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Comparative Effects of Two Different Physical Education Programs Upon the Physical Fitness and Motor Educability of Ninth and Tenth Grade Boys

Charles Russell Reynolds

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COMPARATIVE EFFECTS OF TWO DIFFERENT PHYSICAL EDUCATION PROGRAMS
UPON THE PHYSICAL FITNESS AND MOTOR EDUCABILITY
OF NINTH AND TENTH GRADE BOYS

By
Charles Russell Reynolds

A thesis submitted
in partial fulfillment of the requirements for the
degree Master of Science at South Dakota
State College of Agriculture
and Mechanic Arts
August, 1957
This thesis is approved as a creditable, independent investigation by a candidate for the degree, Master of Science, and acceptable as meeting the thesis requirements for this degree; but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

Thesis Adviser

Head of the Major Department
ACKNOWLEDGEMENTS

The writer wishes to express his appreciation to the individuals who have given of their time and thought in making this study possible: to the administration of Brookings High School for permission to conduct this study; to Mr. Norman Johnson, Director of Physical Education, for his assistance; to subjects used in this experiment for their cooperation; to my advisor, Dr. Campbell Snowberger, for his suggestions; and to fellow graduate students for their help in testing.

C. R. R.
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. THE PROBLEM</td>
<td>1</td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Statement of the Problem</td>
<td>6</td>
</tr>
<tr>
<td>II. RELATED LITERATURE</td>
<td>7</td>
</tr>
<tr>
<td>Strength Testing</td>
<td>11</td>
</tr>
<tr>
<td>Motor Educability Testing</td>
<td>17</td>
</tr>
<tr>
<td>III. PROCEDURE</td>
<td>19</td>
</tr>
<tr>
<td>The Sample</td>
<td>19</td>
</tr>
<tr>
<td>Collection of Data</td>
<td>21</td>
</tr>
<tr>
<td>The Physical Education Programs</td>
<td>34</td>
</tr>
<tr>
<td>The Testers</td>
<td>36</td>
</tr>
<tr>
<td>IV. TREATMENT OF THE DATA</td>
<td>38</td>
</tr>
<tr>
<td>Analysis of Individual Results</td>
<td>38</td>
</tr>
<tr>
<td>Comparison of Range and Variability</td>
<td>40</td>
</tr>
<tr>
<td>Comparison of Mean Gains</td>
<td>41</td>
</tr>
<tr>
<td>Statistical Significance of Mean Gains</td>
<td>42</td>
</tr>
<tr>
<td>V. SUMMARY, CONCLUSIONS, AND IMPLICATIONS</td>
<td>45</td>
</tr>
<tr>
<td>Summary of Results</td>
<td>46</td>
</tr>
<tr>
<td>Conclusions</td>
<td>46</td>
</tr>
<tr>
<td>Implications</td>
<td>46</td>
</tr>
<tr>
<td>LITERATURE CITED</td>
<td>48</td>
</tr>
</tbody>
</table>

iv
# LIST OF TABLES

<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Raw Scores of Experimental and Control Groups in Initial and Final Tests of Physical Fitness and Motor Educability</td>
<td>39</td>
</tr>
<tr>
<td>II. Range of Scores of Experimental and Control Groups in Initial and Final Tests of Physical Fitness and Motor Educability</td>
<td>40</td>
</tr>
<tr>
<td>III. Standard Deviations of Experimental and Control Groups in Initial and Final Tests of Physical Fitness and Motor Educability</td>
<td>41</td>
</tr>
<tr>
<td>IV. Significance of Mean Gains of Experimental and Control Groups in Physical Fitness Index</td>
<td>44</td>
</tr>
<tr>
<td>V. Significance of Mean Gains of Experimental and Control Groups in Motor Educability</td>
<td>44</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Height and Weight</td>
<td>22</td>
</tr>
<tr>
<td>2. Grip Strength Test</td>
<td>23</td>
</tr>
<tr>
<td>3. Back Lift Test</td>
<td>25</td>
</tr>
<tr>
<td>4. Leg Lift Test</td>
<td>27</td>
</tr>
<tr>
<td>5. Push-Up Test</td>
<td>28</td>
</tr>
<tr>
<td>6. Lung Capacity Test</td>
<td>29</td>
</tr>
<tr>
<td>7. Pull-Up Test</td>
<td>31</td>
</tr>
<tr>
<td>8. Metheny Simplified Mat</td>
<td>32</td>
</tr>
<tr>
<td>9. Means of Both Groups in Physical Fitness Index And Motor Educability Before and After Exercise</td>
<td>43</td>
</tr>
</tbody>
</table>
CHAPTER I

THE PROBLEM

Introduction

According to Cureton\textsuperscript{1}, a physically fit person is one who has the ability to participate in strenuous activities over long periods of time. Physical fitness involves such factors as heredity, good health, good hygienic habits, adequate amount of strength and endurance, and the correction of remedial defects. A physically fit person, therefore, is one who is free from handicapping infection, disease, or defects; is properly nourished; practices wholesome mental hygiene; and possesses sufficient strength, endurance, skill, and knowledge to perform successfully the services required in wholesome physical activity.

Physical fitness is considered as one component of total fitness. It does not include all of the aspects of emotional fitness, mental fitness, or social fitness, which are other components of the larger term, total fitness. In emotional fitness the power of thought is paramount—solving problems, rationalizing, making choices, memorizing and computing. In social fitness adaptability to the group and to particular friends is important. Physical fitness is related to these other phases of fitness in addition to being important for itself. A high quality in all components of total fitness is desired for all of our people.

The Joint Committee of the American Medical Association and the American Association for Health, Physical Education and Recreation has defined a physically fit person as one having "... enough strength, speed, agility, endurance, and skill to accomplish the maximum tasks that the day may bring."  

