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A STUDY OF THE MOTOR ABILITY STATUS OF INTERMEDIATE GRADE
STUDENTS IN SELECTED KALISPELL PUBLIC SCHOOLS

by

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B. S. Washington State College, 1952

Presented in partial fulfillment
of the requirements for the degree of
Master of Science

MONTANA STATE UNIVERSITY

1959

Approved by:


Chairman, Board of Examiners


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CHAPTER I

INTRODUCTION TO THE STUDY

The motor skills of running, jumping and throwing are as important to physical performance as reading, writing, and arithmetic are to mental performance. The ability to perform these motor skills determines the motor ability or degree of proficiency in the performance of nearly all the activities that are taught in physical education.

In physical education, as in other phases of education, it is essential to have a firm basis upon which to build and develop the more advanced skills or learnings. To make certain of the readiness of a student to progress to more advanced activities, it is necessary to measure and determine the degree of readiness that exists. Also, the measurement of basic motor skills gives the teacher an opportunity to determine the effectiveness of his program and his teaching.

This study was an attempt to measure the degree of proficiency in selected motor skills by using the procedures established by Latchaw. The basic motor skills as defined by Latchaw¹ and by Larson and Yocom² are running, throwing, catching, striking, jumping, and kicking.

¹Marjorie Latchaw, "Measuring Selected Motor Skills in Fourth, Fifth, and Sixth Grades," The Research Quarterly, XXV (December, 1954), p. 439.

²Leonard A. Larson and Rachael D. Yocom, Measurement and Evaluation in Physical, Health and Recreation Education (St. Louis: C. V. Mosby Company, 1951) p. 184.

According to Latchaw, the skills mentioned above are basic to the performance in physical activities.³ The study determined, through two years of testing, the achievement performance levels of various groups of students in selected motor skills described by Latchaw.⁴

Purpose of the Study. This investigation of selected items of the Latchaw study was undertaken to determine the significance of the differences in motor skills between boys as well as girls in the fourth, fifth and sixth grades of selected Public Schools in Kalispell, Montana. After determining whether or not the differences were significant, achievement scales would be established and a grading system could then be developed to evaluate individual performance.

Basic Assumptions. It was assumed in this study that the selected test items, and procedures used to measure them, were valid, reliable, and objective measures of motor skills performance for intermediate grade school children.

It was also assumed that the difference in ability by grade and by sex would be statistically significant in determining performance as measured by these tests.

Need for the Study. Since a motor ability test is designed to show the students' abilities in motor skills and reveal the strengths and limitations of their physical performances, the investigator found research was needed in the Kalispell intermediate grade physical education program to provide a more effective grading system.

³Latchaw, loc. cit.

⁴Latchaw, op. cit. pp. 440-443.

By testing the students in the selected motor skill items, the physical education program offered a more valid and reliable means of measuring student abilities. Motivation of students to improve their performances, justifying a grading system, and improving the teaching procedure were all the direct results of the basic needs for providing more efficient means of evaluating students' performances.

Motivation is probably one of the greatest single factors of testing or measuring. Scott and French⁵ cited further that:

Any teaching device which motivates students to put forth their best efforts and which gives them interest and understanding merits inclusion in the instructional program. Probably the greatest source of satisfaction in any learning situation is the feeling of accomplishment. Both the student and the teacher share in this sense of achievement.

Since the effectiveness of a physical education program depends a great deal on evaluation, it became important that the investigator be able to intelligently explain to the students what constituted a good performance in a given skill test.

Definitions

Motor Skills. In this particular study "motor skills" refer to the specific physical skills of running, throwing, catching, kicking, striking, and jumping.

Levels of Performance. This has reference to the standards of achievement that have been established whereby a student's score was classified as superior, excellent, good, fair, or poor in each selected

⁵M. Gladys Scott and Esther French, Evaluation in Physical Education (St. Louis: C. V. Mosby Company, 1950) p. 18.

item of grade and sex.

Motor Ability. For purposes of the study this term refers to the capacity of an individual to perform the basic motor skills that were included in the selected test items.

Intermediate Grades. They are the levels in the educational system which include grades four, five, and six.

Limitations of the Study. This investigation was limited to boys and girls in the fourth, fifth, and sixth grades of four Kalispell Public Elementary Schools during the school years 1956-1957 and 1957-1958. During this period approximately eighty percent of all students enrolled in the intermediate grades were measured.

Six of the seven test items used by Latchaw were considered in this investigation. These items served to determine the students' levels of performance on the basis of grade and sex.

Previous experience of the students in the fundamentals of motor skills was not a consideration in this study. No attempt was made to evaluate a student's performance in one grade as compared to his performance in another grade.

This study compared only those students in grades four, five, and six of selected Kalispell Public Schools and made no attempt to compare performances by using established norms.

CHAPTER II

HISTORY OF PREVIOUS RESEARCH

Before discussing motor skill tests as measures of student performance, it might be well to consider the importance of motor ability measurement in physical education. Larson and Yocom¹ stated that the effectiveness with which the body equipment is used depends upon the present skills the individual possesses and that a knowledge of these skills will serve the teacher in selecting activities, determining the speed of presentation, and determining how much can be accomplished in the available time.

Motor ability measurement is not a recent development in the physical education field. At the turn of the century strength testing was the dominant form of measurement. During the early part of 1900, strength tests declined in favor of tests more closely related to motor performance. This led to the development of tests which included the skills of running, jumping, throwing, catching, and others.²

Significant contributions in motor ability measurement were made by Brace and McCloy. In 1927 Brace³ developed motor ability tests used to measure inherent motor skills of students ages eight to eighteen.

¹Leonard A. Larson and Rachael D. Yocom, Measurement and Evaluation in Physical, Health, Recreation Education (St. Louis: C. V. Mosby Company, 1951) p. 185.

²Loc. cit.

³David K. Brace, Measuring Motor Ability (New York: A. S. Barnes Company, 1927).

A few years later McCloy revised the Brace test and greatly increased its validity.

In 1934 McCloy⁴ also devised a test on general motor achievement and general motor capacity for boys and girls in the upper elementary (grades five and six), junior and senior high school grade levels.

Another major contribution in motor ability measurement was made in 1934 by Neilson and Cozens.⁵ Their test was designed to measure achievement using the fundamental skills approach.

Larson and Yocom⁶ stated that measurement of motor skills is governed by the level selected for measurement. The first level included basic elements underlying performance of the skill, such as strength, agility, speed, endurance, accuracy, balance, rhythm, body co-ordination, sensory-motor co-ordination, shiftiness, and steadiness. The second level constituted the fundamental skills of running, throwing, jumping, catching, kicking, climbing and vaulting. The third level included physical education sport skills, such as, skills in gymnastics, skills in basketball, skills in football, and so forth. In the first level one is interested in the underlying causes or the composition of a skill, while in the latter two levels the characteristics of performance are important.

