme.
 - (b) Sit up scores do improve as a result of a daily 15 minute physical fitness programme
 - (c) Softball throw distances do improve as a result of a daily 15 minute physical fitness programme.
 - (d) 550 metre run times do improve as a result of a daily 15 minute physical fitness programme.
 - (e) 5 minute run times do not necessarily improve as a result of a daily 15 minute physical fitness programme.
- 2(a) Pulse rate at rest does not necessarily decrease as a result of a daily 15 minute physical fitness programme.
 - (b) Recovery pulse rate during the period 0-1 minute immediately after a 5 minute exercising period does improve as a result of a daily 15 minute physical fitness programme.
 - (c) Recovery pulse rate during the period 1-2 minutes after a 5 minute exercising period does improve as a result of a daily 15 minute physical fitness programme.
 - (d) Recovery pulse rate during the period 2-3 minutes after a 5 minute exercising period does improve as a result of a daily 15 minute physical fitness programme.
 - (e) Recovery pulse rate during the period 3-4 minutes after a 5 minute exercising period does improve as a result of a daily 15 minute physical fitness

- programme.
3. Basic multiplication facts recall does not improve as a result of a daily 15 minute physical fitness programme.
 4. Basic addition facts recall does improve as a result of a daily 15 minute physical fitness programme.
 5. Multiplication tables at speed do not improve as a result of a daily 15 minute physical fitness programme.
 6. Addition tables at speed do not improve as a result of a daily 15 minute physical fitness programme.
 7. P.A.T.Mathematics raw scores do not improve as a result of a daily 15 minute physical fitness programme.
 8. P.A.T.Reading Comprehension raw scores do improve as a result of a daily 15 minute physical fitness programme.
 9. P.A.T.Reading Vocabulary raw scores do improve as a result of a daily 15 minute physical fitness programme.
 10. P.A.T.Listening Comprehension raw scores do not necessarily improve as a result of a daily 15 minute physical fitness programme.

Conclusions:

On the basis of the above findings, the first major conclusion of this study is that physical fitness among intermediate school children does improve as a result of a daily 15 minute fitness programme.

This conclusion is based on the deduction that the significant trend towards improvement in physical fitness among the experimental group is sufficient to add substance to the theories expounded upon in Chapters I and II, as well as to provide support for the findings of Van Handel (1976), Thoren (1971), Gettman

et al. (1976) and Miles et al. (1976), all of whom reported physical fitness gains, according to similar criteria, among their experimental groups.

This study goes a step further than those reviewed above in that it reveals significant gains in physical fitness among its experimental pupils in a minimum of training time. The experimental group never exceeded its timetabled 15 minutes daily physical fitness exercise block. In fact, daily periods of continuous, submaximal exercise seldom exceeded 12 minutes and one day per week on average was usually lost due to weather or school organisation. This correlates closely with Jackson's (1976) study, reviewed earlier, which provides a rationale for class fitness programmes on the basis of 9 and 12 minute distance runs. It may therefore be concluded that suggested curtailment of Westcott's (1976) second criterion, (refer Chapters 1 and 2) regarding a minimum duration of 20 minutes for fitness activities, is indeed possible, with the provision that fitness activities be submaximal but as continuous as possible.

The second major conclusion of this study is that children who are in a superior state of physical fitness perform better in some areas of their academic work.

With regard to the findings of Cowell and France (1963), Gruber (1975) and Baley and Field (1976), the results of this study did not show any manifestation of enhanced cortical development. Enriched physical activity was certainly provided, but this did not lead to such a clearly observable, concurrent increase in academic achievement as was established by the Vanves Experiment (1951), Frostig (1964), Clay (1972), Vallett (1974) and Blair (1977).

Unlike Gabbard's (1978) investigation (refer Chapter I) academic instruction and testing did not always take place immediately after physical fitness training sessions. Hence it would be difficult to use the results of this thesis as a means of comparison between findings.