The United States Office of Education reports that without vigorous physical activity in the developmental period of youth, optimum body functioning is impossible. Physical activity is the only known means for developing the ability to engage in activities demanding sustained effort. Due to differences among individuals there is no one way in which all persons can develop the same degrees of strength, endurance and skill.  

During recent years there has been a growing conviction among physical educators that a high degree of physical fitness is essential for all people in our land. This conviction has been brought about by several things. The first of these is that our country learned with amazement that a high percentage of the men examined for military service during World War I were rejected because they were not physically fit.  

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Little did people realize that many of these rejections could not be improved upon by physical education as many were from orthopedic, sensory, and other disabilities. A low quality of physical fitness was only a minor part. Yet, this same criticism came with World War II and the Korean War with statements from combat leaders attesting the fact that many lives had been lost simply because troops were not in proper condition for their duties.

The matter of being physically fit is not just that of building muscles. Although strengthening exercises are a very important part of a developmental program, the results attained for the individual go beyond this more apparent phase of the process. Along with increasing strength accrue such other benefits as increased organic vigor, stamina, poise, and an improved mental outlook. Many investigations during the past twenty-five years have substantiated these assumptions. Thus, one of the physical educator's prime duties is to increase his pupils' muscular strength, which is basic to all other growth and development.

In John Locke's "Some Thoughts Concerning Education," the following statement is made by that great educator: "A sound mind in a sound body is a short but full description of a happy state in this world. He that has these two has little else to wish for; and he that wants either of them will be but little better for anything else." Aristotle, also, maintained that education must count on the sound physique of the educand.5

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The importance of physical fitness was brought into focus recently by the announcement of the results of the Kraus-Weber Tests administered to 3,000 European children and over 4,000 American youth. All tests were administered by the authors themselves and were completely standardized. The findings indicated that fifty-seven per cent of the United States youngsters tested failed one or more of the six tests for muscular strength and flexibility, while only 8.7 per cent of the European youngsters failed. It also showed that 44.3 per cent of the United States youngsters failed the one flexibility test, while only 7.8 per cent of the European youngsters failed. It also demonstrated that 35.7 per cent of the United States children failed one or more of the five strength tests, while only 1.1 per cent of the European youngsters failed.

As a direct result of this report, the President of the United States, on June 18, 1956, called a conference on the fitness of American Youth held at the White House in Washington, D. C. This occasion was a definite milestone in the history of physical education in the United States for two reasons; first, it amplified the importance of the problem, and secondly, it was the first peacetime conference on physical fitness to be held.

The need for this conference can best be summarized by quoting parts of Vice-President Nixon's Keynote address.

We are not a nation of softies but we could become one if proper precautions are not taken to provide the normal opportunity for physical health giving exercise.

The objective of an adequate physical fitness program

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can be summed up in one word—participation. The super-athlete is not our primary concern; it is the boy or girl with ordinary physical abilities. Less than fifty per cent of the boys and girls in our high schools have physical education. Ninety-one per cent of the nation's 150,000 elementary schools have no gymnasium. Forty per cent of those person's entering the armed forces in World War II were unable to swim as far as fifty feet.\(^7\)

Objectives of physical education have been stated by many writers in the field of physical education. A majority of these writers list physical fitness, either directly, or indirectly, as one of the objectives of physical education. However, in order to obtain evidence to substantiate the realization of these objectives, one is confronted with a great deal of superficial discussion in an effort to estimate values of regular participation in a physical education program.

Staley has pointed out . . . "that in reviewing the literature of physical education we find a vast array of statements or assumptions that this program does contribute to producing many desirable results. . . yet when we look for the supporting evidence we find that it is singularly limited, if not entirely lacking."\(^8\)

This fact is also expressed by Cureton in a letter to Major Thulin . . . "there is no professional field so badly in need of scientific information to show the effects produced by programs. Most of the research is indirect at best and typified for restricted conditions

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in laboratories or limited to animal experiments, wherein the animals lack the motivation, the training, and the hereditary background of humans."^9

There is however, some published evidence which shows the desirable effects of participation in regular programs of physical training and conditioning.\textsuperscript{10,11} The evidence points to increases in muscular strength, endurance, and organic efficiency.

**Statement of the Problem**

The purpose of this study was to investigate changes in the physical fitness, as measured by the Roger's Physical Fitness Index, and the motor educability, as measured by the Johnson-Metheny Test, of twenty-five ninth and tenth grade boys who were under two different types of physical education programs for a period of ten weeks.


CHAPTER II

RELATED LITERATURE

Strength Testing:

Rogers summarizes the opinion of physical educators and physiologists when he writes concerning the necessity of strength in the human body.

The positive and very high relation of muscular strength to general health, physical fitness, or capacity for activity can hardly be questioned. With no strength there can be no physical activity; moreover, when muscular strength is low, all other life functions are handicapped. One can hardly see as much, hear as much, meet as many people, or contribute as much to social life when one is continually fatigued by the most necessary activities of life—eating, digestion, attention to environment, and the physical movements incident upon travel from one group of surroundings to another. The relation of organic conditions is just beginning to be recognized; but experiences are multiplied which reveal beyond per adventure, the truth of the following rule: Practically every change in the condition or functioning of the vital organs has a corresponding change in the condition or functioning of voluntary muscle.\(^{12}\)

A review of the history of strength-testing reveals the fact that measures of strength have been employed to meet many divergent needs. Clarke\(^{13}\) made a comparative analysis of a group of commonly used objective strength tests and found from the results of the study that there is a significant relationship between muscular strength and general motor ability, and that muscular strength is a major component of physical fitness. The correlation of muscular strength with general


motor ability is from .35 to .90. In instances where a physical fitness
criterion of long, hard, sustained muscular work and endurance is used,
muscular strength tests are always significant. McCloy\textsuperscript{14} points out
that strength testing has two important uses in physical education and
athletics; first, as an index of health or general physical condition,
and, second, as a predictor of potential motor ability.