⁴C. H. McCloy, "The Measurement of General Motor Capacity and General Motor Ability," The Research Quarterly Supplement, V (March, 1934), pp. 45-61.

⁵N. P. Neilson and F. W. Cozens, Achievement Scales in Physical Education Activities for Boys and Girls in Elementary and Junior High Schools. (New York: A. S. Barnes Company, 1934).

⁶Larson and Yocom, op. cit., p. 184.

Motor skill tests are tools that are used to measure student achievement or general motor ability. They are also designed to predict how quickly students learn new skills and develop present skills (motor educability) and to determine the limits of individual skill development (motor capacity).

Motor skill tests, as mentioned previously, have many uses in the physical education program. The results from these tests can be used as a basis for important things such as: classifying students, grading, predicting achievement, measuring improvement, and evaluating the program.

According to Halsey and Porter⁷ motor skill tests have been developed and standardized in a half century of experimentation and most of these have been carried on at the college and high school level.

However, few studies have been conducted on the primary and intermediate grade levels. In 1930 Jenkins⁸ made a survey on three hundred boys and girls and compared their motor development in such things as running, hopping, jumping, throwing and kicking.

Three recent studies that used motor skills for measuring performance of younger grade school boys and girls were made by Seils⁹,

⁷Elizabeth Halsey and Lorena Porter, Physical Education for Children (New York: The Dryden Press Inc., 1958) p. 152.

⁸John F. Bovard, Frederick W. Cozens, and E. Patricia Hagman, Tests and Measurements in Physical Education (Philadelphia and London: W. B. Saunders Company, 1949) pp. 96-97.

⁹Leroy G. Seils, "The Relationship Between Measures of Physical Growth and Gross Motor Performance of Primary Grade School Children," The Research Quarterly, XXIII (May, 1951), pp. 244-260.

Warner¹⁰, and Latchaw¹¹. Seils showed that there was no relationship between gross motor skill performance of primary grade children and their age, height, and weight. Warner investigated the motor ability of elementary school boys in physical education activities and showed that the increase in grade level there was an increase in motor performance on each motor skill test item.

Latchaw, in 1954, conducted a study dealing with measuring selected motor skills in the fourth, fifth and sixth grades. Seven skill tests were developed and appeared to be satisfactory measures of performance in the fundamental skill areas of running, jumping, throwing, catching, striking and kicking for intermediate grade students.

This chapter has attempted to show that selected test items from the Latchaw study, using the fundamental skills level of measurement, as described by Larson and Yocom¹², can be useful in measuring the motor skill performances of boys and girls in the intermediate grades.

¹⁰Albin Paul Warner, "The Motor Ability of Third, Fourth and Fifth Grade Boys in the Elementary School." (Vol. XII, No. 3 of the Dissertation Abstracts, University of Michigan, Inc., Ann Arbor, Michigan, 1952), pp. 271-272.

¹¹Marjorie Latchaw, "Measuring Selected Motor Skills in Fourth, Fifth and Sixth Grades, "The Research Quarterly, XXV (December, 1954), pp. 439-449.

¹²Larson and Yocom, loc. cit.

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CHAPTER III

PROCEDURES OF THE STUDY

This study was primarily concerned with the measurement of motor skill performance of boys and girls. Therefore it was necessary to use motor skill test items that would meet the majority of the statistical and administrative criteria for good tests. The statistical criteria were: reliability, validity, objectivity, accuracy, and scoring. The administrative criteria were economy of time, equipment need, facility space, comprehensiveness of test item instructions and practicability. The motor skill test items of the Latchaw study were selected for use in this study since they satisfactorily met most of the statistical and administrative requirements.

The items of the Latchaw study were as follows: basketball wall pass (used to measure ability in throwing and catching), volleyball wall volley (used to measure ability in striking), shuttle run (used to measure agility and speed in running), soccer wall volley (used to measure ability in kicking), standing broad jump (used to measure ability in jumping for distance), and the vertical jump (used to measure ability in jumping for height) and because of administrative problems it was not feasible to use the softball repeated throws (used to measure ability in throwing).

After selecting the test items, a pilot study was made to determine the following: the amount of time needed to test each group, the number and capabilities of students assisting in administering the test,

and the clarity of instructions. It was found that the students could be tested in their regularly scheduled physical education classes and the administrative assistants and test instructions were adequate.

The investigator supervised all of the testing periods. Students participating in the testing program observed a demonstration of each test item and were informed of the purpose and scoring procedure to be used.¹ Individual score sheets were provided for each student.²

The study was administered over a period of two school years from September 1956 to May 1958. Eight hundred fifty students or approximately eighty percent of those enrolled in the intermediate grades during this time were tested.

Test results were tabulated in terms of the range, mean, standard deviation, and the standard error of the mean for each group of boys and each group of girls in the fourth, fifth and sixth grades. The mean, standard deviation, and standard error of the mean were determined by using the statistical methods outlined by Garrett.³

The degree of difference that existed between grades and sexes was determined by the reliability of the differences in scores achieved. In comparing the various groups, the following steps were carried out: the standard error of the mean and the standard error of the difference between the means of any two groups was determined. The critical ratio

¹Appendix A

²Appendix B

³Henry E. Garrett, Statistics in Psychology and Education, (New York - London - Toronto: Longmans, Green and Company, 1947).

of the observed difference between the means for each of the groups and the standard error of the difference was computed in terms of levels of confidence which would be the basis in determining whether the existing difference between the groups were real or due to chance. Significant differences could be used to determine the number of achievement scales needed.

Each achievement scale has five levels of performance arranged into categories of superior, excellent, good, fair and poor. Figure 1 illustrates the method of determining the classification limits in terms of standard deviation of the scores. The range chart included a spread of six standard deviations (plus and minus three standard deviations from the mean.)

Scores of the good category were between minus .6 standard deviation and plus .6 standard deviation. The scores of those classified in the excellent category were between plus .6 standard deviation and plus 1.8 standard deviations and those in the fair category were between minus .6 standard deviation and minus 1.8 standard deviations. The superior category fell plus 1.8 standard deviations or more and the poor category included scores falling below minus 1.8 standard deviations.

MEAN					
POOR	FAIR	GO	OD	EXCELLENT	SUPERIOR
Minus 3 Standard Deviation	Minus 1.8 Standard Deviation	Minus .6 Standard Deviation	Plus .6 Standard Deviation	Plus 1.8 Standard Deviation	Plus 3 Standard Deviation

FIGURE 1

Arrangement of Achievement Scale in Terms of Standard Deviation

Standard scores were then determined for each test item. The mean and standard deviation were the basic units for calculating the standard scores. These scores could be used to provide a comparison between unlike score units. According to Larson and Yocom.⁴

Data resulting from measurement and evaluation consist of (1) different units of measurement; (2) different sizes in measurement units; (3) different degrees of variability. Because of these differences, scores resulting from measurement are not always directly comparable. Standard scores are therefore designed to translate raw scores into units which have the same size, variability, and unit of measurement, thus making scores comparable. Once this is accomplished, the scores may be summed, divided, multiplied, or used in any arithmetic manipulation.