Contrary to the postulations of Davey (1957), Duffy (1962) and Marteniuk (1976), outlined in Chapter I, the findings on academic progress do not provide sufficient statistically significant evidence to indicate an immediate or later transfer of arousal function, due to exercise, into academic work. However, this is not to deny the above authors' theories regarding arousal function. Indeed they might have received a large measure of support from this study's results, had the random assignment of pupils, intended in the experimental design (ref.p.30), been more effective.

A third, somewhat subjective conclusion, may be reached on the basis of the discussion in Chapter IV concerning individual pupils' test results and observed performance in relation to studies reviewed in Chapters I and II.

In Chapters I and II the current concern regarding obesity and cardiac-related disease was discussed, with reference to several overseas as well as New Zealand studies. The concern about lack of motivation regarding physical fitness exercises and lessons, as well as sports dropout rates, was also discussed. Scrutiny of individual pupils' physical fitness pre-test and post-test results in Chapter IV revealed that some pupils in the experimental group with the highest motivation achieved the greatest gains, while pupils with the lowest motivation achieved the least gains.

No system of material incentives was instituted in this study, unlike Schendel's (1976) study. Instead of ribbons, certificates and trophies, the pupils were motivated by the teacher's own attitude towards the intrinsic value of physical fitness as part of one's total lifestyle. They were also encouraged by the teacher's explanation of the purpose and value of activities, by his example in undertaking exercises with the pupils and, finally, by his encouragement of and praise for their efforts.

On the basis of the above observations, the conclusion, albeit a somewhat subjective one, may be reached that motivation, ideally of an intrinsic nature, is the key to success in physical fitness activities or, for that matter, in any activity.

Implications of the Study:

The implication of this study for New Zealand society is that physical fitness is an important, ongoing aspect of people's daily lives.

The implications for teachers are that fitness programmes should not be spasmodic; activities, even if of short duration due to timetable pressures, weather conditions etc., should be kept as continuous as possible for maximum effect; activities must be interesting; and finally, pupils require constant motivation in the form of example, encouragement and praise. It can further be implied, on the basis of this study, that the regular Physical Education programme employed in our schools is, at best, of doubtful value in terms of pupils' physical fitness.

The implications for Education Department authorities are that physical fitness programmes are at the mercy of weather factors unless suitable equipment, gymnasiums and changing areas are provided; teacher training and inservice courses are necessary to ensure up-to-date and motivating programmes;

Physical Education Advisers are necessary for the purpose of liaison with schools and programme direction; and finally, the creation of positions of responsibility for Physical Education, especially in the formative Intermediate School years, is essential for the instituting, planning and coordination of programmes.

It is significant to note that all the above implications for teachers and Education Department Authorities are issues inherent in the Johnson Report (1977) or arising from it in such articles as that by Going (1978), or reports, e.g. that of Lonsdale (1978), concerning the related recommendations of a seminar of Taranaki Intermediate Schools' principals and senior staff on Physical Education. The principals' three recommendations pertinent to this study were:

- "(1) In all intermediate schools, positions of responsibility be created for heads of department in physical education.
- (2) Provision be made to supply schools with a wider range of physical education equipment, and that grants made for the replacement of "incidental" items be increased.
- (3) Provision be made in all schools both for suitable, equipped and heated indoor spaces, and for all-weather indoor areas, for physical education."

Suggestions for Further Research:

From the results of this study, it is suggested that future studies could well be undertaken in the following areas:

- (1) re replication: repeat this study, exercising greater control over the random assignment of pupils into control and experimental groups, possibly by pre-testing then grouping, if school organisation allows.

- (2) re Physical Education programmes: survey the efficacy of the current New Zealand primary schools' physical education programmes, especially in relation to physical fitness.
- (3) re achievement: continue to explore the relationship between physical fitness and academic achievement, especially in terms of arousal function, concentration and transfer of achievement desire.
- (4) re teacher effect: investigate relationships between physical fitness factors such as motivation, programme activities, teacher beliefs, teacher qualifications, teacher example and participation, pupil involvement and pupil sport dropout rate.
- (5) re pupil factors: investigate relationships between factors such as sports interest, self-concept, fitness, obesity and diet.