Strength-testing started in 1888 when Dudley A. Sargent\textsuperscript{15} developed
a battery of tests designed to predict athletic ability. This test,
called the Intercollegiate Strength Test, consisting of ten items, was
used extensively in the early 1900's but lost prominence during the First
World War. In 1925 Frederick Rand Rogers\textsuperscript{16} revised the test, and de-
veloped norm tables for their intelligent use and interpretation. In
1931 McCloy\textsuperscript{17} refined these computations and started investigations
concerned with validating these tests to specific needs.

Throughout the history of strength-testing there has been concern
as to what part of the body should be measured to get a true picture of
total body strength. There is no standardization in the measurement of
muscle groups between the majority of strength tests. Wendler conducted
an analytical study of strength tests and made the following conclusions:

\textsuperscript{14}C. H. McCloy, "The Apparent Importance of Arm Strength in

\textsuperscript{15}Dudley A. Sargent, "Intercollegiate Strength Tests," American
Physical Education Review, II, December, 1897, p. 216.

\textsuperscript{16}F. R. Rogers, "Physical Capacity Tests in the Administration of

\textsuperscript{17}C. H. McCloy, "A New Method of Scoring Chinning and Dipping,"
Research Quarterly, IV, December, 1931, pp. 3-10.
1. The sum of the strengths of four muscle groups—the thigh flexors, the leg extensors, the arm flexors, and the pectoralis major—gives a highly reliable prediction of total strength of men.

2. The deltoids and hand flexors, plus the four groups for men, when properly combined, will predict total strength of women with approximately the same degree of reliability as the men's battery does for men.

3. The above batteries are almost as valuable for the prediction of total strength as the entire Intercollegiate Strength Test and have the added advantage of requiring no expensive apparatus.18

Numerous studies have been made relating the effects of various types of physical education programs to the physical fitness and strength of high school boys. G. T. Adamson19 conducted an experiment with a small number of boys—age 14 to 15 years—in secondary school. There were two balanced groups of twelve boys in each section. Each group had three physical education periods per week. The test group had an additional overload program amounting to thirty minutes per week for one month. The McCloy Athletic Strength and Physical Efficiency indices and the Harvard five-minute step test were administered at the beginning and end of the four-week period. The test group showed statistically significant gains over the control group in this study.


Emil Rath used ninth grade boys to study effects of different physical education programs on McCloys Strength Test, and confirms the findings of Adamson. Rath used such skill measures as: basketball throw for distance, jump and reach, bar snap for distance, and the dodging run. There were five high schools in the study. Each of four high schools had a control group; three had a basic control group; and all had a test or experimental group. The test group followed a definite program consisting of (1) a time run and variations; (2) rhythmic conditioning exercises; (3) basic events; and (4) game fundamentals. The control group varied from school to school with no definite program. The basic control received no physical education but participated in military activities only. The conclusions verify a generally accepted fact - namely that the quantity and kind of activities comprising a program determines its value for physical development; and secondly, a program planned to do so can produce a strong efficient body. In general, Rath claims that greater physical development seems to have been achieved by the program used by the test groups than by those in vogue in the individual high schools used by the control groups.

Kistler reported an experiment on the results of participation of university men in an eight-weeks physical fitness program. The purpose of the study was to measure the amount of improvement which was

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achieved in a program designed primarily to improve strength, endurance, and agility—three elements of physical fitness. A battery of five tests was used to measure the improvement of the 1,650 subjects. The five tests consisted of the following: a five minute run for distance, an obstacle course run for time, a push-up test, a chinning test, and a sit-up test. The percentage of subjects who improved ranged from 36 per cent in the five minute run to 74 per cent in the push-up test. A surprising number of subjects retrogressed in their abilities during the training period. The range of retrogression was from 15 per cent in the chinning test to 21 per cent in the obstacle course run. In addition to those who retrogressed in their performance there was a considerable number of subjects in which no change in performance was reported. The range for this group in which there was no change in performance was from 7 per cent in the sit-up test to 47 per cent in the five minute run. Of the total number of subjects, 9.8 per cent improved in all five measures; 27 per cent improved in four measures; and 33 per cent improved in three measures. Kistler concluded that the findings seemed to justify the statement that improvement may be achieved in physical fitness elements of strength, endurance, and agility through a specific training program devoted to these elements.

Strength Testing:

Wendler’s Total Strength Index:²² Wendler constructed a strength index to evaluate a large battery of strength tests to determine for each sex the muscle groups that are most valuable in predicting total strength. The instrument used to measure forty-seven different muscle groups was the

²²Wendler, loc. cit.
universal dynamometer. The criterion of strength was the sum of these forty-seven strength measures. From this Wendler devised a short battery which gave a high correlation with the original forty-seven tests. This short battery included; (1) the thigh extensors; (2) the leg extensors; (3) the pectoralis major; (4) the arm flexors; (5) the anterior trunk extensors; and (6) the foot extensors. The short battery seemed to be the most useful, but slightly less accurate. There are no norms for this test.

Clarke Strength Test: The Clarke Strength Test uses the tensiometer for measuring the strength of muscle groups. Measurement can be made from 5 to 300 pounds. The proper position of the joint for the application of pulling force is specified for each test in the strength measurement sequence. This adjustment tends to eliminate any compensatory action of muscles. Strength tests can be given at many of the joints of the body. Test reliabilities are high by this method; however, there are no norms available for this test.

MacCurdy Strength Test: MacCurdy devised a strength test based on the formula: Power = Force X Velocity. He measured the force by the strength of the legs, back, and arms, and the velocity by the vertical jump. The Physical Capacity Index is then calculated by: The Total Force (Sum of Strength Tests) X Vertical Jump divided by 100. The reliability of the index is high (.93). The correlation between the

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Physical Capacity Score with Athletic Achievement is also .93. Norms are not available for administration of this test to high school boys.