⁴Leonard A. Larson and Rachael D. Yocom, Measurement and Evaluation in Physical, Health, Recreation Education (St. Louis: C. V. Mosby Company, 1951) p. 347.

CHAPTER IV

ANALYSIS OF DATA

This study measured motor skill performances of 850 boys and girls or approximately eighty percent of the students enrolled in the fourth, fifth and sixth grades of the Kalispell Public Schools during the school years from September 1956 to May 1958. These students were classified into homogeneous groups according to sex and grade.

The study analyzed the motor skill status of the selected groups to determine the most adequate procedure of evaluating these performances. This required a statistical analysis of data showing the number in each group tested, range of raw scores, means, standard deviations, and standard error of the means. Tables XIII through XVIII show the statistical analysis of the events.¹

Critical ratios were used to determine the significance of the differences between paired groups and the need for achievement (rating) scales. Garrett² indicated in a critical ratio table that 2.61 was needed for 150 cases (the average number of cases selected for this study) to establish a .01 level of confidence, which indicates that in 99 times out of 100, the difference between two means would be a real difference and not due to chance.

¹Appendix C

²Henry E. Garrett, Statistics in Psychology Education, (New York - London - Toronto: Longmans, Green and Company, 1947), p. 191.

Standard scores were also computed. Although no attempt was made in this study to present a comparative picture of an individual's performance in unlike events, the standard scoring method could be used at some future date to do this or to develop a composite score for each individual.

I. COMPARISON OF SOCCER WALL VOLLEY PERFORMANCES

Figure 2 shows a comparison of mean scores in the soccer wall volley. The boys' means for each grade were higher than the girls for the same grade level. There was evidence of progression in mean scores from the fourth grade to the sixth grade for the boys and for the girls. The mean scores between the sixth grade boys and the sixth grade girls showed less spread than between the fourth grade boys and fourth grade girls and the fifth grade boys and fifth grade girls.

Table 1 presents a comparison of the critical ratios between paired groups in the Soccer Wall Volley. The table indicates no real difference between the means of the fifth grade boys and the sixth grade girls. Two comparisons, the sixth grade boys and sixth grade girls (critical ratio of 2.52) and fourth grade boys and fifth grade girls (critical ratio of 2.57) did not reach the .01 level of confidence but could be considered significant at the .02 level.

Two comparisons showed high significance, they were the fourth grade girls and the sixth grade boys with a critical ration of 12.12 and the fifth grade girls and sixth grade boys whose critical ratio was 9.48.

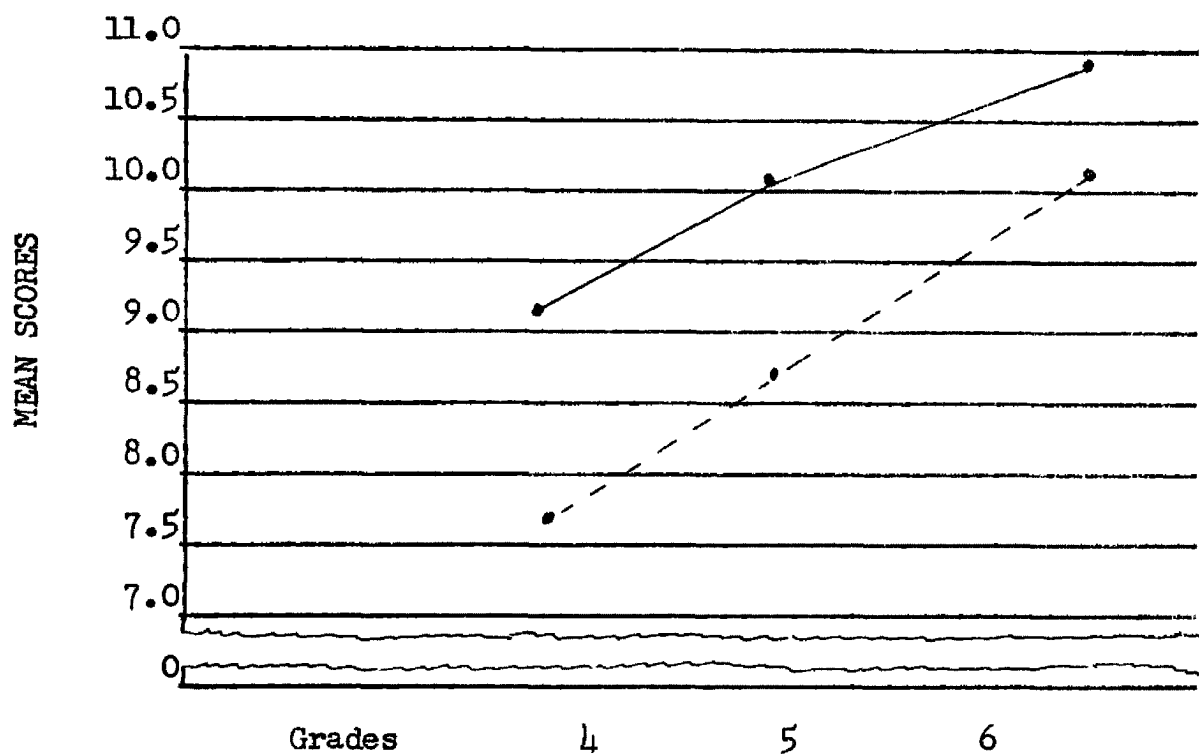


FIGURE 2

MEAN SCORES OF SOCCER WALL VOLLEY

Boys _____

Girls - - - - -

TABLE I

CRITICAL RATIO OF PAIRED GROUPS BY SEX AND
GRADE FOR THE SOCCER WALL VOLLEY

COMPARED GROUPS	OBSERVED DIFFERENCES	STANDARD ERROR OF THE DIFFERENCE	CRITICAL RATIO
4th Gr. Boys-4th Gr. Girls	1.44	.25	5.76
4th Gr. Boys-5th Gr. Boys	.79	.26	3.04
4th Gr. Boys-5th Gr. Girls	.59	.23	2.57*
4th Gr. Boys-6th Gr. Boys	1.59	.25	6.36
4th Gr. Boys-6th Gr. Girls	.86	.29	2.97
4th Gr. Girls-5th Gr. Boys	2.23	.25	8.92
4th Gr. Girls-5th Gr. Girls	.85	.23	3.70
4th Gr. Girls-6th Gr. Boys	3.03	.25	12.12
4th Gr. Girls-6th Gr. Girls	2.30	.29	7.93
5th Gr. Boys-5th Gr. Girls	1.38	.24	5.75
5th Gr. Boys-6th Gr. Boys	.80	.26	3.08
5th Gr. Boys-6th Gr. Girls	.07	.30	.23*
5th Gr. Girls-6th Gr. Boys	2.18	.23	9.48
5th Gr. Girls-6th Gr. Girls	1.45	.27	5.37
6th Gr. Boys-6th Gr. Girls	.73	.29	2.52*

*Not significant at the one percent level of confidence.