SAMPLE BLOCK PLANS

Plan A

TERM I

TERM II

TERM III

Weeks	1 2 3 4 5	6 7 8	9 10 11 12	1 2 3 4 5 6 7	8 9 10 11 12	1 2 3 4 5 6	7 8	9 10 11 12
Physical Education Lessons	Swimming	Fit-ness	Gymnastics	Large Ball	Movement and Dance	Athletics	Fit-ness	Small Ball
Organised Games Programme	Swimming Sports		Gymnastic Festival	Winter Sports Day	School Dance	Athletic Sports		
Special Events	Summer Games - Minor		Major and	Winter Games - Minor		Major and		Summer Games - Minor

Plan B

TERM I

TERM II

TERM III

Weeks	1 2 3 4 5	6 7 8 9	10 11 12	1 2 3 4 5	6 7 8 9	10 11 12	1 2 3 4 5	6 7 8 9	10 11 12
Physical Education Lessons	Swimming	Fitness	Large Ball	Large Ball	Movement and Dance	Gymnastics	Small Ball	Athletics	Swimming and Water Safety

Plan C

TERM I

TERM II

TERM III

Weeks	1 2 3 4	5 6 7 8	9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4	5 6 7	8 9 10	11 12		
Physical Education Lessons	Daily Fitness Programme			Daily Fitness Programme				Daily Fitness Programme		
	Athletics	Small Ball	Gymnastics	Large Ball (Outdoor) Movement and Dance (Indoor) Note: Ensure a balance of approximately 6 weeks on each topic.	Gymnastics	Small Ball	Tab-loids	Water Safety and Resuscitation		

N.Z. Phys. Ed. Handbook "Planning the Programme" 1973.

APPENDIX 1.

Plan D An Intermediate School Programme

Weeks	1 2 3	4 5	6 7 8	9 10 11 12	1 2	3 4 5 6 7	8 9 10 11 12	1 2	3 4 5 6 7	8 9 10	11 12
PROGRAMME OUTLINE	SWIMMING	FIT-NESS	SMALL BALL	LARGE BALL	GYMNASTICS	MOVEMENT AND DANCE	FIT-NESS	ATHLETICS	SMALL BALL	SWIMMING	
General plan for class reference	Stroke correction New strokes	e.g. Circuits	Emphasis should be on throwing and catching skills needed for games.	Emphasis should be on passing and catching skills needed for games.	Graded gymnastic circuits from simple to advanced activities.	Select aspect required.e.g. Teach folk and social dances along with appropriate steps and formations.	On the level charts, distance and map running	Running, jumping and throwing activities. Ensure maximum involvement.	Revision Term I work in 1st week. Batting skills required for games.	Resuscitation and water safety.	
INTRA MURAL SPORTS		SWIMMING	SUMMER SPORTS			INCENTIVE AWARDS	WINTER SPORTS	ATHLETICS	CROSS COUNTRY	TARLOIDS	
EXTRA MURAL SPORTS		SWIMMING	SUMMER SPORTS			GYMNASTIC FESTIVAL	WINTER SPORTS	ATHLETICS			

N.Z. Phys. Ed. Handbook. "Planning the Programme" 1973.

FITNESS PERFORMANCE PROFILE

NAME _____ AGE _____
 CLASS _____ SCHOOL _____

		10	20	30	40	50	60	70	80	90	
1	Shuttle Run										
1	Sit-Up										
1	Pull-Up Hang										
1	Softball Throw										
1	550 m										

1	INDEX										

This example shows a pupil who scored as follows:

1st time of testing:
 48, 55, 35, 70, 60.
 Index (average) = 54

2nd time of testing:
 55, 70, 35, 75, 70.
 Index = 61

Supplies of the Fitness Performance Profile cards may be obtained from physical education advisers.

TEST ADMINISTRATION

Scoring Tables:

Copies of test recording sheets are available from physical education advisers. The age percentile scores (see pages 8-12) are based on testing carried out during 1971 throughout New Zealand schools for boys and girls 9-13 years of age.