McCloy's Strength Test: McCloy devised a new method of scoring chinning and dipping which simplified the computation of actual strength from the number of chins or dips and body weight. Weights were added to the subject until chinning or dipping became an impossibility. Total strength was then equal to the individual weight plus the maximum weight that would allow for only one chin or dip. This test seems somewhat impractical.

Roger's Strength Index (S.I.) and Physical Fitness Index (P.F.I.): This test consists of height and weight and seven tests: (1) lung capacity, (2) back strength, (3) leg strength, (4 and 5) right and left grip strength, and (6 and 7) pull ups and push ups. The scores made by the subject in each test are summed in order to get the Strength Index (S.I.), and the Physical Fitness Index (P.F.I.) quotient may then be obtained by dividing the achieved strength index by the normal strength index for the age and weight in question. The Strength Index (S.I.) indicates the strength of the large voluntary muscles of the body. It is used to measure general athletic ability and to classify individuals into homogeneous groups for team competition. The Physical Fitness Index (P.F.I.) is frequently used to schedule individuals into physical education classes in accordance with their fitness for activity. It is also used to measure


physical fitness changes resulting from activity. This test has a validity of .85. The basis for validation of the Roger's Physical Fitness Index consisted of a criterion measure of athletic ability which included the 100 yard dash, running broad jump, running high jump, and the standing bar vault. The Roger's Physical Fitness Test was used in the present investigation because of its popularity, because it has norms, and because of the availability of equipment.

A critical analysis of this test by McCloy27 demonstrates that the arm strength formula accounts for about ninety per cent of the test as a measure of athletic ability. This arm strength is dynamic strength, which is a more significant index of motor ability than static strength.

McCloy continues as follows:

In case the arms are well developed as to strength, the back and legs are usually also well developed. The individual develops his legs doing activities which use the other muscles. The reverse however, is not necessarily true; for individuals who engage in running or jumping programs do not necessarily develop the arms. The correlation between chinning strength alone and all the rest of the body in a study in which this comparison was made was .91.28

Several other experiments have been conducted in the past that have helped to make strength testing more valid at the present time. Carpenter29 found that the amount of strength registered by the leg lift test is determined to a large degree by the angle of pull.


Hunsicker\textsuperscript{30} found a significant correlation (.58) between the rate of chins and chinning strength. Powell\textsuperscript{31} states that the push-ups and pull-ups involve a considerable amount of skill and endurance as well as strength. Martin and Rich\textsuperscript{32} indicated that where two individuals of equal weight differ widely in muscular strength, it is due to at least four factors, namely: (1) actual amount of muscle tissue; (2) bodily configuration; (3) muscle quality; and (4) muscle innervation.

**Motor Educability Testing:**

Two major developments in the history of motor educability testing are worthy of note. The first of these was the discovery of the high relationship (.35 to .90) of muscular strength with motor performance.\textsuperscript{33} The second development was that of introducing scientific methods of test construction into physical education. The works of Rogers,\textsuperscript{34} Brace,\textsuperscript{35} and Cozens\textsuperscript{36} have served as a guide for the modern

\begin{itemize}
    \item \textsuperscript{31} Elizabeth Powell, "The Present Status of Physical Indices," Research Quarterly, XI, May, 1940, pp. 3-17.
    \item \textsuperscript{33} F.R. Rogers, "Physical Capacity Tests in the Administration of Physical Education," Contributions to Education, CLXXIII, 1925.
    \item \textsuperscript{34} Ibid.
    \item \textsuperscript{35} K. Brace, Measuring Motor Ability, (New York: A. S. Barnes and Co., 1927).
\end{itemize}
work of test construction in this area.

Larson and Yocom\textsuperscript{37} state that researchers interested in the fundamental motor skills and their measurement and development must also be concerned with the rate of learning fundamental skills (motor educability) and the limits of development of the skills (motor capacity). McCloy\textsuperscript{38} has made an analysis of the constituents of motor educability and has included the prerequisites for effective learning of motor skills to be the following: muscular strength, dynamic energy, agility, flexibility, peripheral vision, concentration, understanding of the mechanics of the activity, and absence of disturbing complications.

The factors of fundamental motor ability are of two kinds:\textsuperscript{39} first, those factors that constitute the ability and, second, those factors that aid or hinder performance of the ability.

The factors which constitute the ability are elements of motor ability such as accuracy, agility, and coordination, and the fundamental skills of motor ability such as running, jumping, and throwing.

The factors which aid or hinder motor performances are such factors as age, weight, height, and body build. These are some of the factors which must be considered when interpreting the results of motor performances and must also be considered when norms are prepared. At the present time tests are not available which correct all of these various influences.


\textsuperscript{39}Larson and Yocom, \textit{op. cit.}, p. 187.
The motor educability tests represent a pioneer development in the field of motor ability testing. Research has been done in motor learning but a majority of it has been done with small muscle skills which do not have a great relationship to physical education skills. Morehouse has combined a knowledge of psychology and motor learning, and has listed six objectives which will serve the individual in the mastery of motor skills, and in the process of learning. These are: (1) improvement of timing; (2) reduction of extra useless movements; (3) adjustment of movements so that forces are applied directly; (4) muscle teamwork or relaxation of non-working muscles during performance; (5) proper pacing or distribution of effort; and (6) resolving of as many movements as possible to a reflex level.

Types of Motor Educability Tests:

The Brace Test: The Brace Test consists of twenty stunts, graduated from simple to the more complex. It is scored on a success or failure basis with the total successes constituting the score. The elements which seem to be measured in this test are: balance, coordination, control, agility, accuracy, and steadiness.

The Iowa Brace Test: McCloy has done considerable research in the stunt type tests and has used the Brace test as the foundation for his research. He reduced the number of items in the Brace Test

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from twenty to ten. The ten are divided into two batteries of five each.
The selected tests vary for each group of girls and boys of the elementary,
junior, and senior high school grades.