II. COMPARISON OF VOLLEYBALL WALL VOLLEY PERFORMANCES

The comparison of means in the volleyball wall volley is shown in Figure 3. The boys' means were better than the girls at each grade level. The spread was less between the fourth grade boys and girls than it was between the boys and girls of the other two grades. The rate of progression in mean scores was greater for the boys and for the girls from grades four to five than from grades five and six.

Table II shows the critical ratio comparisons of the paired groups in the volleyball wall volley. In this event only one comparison, the fifth grade boys and the sixth grade girls, failed to reach the .01 level of confidence. This group comparison had an insignificant critical ratio of .19 which meant there was no real difference in the mean scores of these two groups. Also noted was the fact that two comparisons, sixth grade boys and sixth grade girls (critical ratio of 2.65) and fifth grade boys and sixth grade girls (2.74 critical ratio) just reached the requirement for the .01 level of confidence.

The group comparisons having the largest and most significant critical ratios were: the sixth grade boys and fourth grade girls, 13.35; the fifth grade boys and fourth grade girls, 10.59; and the sixth grade boys and fourth grade boys, 10.58.

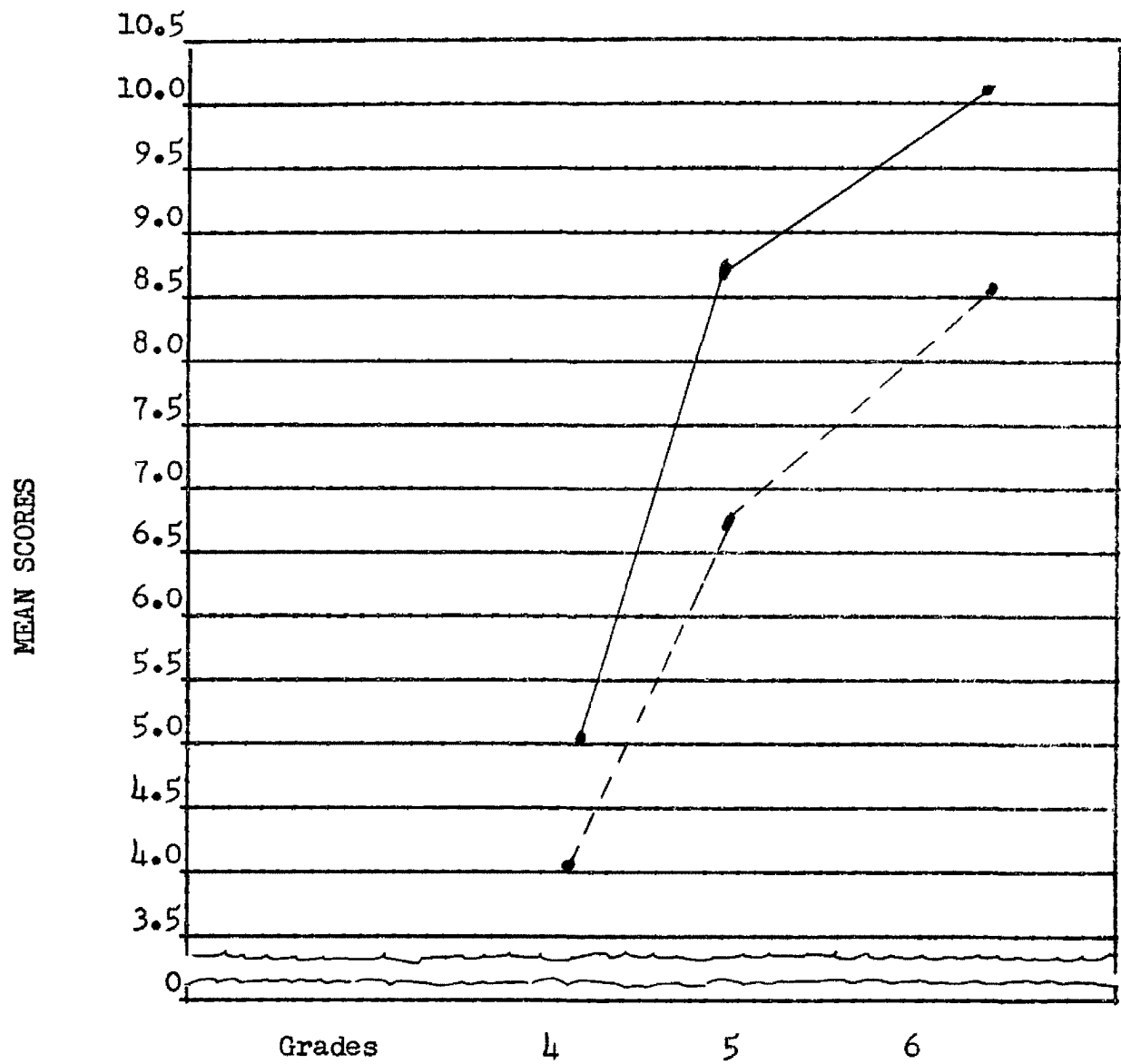


FIGURE 3

MEAN SCORES OF VOLLEYBALL WALL VOLLEY

Boys _____

Girls - - - - -

TABLE II

CRITICAL RATIO OF PAIRED GROUPS BY SEX AND
GRADE FOR THE VOLLEYBALL WALL VOLLEY

COMPARED GROUPS	OBSERVED DIFFERENCES	STANDARD ERROR OF THE DIFFERENCE	CRITICAL RATIO
4th Gr. Boys-4th Gr. Girls	1.06	.35	3.03
4th Gr. Boys-5th Gr. Boys	3.60	.45	8.00
4th Gr. Boys-5th Gr. Girls	1.60	.40	4.00
4th Gr. Boys-6th Gr. Boys	5.08	.48	10.58
4th Gr. Boys-6th Gr. Girls	3.49	.52	6.71
4th Gr. Girls-5th Gr. Boys	4.66	.44	10.59
4th Gr. Girls-5th Gr. Girls	2.66	.39	6.82
4th Gr. Girls-6th Gr. Boys	6.14	.46	13.35
4th Gr. Girls-6th Gr. Girls	4.55	.51	8.92
5th Gr. Boys-5th Gr. Girls	2.00	.48	4.17
5th Gr. Boys-6th Gr. Boys	1.48	.54	2.74
5th Gr. Boys-6th Gr. Girls	.11	.58	.19*
5th Gr. Girls-6th Gr. Boys	3.48	.51	6.83
5th Gr. Girls-6th Gr. Girls	1.89	.54	3.50
6th Gr. Boys-6th Gr. Girls	1.59	.60	2.65

*Not significant at the one percent level of confidence.