Scoring Method

- Refer to appropriate age tables.
- Check the pupil's actual test result on the vertical column.
- The raw score is found in the vertical column under the appropriate test heading. The corresponding percentile is then read off horizontally in column one.
- The highest percentile is always taken (i.e., where the same raw score is repeated).

PHYSICAL EDUCATION
FITNESS CLASSIFICATION

	1	2	3	4	5	6	7	8	9	10
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
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N.Z. Phys. Ed. Handbook "Fitness Activities" 1973.

TEST ONE

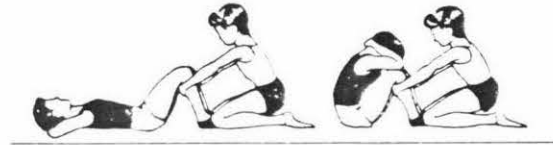
SHUTTLE RUN : BOYS AND GIRLS



- EQUIPMENT:** Two blocks of wood 100 x 50 x 50mm; stopwatch; tape-measure.
- COURSE DETAILS:** Starting lines each 1 m long and 25 mm wide are marked 9.14m apart. Behind each line and touching it is a circle 50cm diameter. Lines may be painted or chalked 25 mm wide.
- STARTING POSITION:** Standing start position with leading foot inside circle and behind starting line. In the opposite circle the two blocks are placed side by side, but spaced for easy pick-up.
- ACTION:** On the signal "ReadyGo!", the runner dashes across to the opposite circle, picks up one block and returns to place it inside the start circle. The runner returns for the second block and then runs past the starting line at full speed with the block in hand. After the run-through, the runner sets the blocks in position for the next runner who starts from the opposite end.
- TIMING:** The stopwatch is started immediately after the word "Go" has been given. It is stopped as the runner crosses the starting line, i.e., after four trips. Timing is to the nearest tenth of a second.
- PURPOSE:** Speed and agility.

TEST TWO

BENT KNEE SIT UPS (60 SECS) : BOYS AND GIRLS



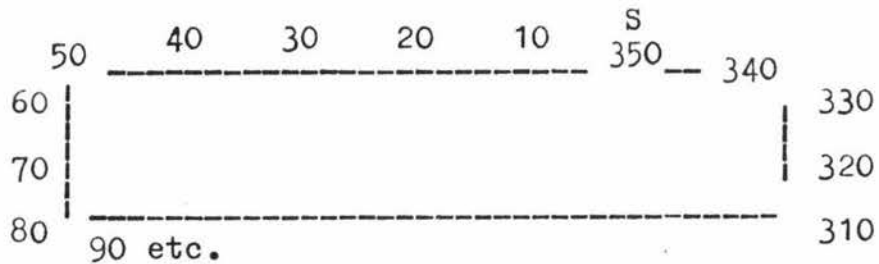
- EQUIPMENT:** Stopwatch.
- STARTING POSITION:** See diagram.
- Performer:** Lies on back, fingers interlaced behind neck, knees raised at approximately 90° angle, feet flat on floor.
- Partner:** Kneels with knees outside performer's feet and touching them. Hands are placed above calves and behind knees, arms straight. The main purpose is to fix performer's lower limbs.
- ACTION:** See diagram. On signal "Begin!" performer sits up so that elbows are placed on top of knees then lowers trunk until back touches the ground. This movement is continued as many times as possible until "Stop" is called. Performers seat must keep in contact with floor throughout.
- SCORING:** Scoring is done by partner who counts one for each correctly performed sit up movement.
- TIME:** The time is 60 seconds. The timekeeper should call "Half-time" after 30 seconds.
- PURPOSE:** Trunk strength.

APPENDIX 5.

TEST THREE.

5 MINUTE RUN : BOYS AND GIRLS.

- EQUIPMENT:** Stopwatch; measuring tape or rototape;
10 metre markers.
- MARKINGS:** Starting line; divisions every 10 metres.
- COURSE:** The course is laid out on a level hard
area as indicated in diagram.