The Johnson Test: In 1932, Granville B. Johnson proposed a
simple test as a measure of native neuromuscular skill with the purpose
of sectioning students into homogeneous groups for instruction. This
test consisted of ten test items which are as follows: straddle jump,
stagger skip, stagger jump, forward skip, holding opposite foot from
behind, forward rolls, half turns right or left, backward rolls, half
turns right and left, front and back roll combination, and full turns
jumping. The test requires a canvas mat covered with a painted pattern
of lines and squares. Johnson also stated that the test has a reliabil­
ity of .97 and a validity of .69, although he did not state against
what criterion it was validated.

In 1935, Barton experimented with this test and with other
similar items on junior high school girls and concluded that the Johnson-
type test was more accurate than the Brace type of test for measuring
motor educability, but that it required more time for administration. In
1936, Roads reported a similar conclusion for senior high school girls.

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43G. B. Johnson, "Physical Skill Tests for Sectioning Classes in

44Gertrude Barton, "A Comparative Study of the Brace Type of Test
and the Johnson Type of Test as Measures of Motor Educability in the Junior

45Brace, loc. cit.

46H. M. Roads, "A Comparative Study of the Brace-Type of Test and
the Johnson-Type of Test as Measures of Motor Educability in the Senior
High School Girl as Shown by Two Selected Criteria," (unpublished M.S.
thesis, State University of Iowa, 1936).
In 1937, Koob\textsuperscript{17}, using as his criterion of motor educability the number of trials required for junior high school boys to learn a series of ten tumbling stunts, found a correlation of .97 between the Johnson test and motor educability, and a correlation of .81 between the Johnson test and the scores made on three track and field events. The results of these three experimenters led to the conclusion that it was a good test of motor educability, but that it would never attain the widespread use it deserved because it required so long to administer.

The above conclusion prompted Eleanor Metheny\textsuperscript{18} to analyze the items of the Johnson test and try to devise some method for reducing the time required to administer the test. In this research, the test was reduced to a battery of four items without loss of validity (.97 correlation with the ten original Johnson test items). Metheny found that the difference in results between the two tests was not great enough to justify the use of the additional six items included in the original Johnson test. She therefore suggested the use of the following four test items performed on a modified mat pattern: front roll, back roll, jumping half turns, and jumping full turns for boys; and front roll, back roll, and jumping half turns for girls.

This condensed form of the Johnson test was used as a measuring instrument of motor educability in the present study because of its ease of administration, its validity (.69), and its reliability (.97).


The sample consisted of twenty-five ninth and tenth grade boys enrolled in the required physical education classes at Brookings High School during the 1956-1957 school year. The control group consisted of thirteen boys, while the experimental group contained twelve boys.

The two groups were chosen on the basis of the results of the Roger's Physical Fitness Test administered prior to the beginning of the program. A total of 67 boys were tested initially, thirty-eight in the class from which the experimental group was taken and twenty-nine in the class from which the control group was chosen. All subjects obtaining a score below ninety in the test were chosen for this investigation, and were further required to take the Johnson-Metheeny Test. The results of this test indicated that eighteen from the experimental class had received a score of below ninety, and thirteen from the control class had obtained a score of below ninety.

Of the original eighteen boys in the experimental group, two moved away, two others were dropped from physical education classes, one was ill for three weeks, and one boy injured his hand in an accident.

The above six cases were eliminated from the study in order to increase the reliability of the results. This left a total of twelve boys in the experimental group and thirteen boys in the control group.

A comparison between the two groups of pupils indicated that the mean age of the experimental group was 15.02 years as against 15.03
years in the control group. Further comparison indicated that the experimental group consisted of six freshman and six sophomores of whom five lived in a rural environment while seven lived in urban surroundings; the control group consisted of nine freshman and four sophomores with all except two living in Brookings. A comparison of absences indicated that the experimental group had a total of eight absences with two individuals being absent twice, while the control group had a total of three absences, no one being absent more than once.

Collection of Data

The testing and scoring techniques for the Roger's Physical Fitness Index followed in accordance with those described by Clarke,19 and the techniques for the Johnson-Metheny Motor Educability Test followed that of Metheny.50 The various parts of these tests and the order in which they were administered are described in detail in the following paragraphs.

Rogers Physical Fitness Index:

**Age, Height, Weight (Figure 1):** The age, height, and weight of each individual were recorded on individual forms. This was done with gymnasium uniforms on and the tennis shoes off.

**Grip Strength (Figure 2):** A hand dynamometer was used to measure grip strength; both right and left hands were tested. The tester placed the hand dynamometer in the subject's hand with the

---


Figure 1. Age, Height and Weight
Figure 2. Grip Strength
dial facing the palm, in such a manner that the convex edge of the dynamometer was between the first and second joints of the fingers and the rounded edge against the base of the hand. Each subject was encouraged to bend the elbow and swing his arm in a downward sweeping arc as he squeezed the hand dynamometer. The hands were not allowed to touch the body, or any object, while the test was being administered. The right hand was tested first and then the left; the indicator was returned to zero after each test.

**Back Lift (Figure 3):** The back and leg dynamometer was the instrument used for measuring the strength of both back and leg muscles. This instrument measured the amount of weight lifted in pounds. In this study the dynamometer was placed on a platform; the subject being tested then placed his feet about six inches apart on the platform. With the feet in the proper position, the subject stood erect with the hands on the front of the thighs, fingers extended downward. The tester then hooked the chain so that the bar level was just below the finger tips of the subject. Each subject then grasped the handle firmly at the ends of the bar, with one palm forward and one palm backward. In this position of readiness to lift, the back was slightly bent at the hips; the legs were straight with no bend at the knees; and the head was up with the eyes directed straight ahead. At this point the subject merely attempted to straighten out the back. The tester grasped the subject's hands firmly during the lift so they would not slip off of the bar.
Figure 3. Back Lift Test
Leg Lift Test (Figure 4): In the leg lift the subject placed his feet in the same position as that of the back lift. The subject held the bar so that it rested at the junction of the thighs and trunk, while the tester adjusted the belt. The subject then bent his knees slightly and the tester hooked the chain. Before the subject was instructed to lift, care was taken to make sure that the subject's arms and back were straight, the head erect, and the chest up. Maximum lifts occur when the subject's legs are nearly straight at the end of the lifting effort; therefore, extreme care was taken to adjust the chain at the right leg angle in order to obtain the maximum leg lift.