III. COMPARISON OF BASKETBALL WALL PASS PERFORMANCES

The mean scores for the basketball wall pass are shown in Figure 4. There was a close parallel in mean score performances in this event. The largest difference in the means comparison was between the fifth grade boys and fifth grade girls. The boys mean for the three grades were higher at each grade level than were those for the girls. The rate of progression for the boys and for the girls was constant from the fourth grade to the sixth grade.

From the evidence in Table III, one comparison revealed there was no significant difference between the means in this event. This comparison was between the fifth grade boys and sixth grade girls (critical ratio 2.09). A critical ratio of this size was significant at the .05 level of confidence, therefore the significance of the difference between the fifth grade boys and sixth grade girls' means was 95 times out of 100 real and not due to chance.

The remaining critical ratios were significant at the .01 level of confidence. The comparison of the sixth grade boys and fourth grade girls (critical ratio 22.89) was the largest and most dignificant. (Refer to Table III)

IV. COMPARISON OF STANDING BROAD JUMP PERFORMANCES

According to Figure 5 the comparison of mean scores in the standing broad jump showed a rate of progression from the fourth grade to the sixth grade for both sexes. Greater progress was made between the fourth and fifth grades than between grades five and six. The boys' means were higher

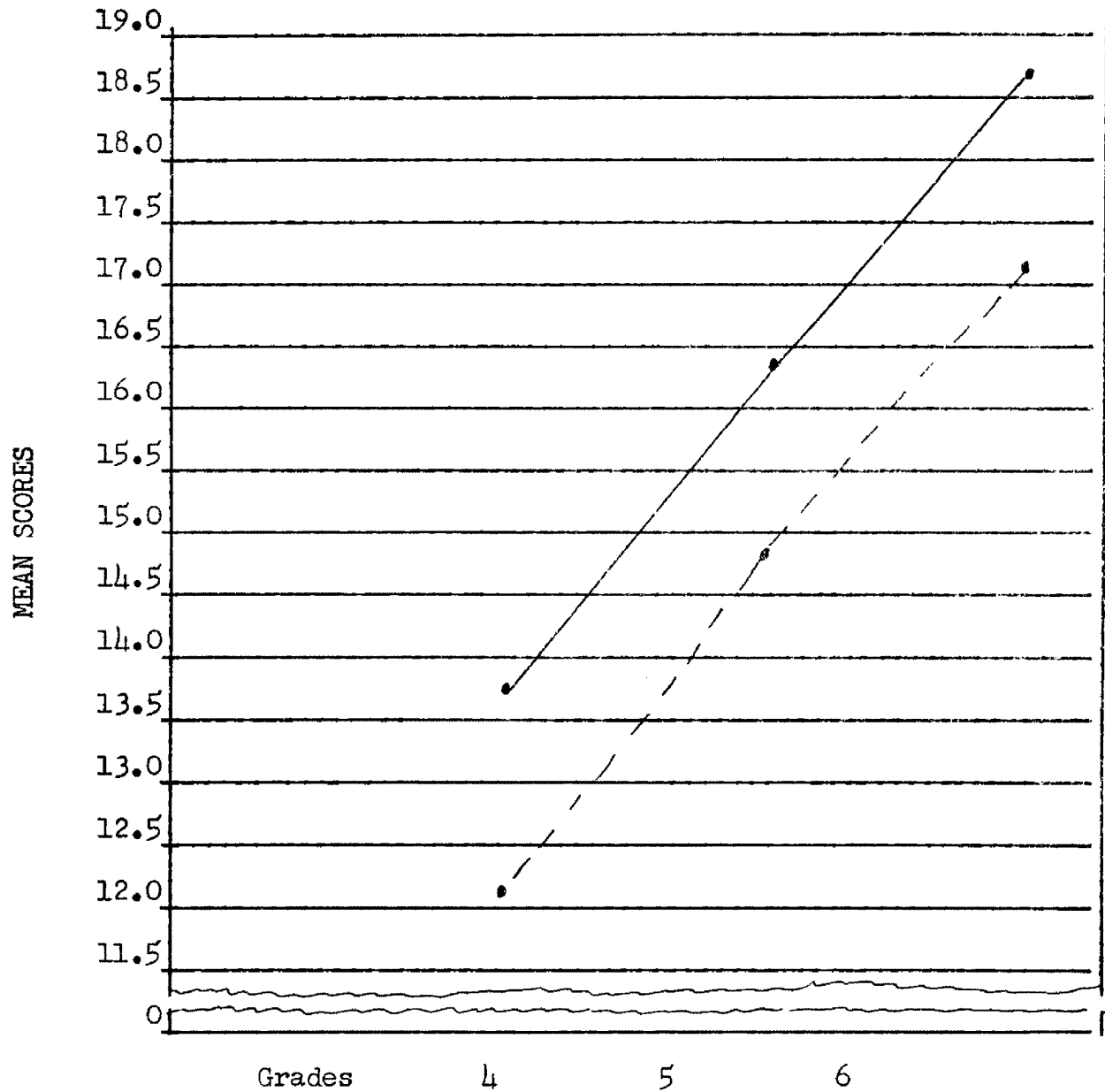


FIGURE 4

MEAN SCORES OF BASKETBALL WALL PASS

Boys _____

Girls- - - - -

TABLE III

CRITICAL RATIO OF PAIRED GROUPS BY SEX AND
GRADE FOR THE BASKETBALL WALL PASS

COMPARED GROUPS	OBSERVED DIFFERENCES	STANDARD ERROR OF THE DIFFERENCE	CRITICAL RATIO
4th Gr. Boys-4th Gr. Girls	1.53	.29	5.28
4th Gr. Boys-5th Gr. Boys	2.73	.30	9.10
4th Gr. Boys-5th Gr. Girls	1.14	.30	3.80
4th Gr. Boys-6th Gr. Boys	4.88	.29	16.83
4th Gr. Boys-6th Gr. Girls	3.44	.33	10.42
4th Gr. Girls-5th Gr. Boys	4.26	.30	14.20
4th Gr. Girls-5th Gr. Girls	2.67	.30	8.90
4th Gr. Girls-6th Gr. Boys	6.41	.28	22.89
4th Gr. Girls-6th Gr. Girls	4.97	.33	15.06
5th Gr. Boys-5th Gr. Girls	1.59	.31	5.13
5th Gr. Boys-6th Gr. Boys	2.15	.30	7.17
5th Gr. Boys-6th Gr. Girls	.71	.34	2.09*
5th Gr. Girls-6th Gr. Boys	3.74	.30	12.47
5th Gr. Girls-6th Gr. Girls	2.30	.34	6.78
6th Gr. Boys-6th Gr. Girls	1.44	.33	4.36

*Not significant at the one percent level of confidence.

than the girls' means for each grade level. The difference between means of the fourth grade boys and fourth grade girls differ slightly more than do the means for the boys and girls in grades five and six.