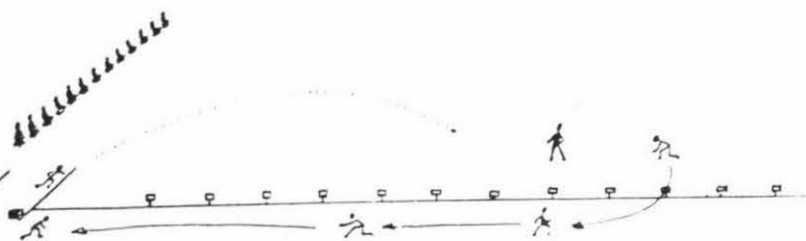
Circuits shorter than 200 metres handicap runners because of constant turning of corners. There should be a good, wide straight at the start to reduce the possibility of stumbles through jostling.

Timing: Timekeeper sets runners off then calls "stop" after 5 minutes have elapsed. Each runner has a partner who acts as distance recorder by counting the runner's laps each time he re-crosses the start line, then adding on the number of metres to the nearest ten, covered in the last lap when "STOP" is called.
e.g. 3 laps 20 metres.

Purpose: Cardio-respiratory endurance.

TEST FOUR

SOFTBALL THROW : BOYS AND GIRLS

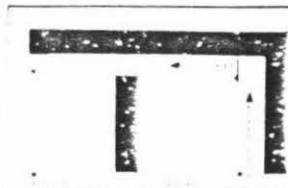


- EQUIPMENT:** 6 standard softballs in shallow box; tapemeasure; marking pegs - 6m, 9m, 12m etc.
- MARKINGS:** Starting line.
Restraining line 3m behind it. Throwing line pegged at 3m intervals with clearly painted distance markers.
- ACTION:** Performer throws three consecutive times with correct overarm throws from behind the starting line.
(For simplifying control, note in diagram, that if performers throw to one side of line, helpers can relay thrown balls back to box at starting line).
- SCORING:** Tester records the distance of the best of the three throws, to the nearest metre. Note that "no throws" do not count.
- PURPOSE:** Throwing ability plus explosive strength.

TEST FIVE

550 METRE RUN : BOYS AND GIRLS

- EQUIPMENT:** Stopwatch, measuring tape or rototape.
- MARKINGS:** Starting and finishing line.



- COURSE:** The course is preferably laid out on a level hard area as indicated in diagram.
(All testing for the norm was done on a hard surface.)
One-, two-, three-lap courses are suitable. Circuits shorter than 200 metres handicap runners because of constant turning of corners. There should be a good wide straight at the start to reduce possibility of stumbles through jostling.
- TIMING:**
- Method 1:** Each runner has a partner who acts as timekeeper picking up the time from the tester who calls aloud the elapsed time as the runners cross the finishing line. (e.g. 1 minute 59 2 minutes one etc.)
- Method 2:** A reliable recorder takes down the times as they are called out. The timekeeper calls out the time of every runner. This method works very well with groups of up to 12.

NOTE: Where children run regularly on the normal P.E. programme, they can be expected to run non-stop in the 550 metre test. However, no pressure should be brought to bear upon pupils and they should be encouraged to cover the course at their own best pace.

- PURPOSE:** Cardio-respiratory endurance.

APPENDIX 7

Pupil Step Test Record

Name:			
	Pre - test		Post-test
Age:	yrs.	mths.	yrs. mths.
Date:	/	/	/ /
Resting Pulse:			
Immed. Post:			
1-2 min. "			
2-3 min. "			
3-4 min. "			
Health Risk:			

APPENDIX 8.

36 Basic multiplication facts Test.
 45 Basic addition facts Test.

Procedures:

Test the students on the basic facts listed below. When testing, read them quite quickly - say 3-4 second delays. Record the results, using separate columns for +, x. Leave two adjacent columns blank for a post-test.