Push-Up Test (Figure 5): The push-up test was administered on the regular gymnasium parallel bars. The bars were adjusted at approximately shoulder height. Each subject stood at the end of the parallel bars, grasping one bar in each hand. He then jumped to the front support position with arms straight (this counts one). He then lowered his body until the angle of the upper arm and forearm was less than a right angle, then pushed up to the straight-arm position (this counted two). This movement was repeated as many times as possible. The subject was not permitted to jerk or to kick when executing the push-ups.

Lung Capacity Test (Figure 6): The lung capacity was measured in cubic inches with a wet spirometer. The spirometer was equipped with a rubber hose of sufficient length so that subjects were not uncomfortable in performing this requirement. An individual wooden mouthpiece was used for each subject. Each subject took two deep breaths before the test. Then, after the fullest possible inhalation, he slowly and steadily
Figure 4. Leg Lift Test
Figure 5. Push-Up Test
exhaled while bending forward over the hose until all the air within his control was expelled. The tester watched the indicator closely in order to note when it reached the highest point.

**Pull-Up Test (Figure 7):** In taking the pull-up test, each subject hung from the bar by his hands, palms forward, and then chinned himself as many times as he could. The subjects were not permitted to kick, to jerk, or to use a kip motion in performing chin-ups. Half-counts were recorded on the pull-ups and push-ups if the subject did not pull all the way up, if he did not straighten his arms completely when lowering the body or if he kicked, jerked, or kipped in performing the movement.

**Scoring of the Physical Fitness Index:** Scoring of the Physical Fitness Index tests were accomplished in the following manner. Arm strength was scored according to the following formula; 

\[
\text{Arm strength score} = (\text{push-ups} + \frac{W}{\text{pull-ups}}) \times (100 + H - 60).
\]

The strength index was then determined by adding together the scores made on each test item; lung capacity, right grip, left grip, back strength, leg strength, and arm strength. Norm charts have been prepared for the Physical Fitness Index based upon sex, weight, and age. The Physical Fitness Index was then found for each subject by use of the following formula: 

\[
PFI = \frac{\text{Achieved SI}}{\text{Normal SI}} \times 100.
\]

**Johnson-Metheny Test and Procedure:**

**The Mat (Figure 8):** A lane twenty-four inches wide was marked down the center of a fifteen foot mat. This lane was divided into two equal narrow lanes by a center line, and into ten equal parts lengthwise by lines every eighteen inches. These lines were alternately 3/4 inches
Figure 7. Pull-Up Test
METHENY SIMPLIFIED MAT

Figure 8.
wide and three inches wide; the eighteen inch distance was measured to
the middle of the line in each case. On this mat the selected Johnson-
Hetheny test items were performed as follows.

**Forward Roll:** The performer executed two forward rolls in the
entire twenty-four inch lane. The subject started the first forward
roll with the feet outside of the chart and the second forward roll with
the feet behind the middle three inch line. The first roll was per-
formed within the limits of the first half of the lane (not going beyond
the middle three inch line); the second roll was performed within the
limits of the second half - never touching or over-reaching the lanes.

**Score:** The tester counted five points for each roll. Two
points were deducted for over-reaching the side line right or left for
each roll and one point for over-reaching the end limit on each roll,
and five points for failure to perform a true roll.

**Backward Roll:** The performer executed two backward rolls in the
entire twenty-four inch lane, one in each half of the lane. The pro-
cedure and scoring were the same as that of the forward roll.

**Jumping Half Turns:** The half turns were performed in either
the right or left half of the lane, the heavy three inch lines
serving as the targets for the performer. The performer started
with the feet on the first three inch line. He then jumped with both
feet to the second three inch line, executing a half-turn either right
or left. He then jumped to the third three inch line, executing a half-
turn in the opposite direction. He then continued the length of the mat,
alternating directions of rotation.
Score: Two points were deducted for each jump in which the subject did not land with both feet on the three inch line, or turned the wrong way, or jumped out of the boundary, or all three.

Jumping Full Turns: The performer started with the feet outside the chart at about the center of the lane. He jumped to the second rectangular space, executing a full turn with the body either right or left. He continued across the mat, executing full turns, rotating in the same direction, being sure to land on both feet in every second rectangular space.

Score: The performance was scored as in the above, deducting two points if the performer failed to land on both feet, overstepped the square, turned too far or not far enough, or lost his balance before starting the next jump.

After the initial tests were taken, twenty class periods fifty-five minutes in length, were used to conduct two different physical education programs. The last two periods in each class were utilized to administer the Roger's Physical Fitness Index Tests and Johnson-Metheny Motor Educability Test to determine the improvement or retrogression of each individual and the group.

The Physical Education Programs:

The two groups met every Tuesday and Thursday at different hours, the control group meeting at 11:00 A. M. while the experimental group met at 1:00 P. M. Both groups were informed that they were a part of an experiment and were encouraged toward maximum effort at all times during the ten week study.
The program of the experimental group was classified as a developmental physical education program. The core of the program was patterned after the "daily dozen," a set of twelve exercises used by the United States Army in developing physical fitness among soldiers. Following is a list of the twelve exercises and the order in which they were given:

1. High jumper
2. Bend and reach
3. Squat thrust
4. Rowing exercise
5. Squat bender
6. Push-up
7. Side bender
8. Body twist
9. Squat jumper
10. Trunk twister
11. Stationary run
12. Eight count push-up

In applying these exercises, the beginning dosage was three repetitions of each exercise; one additional repetition was added each week until a total of twelve repetitions was reached.