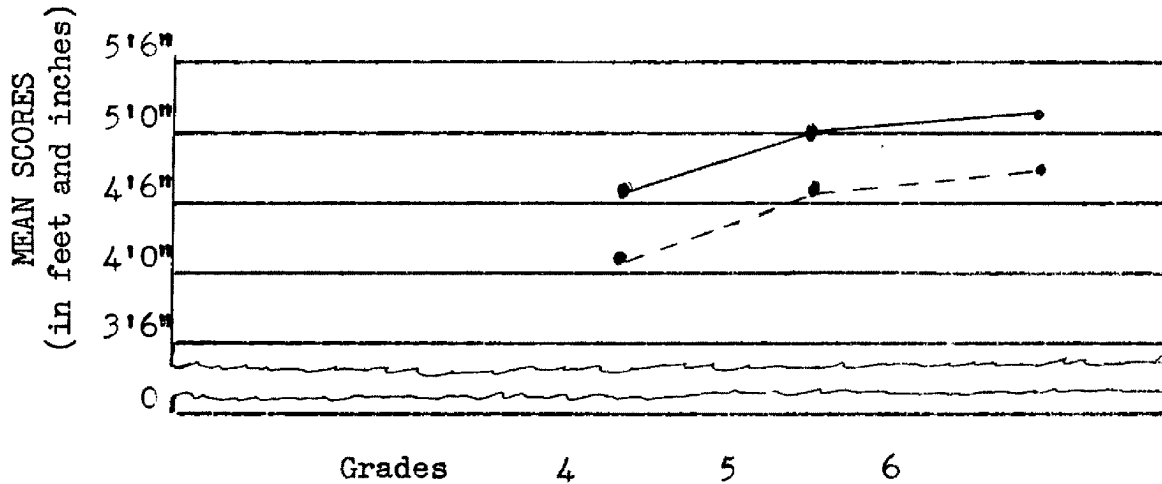


FIGURE 5

MEAN SCORES OF STANDING BROAD JUMP

Boys _____

Girls _ _ _ _ _

Table IV showed four comparisons in the standing broad jump that had no significant difference between the means, they were: fifth grade boys and sixth grade boys (critical ratio 1.12), fifth grade boys and sixth grade girls (critical ratio 1.18), fourth grade boys and fifth grade girls (critical ratio 1.46), and fifth grade girls and sixth grade girls (critical ratio 1.70). The mean difference between the sixth grade boys and sixth grade girls revealed a critical ratio of 2.23 which could be considered at the .05 level of confidence but not at the .01 level.

The most significant difference between the mean score performances for the paired groups was the sixth grade boys and fourth grade girls with a critical ratio of 9.88 and the fourth grade girls and fifth grade boys whose critical ratio was 8.76.

TABLE IV

CRITICAL RATIO OF PAIRED GROUPS BY SEX AND
GRADE FOR THE STANDING BROAD JUMP

COMPARED GROUPS	OBSERVED DIFFERENCES	STANDARD ERROR OF THE DIFFERENCE	CRITICAL RATIO
4th Gr. Boys-4th Gr. Girls	.38	.089	4.27
4th Gr. Boys-5th Gr. Boys	.4	.089	4.49
4th Gr. Boys-5th Gr. Girls	.13	.089	1.46*
4th Gr. Boys-6th Gr. Boys	.5	.089	5.62
4th Gr. Boys-6th Gr. Girls	.29	.094	3.09
4th Gr. Girls-5th Gr. Boys	.78	.089	8.76
4th Gr. Girls-5th Gr. Girls	.51	.089	5.73
4th Gr. Girls-6th Gr. Boys	.88	.089	9.88
4th Gr. Girls-6th Gr. Girls	.67	.094	7.13
5th Gr. Boys-5th Gr. Girls	.27	.089	3.03
5th Gr. Boys-6th Gr. Boys	.1	.089	1.12*
5th Gr. Boys-6th Gr. Girls	.11	.094	1.18*
5th Gr. Girls-6th Gr. Boys	.37	.089	4.16
5th Gr. Girls-6th Gr. Girls	.16	.094	1.70*
6th Gr. Boys-6th Gr. Girls	.21	.094	2.23*

*Not significant at the one percent level of confidence.

V. COMPARISON OF SHUTTLE RUN PERFORMANCES

In the shuttle run the mean scores, shown in Figure 6, for the boys and girls paralleled each other through the three grades with the largest spread being between the fourth grade boys and the fourth grade girls. The boys' means for their respective grade levels were higher than the girls of the same level.

The analysis of the critical ratios in the shuttle run as shown in Table V, revealed no significant difference for three comparisons, the fourth grade boys and fifth grade girls $-.36$, and the fifth grade boys and sixth grade girls $-.43$. For the number of students tested the performance of these groups in the shuttle run cannot be classified as

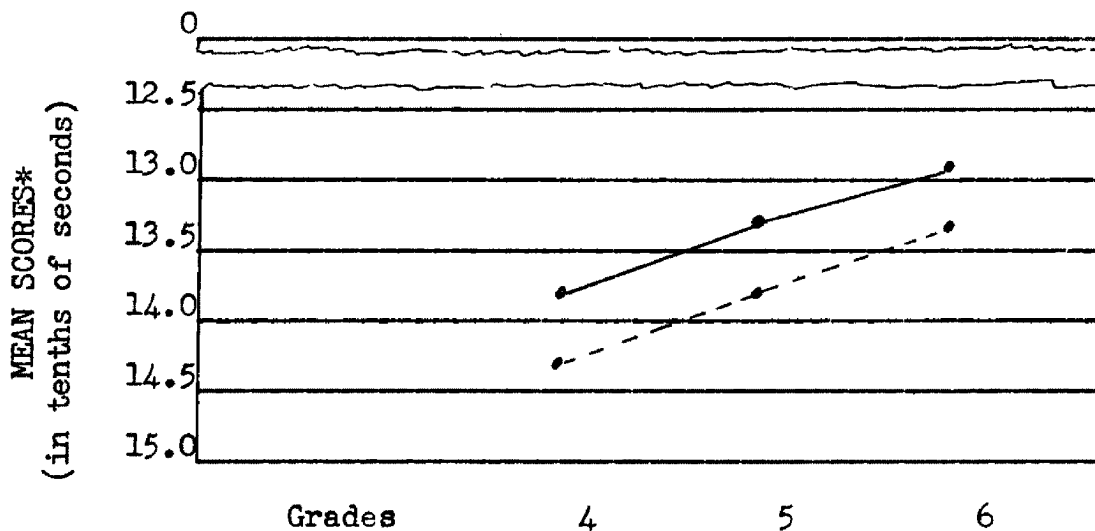


FIGURE 6

MEAN SCORES OF SHUTTLE RUN

Boys _____

Girls - - - - -

*Mean scores in reverse order.

