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

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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.

TABLE OF CONTENTS

			page
		LIST OF TABLES.....	v.
		LIST OF APPENDICES	vi.
CHAPTER	I	INTRODUCTION	1.
CHAPTER	II	LITERATURE REVIEW.....	15.
CHAPTER	III	EXPERIMENTAL DESIGN.....	27.
CHAPTER	IV	RESULTS.....	35.
CHAPTER	V	CONCLUSIONS	60.
		APPENDICES	67.
		BIBLIOGRAPHY	82.

LIST OF TABLES

	page	
Table 2.1	Timetable used in Vanves since 1961	18.
Table 2.2	Changes in Mean Heartrate among Obese Pupils as a Result of Training	21.
Table 3.1	Experimental Timetable	29.
Table 3.2	Control Timetable	29.
Table 3.3	Testing Battery for Experimental and Control Classes	31.
Table 4.1	Motor Fitness Performance Test:	
	(a) Shuttle Run	35.
	(b) Sit Ups	36.
	(c) Softball Throw	37.
	(d) 550 metre Run	38.
	(e) 5 minute Run	39.
Table 4.2	Harvard Step Test:	
	(a) Pulse Rates at Rest	40.
	(b) Pulse Rates-immediate post exercise	41.
	(c) Pulse Rates- 1 min. post exercise	42.
	(d) Pulse Rates- 2 min. post exercise	43.
	(e) Pulse Rates- 3 min. post exercise	44.
	(f) Summary of Physical Fitness Test Results.	45.
Table 4.3	Mathematics Basic Facts Multiplication Results	47.
Table 4.4	Mathematics Basic Facts Addition Results.	48.
Table 4.5	Mathematics Times Tables Results	49.
Table 4.6	Mathematics Addition Tables Results	50.
Table 4.7	Mathematics P.A.T. Results	51.
Table 4.8	Reading Comprehension P.A.T.Results	52.
Table 4.9	Reading Vocabulary P.A.T.Results	53.
Table 4.10	Listening Comprehension P.A.T.Results	54.
Table 4.11	Summary of Academic Test Results	55.
Table 4.12	Selected Sub-group of Experimental Pupils' Harvard Step Test Results	58.

LIST OF APPENDICES

1.	Sample Block Plans for Primary School Phys. Ed.	67.
2.	Sample Block Plan for Intermediate School Phys.Ed.	68.
3.	Fitness Performance Profile	69.
4.	Shuttle Run and Sit-Up Test Outlines	70.
5.	5 Minute Run Test Outline	71.
6.	Softball Throw and 550m.Run Test Outlines	72.
7.	Pupil Step Test Record	73.
8.	Basic Facts Tests in Addition and Multiplication	74.
9.	Tables Tests in Multiplication and Addition	75.
10.	Mathematics P.A.T. Answer Sheet	76.
11.	Reading Comprehension P.A.T.Answer Sheet	77.
12.	Reading Vocabulary P.A.T.Answer Sheet	78.
13.	Listening Comprehension P.A.T.Answer Sheet	79.
14.	Boys' and Girls' Fitness Tests Means and Standard Deviations	80.
15.	Boys' and Girls' Academic Test Means and Standard Deviations	81.

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 Bassey'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.