In addition to the conditioning exercises, the program consisted of weight lifting, rope climbing, individual stunts, combatives, and chinning.

Because of the wide range in weight at this age, the group was divided into three weight classifications. This division facilitated the efficiency of the class by allowing each group to be working at a given thing, and also eliminated the necessity of changing the amount of weight to be lifted for each individual. The three weight classifications were as follows:

1. Group A 100-117 lbs.
2. Group B 120-130 lbs.

The daily pattern of activity for the experimental group was
somewhat repetitious. The first ten minutes of the class were allowed for changing from street clothes into the proper attire for physical education class. Twenty minutes were required for the "daily dozen." The next fifteen minutes were given to group rotation between weight lifting, rope climbing, combatives, stunts, and chinning. Each subject was required to do eight repetitions of four different weight lifting exercises each class meeting. The following four exercises were used: the deep knee bend, the two-arm press, the two-arm curl, and the stiff legged dead weight lift. Each group was also required to climb the rope each day. Combatives, stunts and chinning were engaged on alternate days. Five minutes were allowed at each activity for each group; thus, each individual was given ample time to perform the required exercise. The last five to ten minutes were spent in some group activity such as games of low organization or group relays. Ten minutes were allowed at the end of each period for showering and changing back into street clothes.

The program of the control group was that of the regular physical education classes. It allowed ten minutes for changing from street clothes, ten minutes for exercises, and thirty minutes in the learning of activities. The teaching units for the duration of this study were those of basketball and volleyball.

The Testers

Assistance in Physical Fitness Index testing was obtained from the graduate students in physical education at South Dakota State College. All of these students were experienced testers as they had previously administered the Roger's Physical Fitness Index to all freshman male
students enrolled in physical education at South Dakota State College. In the case of the Johnson-Metheny test all of the testing was done by the author. In order to improve the objectivity, several practice sessions were carried on before administering the test to the subjects in this study. All testing was supervised by Dr. Campbell Snowberger, advisor for graduate students in physical education at South Dakota State College.
CHAPTER IV

TREATMENT OF THE DATA

This chapter will be devoted to a presentation of the results in tabular and graphic form. The results are presented under the following headings: analysis of individual results, comparison of range and variability, comparison of mean gains, and statistical significance of mean gains. The most notable findings appear in analyzing the statistical results.

Analysis of Individual Results:

The test results and point improvement in each test for each individual taking part in the study can be found in Table 1.

An analysis of the data provided in Table I indicated that a high score in the motor educability test did not necessarily indicate a high score in the physical fitness index. This was exemplified in the cases of subject ten of the experimental group and subject six of the control group. These two individuals received the highest scores in the Johnson-Metheny Test, yet they were far from the top in the Roger's Physical Fitness Index. This would tend to suggest that although strength is an important factor in motor educability there are also other elements involved. The improvement of these two subjects did indicate, however, that as the physical fitness index improved, motor educability also improved.

There were three cases in the study which showed no relationship between a change in physical fitness index with that of motor educability.
## TABLE I

RAW SCORES OF EXPERIMENTAL AND CONTROL GROUPS IN INITIAL AND FINAL TESTS OF PHYSICAL FITNESS AND MOTOR EDUCABILITY

### Experimental Group

<table>
<thead>
<tr>
<th>Subject</th>
<th>Initial PFI</th>
<th>Final PFI</th>
<th>PFI Improvement</th>
<th>Initial Motor Educability</th>
<th>Final Motor Educability</th>
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<th>Initial Motor Educability</th>
<th>Final Motor Educability</th>
<th>Motor Educability Improvement</th>
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<td>63</td>
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<td>4</td>
<td>4</td>
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</tbody>
</table>
These three cases were subjects nine, ten, and eleven of the control group.

Comparison of Range and Variability:

The range of scores for the initial and final tests for each group are shown in the following table.

TABLE II

RANGE OF SCORES OF EXPERIMENTAL AND CONTROL GROUPS IN INITIAL AND FINAL TESTS OF PHYSICAL FITNESS AND MOTOR EDUCABILITY

<table>
<thead>
<tr>
<th>Group</th>
<th>Initial PFI</th>
<th>Final PFI</th>
<th>Initial Motor Educability</th>
<th>Final Motor Educability</th>
</tr>
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<td>6-23</td>
<td>6-34</td>
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<td>Control</td>
<td>63-83</td>
<td>62-93</td>
<td>4-29</td>
<td>4-36</td>
</tr>
</tbody>
</table>

It is indicated that there was a greater range in scores in the final test than in the initial test in both groups. Although the reasons for this are beyond the scope of this study, observations made by the author would suggest that factors such as attitude and effort had some effect on the results.

The amount of variability with the experimental group increased in the final tests, the initial standard deviation being 11.43 and the final standard deviation being 15.31 in the physical fitness index. The initial and final standard deviations for the experimental group in the Johnson-Metheny Test were 4.5 and 5.76 respectively.

The standard deviation of the control group in the Roger's Physical Fitness Index was 6.04 initially and 10.63 in the final test. The amount of variability for the same group in the Johnson-Metheny Test increased
from 6.1 in the first test to 8.3 in the final test.

Observation of the amounts of variability of the two groups in the two tests indicated that there was an increase in variability for both groups between the initial and final tests; however, the standard deviation for the control group increased more than it did for the experimental group. The standard deviations of these two groups are shown in Table III.

**TABLE III**

<table>
<thead>
<tr>
<th>Group</th>
<th>Initial PFI</th>
<th>Final PFI</th>
<th>Initial Motor Educability</th>
<th>Final Motor Educability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>11.43</td>
<td>15.31</td>
<td>4.50</td>
<td>5.76</td>
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<tr>
<td>Control</td>
<td>6.04</td>
<td>10.63</td>
<td>6.10</td>
<td>8.30</td>
</tr>
</tbody>
</table>

Although the standard deviation values were not subjected to strict statistical evaluation, it might be hypothesized however, that these differences were due to the nature of the two physical education programs.