TABLE V

CRITICAL RATIO OF PAIRED GROUPS BY SEX AND
GRADE FOR THE SHUTTLE RUN

COMPARED GROUPS	OBSERVED DIFFERENCES	STANDARD ERROR OF THE DIFFERENCE	CRITICAL RATIO
4th Gr. Boys-4th Gr. Girls	-.48	.11	-4.36
4th Gr. Boys-5th Gr. Boys	-.43	.13	-3.31
4th Gr. Boys-5th Gr. Girls	-.04	.11	-.36*
4th Gr. Boys-6th Gr. Boys	-.83	.12	-6.92
4th Gr. Boys-6th Gr. Girls	-.37	.13	-2.85
4th Gr. Girls-5th Gr. Boys	-.91	.13	-7.00
4th Gr. Girls-5th Gr. Girls	-.52	.11	-4.73
4th Gr. Girls-6th Gr. Boys	-1.31	.12	-10.92
4th Gr. Girls-6th Gr. Girls	-.85	.13	-6.54
5th Gr. Boys-5th Gr. Girls	-.39	.13	-3.00
5th Gr. Boys-6th Gr. Boys	-.40	.13	-3.08
5th Gr. Boys-6th Gr. Girls	-.06	.14	-.43*
5th Gr. Girls-6th Gr. Boys	-.79	.12	-6.58
5th Gr. Girls-6th Gr. Girls	-.33	.13	-2.54*
6th Gr. Boys-6th Gr. Girls	-.46	.13	-3.54

*Not significant at the one percent level of confidence.

being significantly different because of the close relationship of their performances. The critical ratio tabulated from the comparison of the fifth grade girls and sixth grade girls was -2.54 or approximately at the .02 level of confidence.

The critical ratio of -10.92 was the result of comparing the sixth grade boys and fourth grade girls. This was the most prominent comparison showing a clear significance far beyond the .01 level. The fourth grade boys and sixth grade girls had a -2.85 critical ratio which indicated the difference was significant at the .01 level.

VI. COMPARISON OF VERTICAL JUMP PERFORMANCES

Figure 7 shows the mean scores of the test groups in the vertical jump. The boys' means were better than the girls' for each grade level. There was a rate of progression in the mean scores from the fourth grade to the sixth grade for both sexes and the largest difference between the means of boys and girls was in the sixth grade. The smallest spread of means was between the fifth grade boys and the fifth grade girls. In this event the rate of increase was more noticeable between the fifth grade boys and sixth grade boys than it was between the fourth grade boys and fifth grade boys.

Table VI shows that the fourth grade boys and fifth grade girls; fifth grade boys and fifth grade girls, had identical critical ratios of 1.10. The fourth grade boys and fourth grade girls had a critical ratio of 1.85 and the fourth grade boys and fifth grade boys critical ratio was 2.19. All these comparisons lacked the needed 2.61 for the .01 level of confidence, however the latter comparison was significant at the .05 level of confidence.

The remaining comparisons reached the .01 level. The fourth grade girls and fifth grade girls (2.86) just met the requirement for establishing the significant difference between means. The largest critical ratio was registered by the comparison of the sixth grade boys and fourth grade girls (9.29).

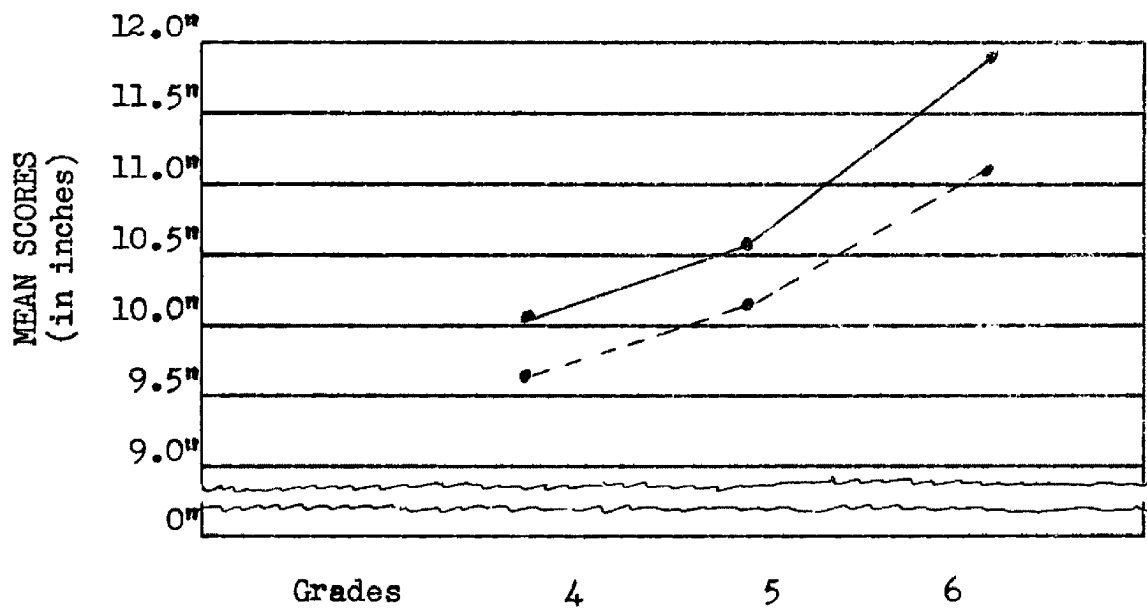


FIGURE 7

MEAN SCORES OF VERTICAL JUMP

Boys _____

Girls - - - - -

TABLE VI

CRITICAL RATIO OF PAIRED GROUPS BY SEX AND
GRADE FOR THE VERTICAL JUMP

COMPARED GROUPS	OBSERVED DIFFERENCES	STANDARD ERROR OF THE DIFFERENCE	CRITICAL RATIO
4th Gr. Boys-4th Gr. Girls	.37	.20	1.85*
4th Gr. Boys-5th Gr. Boys	.46	.21	2.19*
4th Gr. Boys-5th Gr. Girls	.23	.21	1.10*
4th Gr. Boys-6th Gr. Boys	1.86	.24	7.75
4th Gr. Boys-6th Gr. Girls	1.83	.24	7.63
4th Gr. Girls-5th Gr. Boys	.83	.21	3.95
4th Gr. Girls-5th Gr. Girls	.60	.21	2.86
4th Gr. Girls-6th Gr. Boys	2.23	.24	9.29
4th Gr. Girls-6th Gr. Girls	2.20	.24	9.17
5th Gr. Boys-5th Gr. Girls	.23	.21	1.10*
5th Gr. Boys-6th Gr. Boys	1.40	.24	5.83
5th Gr. Boys-6th Gr. Girls	1.37	.24	5.71
5th Gr. Girls-6th Gr. Boys	1.63	.24	6.79
5th Gr. Girls-6th Gr. Girls	1.60	.24	6.67
6th Gr. Boys-6th Gr. Girls	.83	.27	3.07

*Not significant at the one percent level of confidence.

VII. PERFORMANCE STANDARDS FOR TEST ITEMS
BY GRADE AND BY SEX

To make an analysis of individual performance in the various test items, a series of rating scales were developed. The rating scales presented a method of assigning a grade to students by means of interpreting raw scores.