45 Basic + Facts

4+9=13	3+9=12	9+9=18	4+8=12
3+8=11	8+9=17	8+8=16	3+7=10
4+7=11	4+6=10	3+6=9	7+9=16
7+8=15	3+5=8	4+5=9	4+4=8
3+4= 7	7+7=14	6+9=15	6+8=14
2+9=11	1+8=9	1+7=8	2+8=10
6+7=13	6+6=12	5+9=14	2+6= 8
1+5= 6	1+4= 5	2+5= 7	5+8=13
5+7=12	2+4= 6	1+3= 4	1+2= 3
2+3= 5	5+6=11	5+5=10	2+2= 4
1+1= 2	1+6= 7	2+7= 9	3+3= 6
1+9=10			

36 Basic X Facts

2x5=10	4x6=24	2x9=18	4x5=20
6x9=54	3x6=18	5x6=30	8x8=64
4x7=28	5x8=40	3x5=15	6x8=48
3x7=21	5x5=25	3x3= 9	9x9=81
5x7=35	7x7=49	2x6=12	5x9=45
3x4=12	2x3= 6	4x8=32	2x8=16
6x7=42	4x4=16	8x9=72	4x9=36
7x9=63	6x6=36	2x2= 4	7x8=56
2x7=14	3x9=27	3x8=24	2x4= 8

APPENDIX 9.Times Tables Tests.

X	3	5	8	2	10	1	12	7	11	4	9	6
4												
9												
6												
11												
7												
1												
10												
12												
5												
2												
8												
3												

144

+	3	5	8	2	10	1	12	7	11	4	9	6
4												
9												
6												
11												
7												
1												
10												
12												
5												
2												
8												
3												

144

Time allowed: 4 minutes for each test.

APPENDIX 11.**READING COMPREHENSION**Progressive Achievement Test**ANSWER SHEET FORM A PART 6**Name:
(First) (Last)

School:

Age: Class:

Raw Score Level Score Percentile **SAMPLE
ANSWERS****S.1. (C)****S.2. ()****START THE
TEST HERE**

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. ()

APPENDIX 12.

READING VOCABULARYProgressive Achievement TestANSWER SHEET FORM **A** PART **6**Name:
(First) (Last)

School:

Age: Class:

Raw Score Level Score Percentile **SAMPLE
ANSWERS****S.1. (B)****S.2. ()****START THE
TEST HERE**

- | |
|---------|
| 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. () |

Appendix 14.

Boys' and Girls' Fitness Test Means and Standard Deviations.

	Control Group I				Control Group II				Experimental Group			
	Girls (14)		Boys (14)		Girls (15)		Boys (14)		Girls (15)		Boys (14)	
	Control	Control	Control	Control	Control	Control	Expt.	Expt.	Expt.	Expt.		
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Shuttle	\bar{x} 8.77	9.57	8.30	9.24	9.08	10.16	9.00	10.45	8.70	8.42	8.16	7.90
	σ 0.39	0.59	0.89	0.80	1.28	1.01	1.00	0.61	0.33	0.35	0.69	0.77
Sit up	\bar{x} 23.29	25.64	33.79	35.23	24.00	25.20	32.93	32.36	25.33	30.87	31.07	35.79
	σ 4.78	5.02	6.10	6.70	10.07	9.69	10.64	8.55	9.99	8.63	10.82	10.71
Pull up	\bar{x} 6.39	4.93	3.71	3.21	8.93	6.70	3.21	4.00	7.87	11.53	3.29	6.36
	σ 5.18	2.67	3.67	2.72	6.84	7.07	2.99	3.49	9.26	11.24	3.85	7.09
Throw	\bar{x} 16.36	14.71	28.43	29.64	15.06	14.53	28.57	28.86	19.73	25.73	25.71	31.64
	σ 6.32	7.60	5.41	5.21	4.11	4.172	7.92	8.34	4.37	3.89	8.81	8.81
550m	\bar{x} 2.27	3.03	2.10	2.31	2.33	2.726	2.09	2.44	2.33	2.34	2.17	2.06
	σ 0.30	0.49	0.19	6.26	0.311	0.495	0.32	0.611	0.15	0.15	0.42	0.44
5 min. run	\bar{x} 868.57	848.57	957.86	982.86	885.33	896.00	1013.57	1055.00	838.00	935.33	940.714	1047.86
	σ 70.80	102.05	225.19	208.71	129.28	127.44	145.79	163.60	129.24	136.58	212.22	210.13
Step Test												
Rest	\bar{x} 91.57	90.07	87.86	86.143	86.40	84.53	86.86	85.71	88.93	85.40	88.71	86.71
	σ 10.50	8.45	10.33	8.96	11.69	11.58	8.55	9.47	9.99	7.54	6.05	4.68
Zero	\bar{x} 144.14	146.57	136.86	133.86	148.00	153.60	145.29	149.86	148.00	132.53	142.79	126.86
	σ 11.65	9.49	11.68	8.82	13.16	13.48	11.08	15.08	13.14	10.13	12.64	14.37
1 min.	\bar{x} 126.57	125.71	119.43	120.14	124.66	127.30	114.00	117.14	121.20	108.60	115.00	108.43
	σ 6.58	7.18	8.64	7.63	10.22	11.08	8.49	11.49	11.48	9.73	10.22	11.32
2 min.	\bar{x} 112.71	112.86	107.14	107.43	109.06	110.26	101.14	103.00	110.26	101.33	106.00	95.71
	σ 7.30	6.36	9.40	7.98	13.68	12.58	8.73	7.56	12.58	7.69	8.59	7.48
3 min.	\bar{x} 104.57	103.71	97.86	98.14	95.86	96.00	92.00	92.86	102.53	90.70	98.86	87.29
	σ 10.94	7.68	11.35	12.32	14.23	13.115	6.70	7.09	12.45	7.78	8.97	5.06