**Comparison of Mean Gains:**

It is indicated that the mean improvement of the experimental group in both tests was considerable. The mean of the initial physical fitness index was 75.8 and that of the final physical fitness index was 90.2. This indicated a mean gain of 14.4 points during the ten-week study. Only one subject from the experimental group failed to improve during the study.
This can be attributed to improper attitude and a minimal amount of effort on the subject's part (the author's observations).

The results of the Johnson-Metheny Test of Motor Educability with the experimental group indicated an initial mean of 15.5 and a final mean of 22.7. This resulted in a mean gain of 7.2 points for the group as a whole. Again one person failed to improve, that being the same individual who regressed in the Roger's Physical Fitness Index.

The results of the Roger's Physical Fitness Index with the control group showed initial and final means of 71 and 77.7 respectively. This demonstrated a mean improvement of 6.7 points; however, there was less consistency with this group as four subjects retrogressed between the initial and final tests and one subject remained stationary.

Motor educability was more stable than physical fitness for the control group, the initial mean being 17 and the final mean being 19.6. This resulted in a mean gain of 2.6 points. One person retrogressed and three additional subjects failed to improve. The initial and final means in the two tests for both groups are represented graphically in Figure 9, page 43.

**Statistical Significance of Mean Gains:**

The significance of the mean gains of the experimental and control groups in the Roger's Physical Fitness Index is shown in the following table. The boys in the experimental group had a mean gain of 14.4 points from the original test to the end of the training period. This gain was highly significant beyond the .01 level of confidence, the critical ratio at this level being 3.11 as compared to 4.73, the obtained critical ratio for this group.
MEANS OF PFI AND JOHNSON-METHENY BEFORE AND AFTER EXERCISE

EXPERIMENTAL GROUP

JOHNSON-METHENY TEST
ROGER'S PFI

CONTROL GROUP

Figure 9.
The subjects in the control group had a mean gain of 6.7 points during the ten-week study. This mean difference was significant just beyond the .05 level of confidence. This gives an indication that both groups improved in physical fitness as measured by the Roger's Physical Fitness Index, but that the experimental group showed greater progress.

The significance of the mean gains of the two groups in the Johnson-Metheny Test of Motor Educability is shown in the following table. The mean gain of 7.2 points for the experimental group was highly significant beyond the .01 level of confidence. This can be compared to a mean gain of 2.6 points for the control group, which did not reach significance at the .05 level of confidence. It should be noted that while both groups showed improvement in motor educability, the rate of acceleration for the experimental group was slightly superior.

### TABLE V

<table>
<thead>
<tr>
<th>Group</th>
<th>Initial Mean</th>
<th>Final Mean</th>
<th>Mean Gain</th>
<th>t Ratio</th>
<th>Level of Significance</th>
<th>t Ratio for Level of Significance</th>
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<td>Experimental</td>
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<td>7.2</td>
<td>5.13</td>
<td>.01</td>
<td>3.11</td>
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<tr>
<td>Control</td>
<td>17.0</td>
<td>19.6</td>
<td>2.6</td>
<td>1.57</td>
<td>.05</td>
<td>2.18</td>
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</table>
CHAPTER V

SUMMARY, CONCLUSIONS AND IMPLICATIONS

The purpose of this study was to compare the relative influence of two different physical education programs upon the strength and motor educability of ninth and tenth grade boys.

Selection of the subjects was based upon the results of the Roger's Physical Fitness Index given initially to sixty-seven boys. Those achieving a score of below ninety were used as subjects for this experiment. A single criterion of a score of below ninety on the physical fitness index was the only basis of equating the two groups.

The subjects selected were twenty-five male students regularly enrolled in physical education classes at Brookings High School, Brookings, South Dakota. An experimental and a control group were determined and both groups were subjected to a prescribed schedule of twenty class periods. Of the twenty-five subjects used, twelve formed the experimental group and the remaining thirteen constituted the control group.

After the sample was chosen, the Johnson-Metheny Test of Motor Educability was also given to the two groups. This initial testing was followed by a ten-week period of physical education instruction. The control group was given the same program as that of the regular physical education classes, while the experimental group was segregated and given a developmental type program. At the end of the ten week period both groups were retested in the Roger's Physical Fitness Index and Johnson-Metheny Motor Educability Tests.
Summary of Results:

Statistical treatment utilizing the t test of significance was applied to the findings. The results indicated that the mean gain for the experimental group was highly superior to that of the control group, extending beyond the .01 level of confidence as compared to the control group which reached significance just beyond the .05 level of confidence. The superiority of the prescribed developmental program over the usual physical education program appears to be clearly established.

Conclusions:

Although it is felt that this study is limited both in scope and methodology, certain limited conclusions are apparent. An analysis of the individual results indicated that through participation in a physical education program heavily designed for physical development, a parallel improvement in both muscular strength and ability to learn new skills takes place. It is also discernible that a developmental program designed to strengthen body muscles has the greatest effect on the improvement of physical fitness and motor educability as measured by the tests used in this study. A comparison of the range of scores of the two groups seemed to indicate that the developmental program was more demanding of each individual, thus a greater distribution of scores.

Implications:

The benefits of a physical education program upon the improvement in physical fitness and motor educability have certainly been brought into awareness by this study. Therefore, it would seem that every physical education program should include activities that contribute to strengthening the large muscles of the body. It would also seem
indicative from the results of this study that physical education, as a definite program, should assume a position of equal importance to any other program in the school curriculum.

Further research utilizing more refined statistical procedures and methodology would enhance the potentiality of this area of investigation. Specific controls such as carefully equated groups and additional refined measuring instruments would be a decided improvement in further investigation.
LITERATURE CITED

BOOKS


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PERIODICALS


MISCELLANEOUS MATERIAL