Appendix 14.

Appendix 15.

Boys' and Girls' Academic Test Means and Standard Deviations.

	Control Group I				Control Group II				Experimental Group			
	Girls (14)		Boys (14)		Girls (15)		Boys (14)		Girls (15)		Boys (14)	
	Control	Control	Control	Control	Control	Control	Control	Control	Expt.	Expt.	Expt.	Expt.
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Maths.P.A.T.	\bar{x} 23.36	25.69	24.50	27.79	25.87	27.93	22.57	23.50	21.53	26.70	21.20	26.06
	σ 6.62	6.81	9.26	10.08	9.20	9.88	7.52	9.52	4.50	8.42	10.04	10.39
X Tables	\bar{x} 72.50	92.50	59.14	73.93	71.13	93.93	76.14	90.21	68.80	103.53	61.73	88.06
	σ 19.17	18.15	26.64	35.13	29.22	24.62	27.34	29.21	22.62	21.58	24.37	41.13
+ Tables	\bar{x} 78.79	111.79	74.07	99.99	86.93	117.20	78.71	95.57	70.93	105.80	72.20	101.06
	σ 37.65	18.12	25.94	34.45	27.98	19.93	21.96	30.13	14.68	17.64	24.24	31.39
Basic X facts	\bar{x} 30.35	33.00	28.43	30.79	33.60	34.93	31.29	31.64	31.53	34.66	28.73	31.60
	σ 5.88	3.62	7.41	6.60	3.89	1.83	5.38	5.32	3.56	1.95	8.69	5.73
Basic + facts	\bar{x} 43.79	44.00	40.43	40.43	44.20	44.53	42.93	43.57	41.06	44.60	39.40	42.00
	σ 1.88	1.62	7.98	11.34	1.47	0.92	6.63	3.46	4.35	0.63	6.59	4.59
Listening	\bar{x} 28.71	28.29	29.36	30.00	26.73	29.13	27.50	30.00	26.33	31.33	27.80	30.86
	σ 5.12	7.69	6.22	6.88	7.53	6.19	3.18	4.85	7.35	6.29	4.69	2.89
Comprehension	\bar{x} 28.50	29.50	28.00	30.07	27.53	27.26	25.93	29.29	21.06	26.87	22.06	28.86
	σ 6.49	6.95	7.93	9.04	8.26	7.95	7.14	7.28	9.45	9.45	10.82	10.64
Vocabulary	\bar{x} 41.14	44.43	42.29	44.43	40.40	43.20	40.78	41.79	36.47	39.40	33.00	38.73
	σ 8.54	7.00	14.72	15.11	11.26	7.91	7.86	11.10	13.32	12.63	13.85	14.39

Appendix 15.

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