Due to the variety of methods used to record raw scores (number of times, feet and inches, seconds) it was not possible to compare these unlike scores or to arrive at a composite score that would indicate total ability in all the test items. To allow a comparison of unlike raw scores and have a method that could be used in the future to establish total ability, the standard or Z-score was developed.

Tables VII through XII are the achievement scales for the various test items by grade and sex. Each Table presents the performance levels of poor, fair, good, excellent and superior and each level may be interpreted by using either the raw or standard scores. See Tables XIX through XXIV for standard scores.¹

¹Appendix C

TABLE VII

PERFORMANCE STANDARDS IN TERMS OF RAW AND STANDARD SCORES
FOR EACH TEST GROUP - SOCCER WALL VOLLEY

TEST GROUP		POOR	FAIR	GOOD	EXCELLENT	SUPERIOR
4th Grade Boys	Raw Scores	4-down	5-7	8-10	11-13	14-up
	Standard Scores	29-down	30-43	44-57	58-71	72-up
4th Grade Girls	Raw Scores	4-down	5-6	7-10	11-12	13-up
	Standard Scores	34-down	35-45	46-65	66-75	76-up
5th Grade Boys	Raw Scores	6-down	7-8	9-11	12-14	15-up
	Standard Scores	35-down	36-44	45-57	58-70	71-up
5th Grade Girls	Raw Scores	5-down	6-7	8-9	10-12	13-up
	Standard Scores	36-down	37-45	46-55	56-70	71-up
6th Grade Bcys	Raw Scores	6-down	7-9	10-12	13-15	16-up
	Standard Scores	32-down	33-45	46-58	59-71	72-up
6th Grade Girls	Raw Scores	5-down	6-8	9-11	12-14	15-up
	Standard Scores	32-down	33-44	45-56	57-68	69-up

TABLE VIII

PERFORMANCE STANDARDS IN TERMS OF RAW AND STANDARD SCORES
FOR EACH TEST GROUP - VOLLEYBALL WALL VOLLEY

TEST GROUP		POOR	FAIR	GOOD	EXCELLENT	SUPERIOR
4th Grade Boys	Raw Scores	0	1-3	4-6	7-10	11-up
	Standard Scores	36-down	37-46	47-55	56-68	69-down
4th Grade Girls	Raw Scores	0	1-2	3-5	6-9	10-up
	Standard Scores	38-down	39-45	46-56	57-70	71-up
5th Grade Boys	Raw Scores	0	1-5	6-11	12-16	17-up
	Standard Scores	32-down	33-43	44-56	57-67	68-up
5th Grade Girls	Raw Scores	0	1-4	5-9	10-13	14-up
	Standard Scores	35-down	36-45	46-57	58-67	68-up
6th Grade Boys	Raw Scores	1-down	2-7	8-13	14-18	19-up
	Standard Scores	32-down	33-44	45-57	58-68	69-up
6th Grade Girls	Raw Scores	0	1-5	6-11	12-17	18-up
	Standard Scores	34-down	35-44	45-56	57-68	69-up

TABLE IX

PERFORMANCE STANDARDS IN TERMS OF RAW AND STANDARD SCORES
FOR EACH TEST GROUP - BASKETBALL WALL PASS

TEST GROUP		POOR	FAIR	GOOD	EXCELLENT	SUPERIOR
4th Grade Boys	Raw Scores	9-down	10-12	13-15	16-18	19-up
	Standard Scores	34-down	35-46	47-58	59-69	70-up
4th Grade Girls	Raw Scores	7-down	8-10	11-13	14-16	17-up
	Standard Scores	32-down	33-44	45-56	57-68	69-up
5th Grade Boys	Raw Scores	11-down	12-14	15-18	19-21	22-up
	Standard Scores	32-down	33-44	45-58	59-69	70-up
5th Grade Girls	Raw Scores	9-down	10-13	14-16	17-19	20-up
	Standard Scores	32-down	33-46	47-56	57-67	68-up
6th Grade Boys	Raw Scores	14-down	15-17	18-20	21-22	23-up
	Standard Scores	34-down	35-46	47-59	60-67	68-up
6th Grade Girls	Raw Scores	12-down	13-15	16-18	19-22	23-up
	Standard Scores	34-down	35-45	46-55	56-69	70-up

TABLE X

PERFORMANCE STANDARDS IN TERMS OF RAW AND STANDARD SCORES
FOR EACH TEST GROUP - STANDING BROAD JUMP

TEST GROUP		POOR	FAIR	GOOD	EXCELLENT	SUPERIOR
4th Grade Boys	Raw Scores*	3'3"-down	3'4"-4'2"	4'3"-5'0"	5'1"-5'8"	5'9"-up
	Standard Scores	28-down	29-44	45-59	60-70	71-up
4th Grade Girls	Raw Scores	2'11"-down	3'0"-3'8"	3'9"-4'6"	4'7"-5'5"	5'6"-up
	Standard Scores	29-down	30-42	43-55	56-70	71-up
5th Grade Boys	Raw Scores	3'7"-down	3'8"-4'5"	4'6"-5'4"	5'5"-6'2"	6'3"-up
	Standard Scores	26-down	27-40	41-56	57-70	71-up
5th Grade Girls	Raw Scores	3'4"-down	3'5"-4'3"	4'4"-5'1"	5'2"-6'0"	6'1"-up
	Standard Scores	29-down	30-44	45-58	59-73	74-up
6th Grade Boys	Raw Scores	3'8"-down	3'9"-4'6"	4'7"-5'5"	5'6"-6'4"	6'5"-up
	Standard Scores	26-down	27-40	41-56	57-71	72-up
6th Grade Girls	Raw Scores	3'5"-down	3'6"-4'4"	4'5"-5'3"	5'4"-6'2"	6'3"-up
	Standard Scores	29-down	30-44	45-58	59-72	73-up

*Raw score ranges recorded in terms of feet and inches.

TABLE XI

PERFORMANCE STANDARDS IN TERMS OF RAW AND STANDARD SCORES
FOR EACH TEST GROUP -- SHUTTLE RUN

TEST GROUP		POOR	FAIR	GOOD	EXCELLENT	SUPERIOR
4th Grade Boys	Raw Scores*	15.5-up	15.4-14.4	14.3-13.2	13.1-12.1	12.0-down
	Standard Scores	31-down	32-43	44-56	57-68	69-up
4th Grade Girls	Raw Scores	16.1-up	16.0-14.9	14.8-13.7	13.6-12.5	12.4-down
	Standard Scores	31-down	32-43	44-55	56-67	68-up
5th Grade Boys	Raw Scores	15.4-up	15.3-14.1	14.0-12.7	12.6-11.3	11.2-down
	Standard Scores	32-down	33-43	44-55	56-68	69-up
5th Grade Girls	Raw Scores	15.6-up	15.5-14.4	14.3-13.1	13.0-11.9	11.8-down
	Standard Scores	32-down	33-43	44-56	57-68	69-up
6th Grade Boys	Raw Scores	14.8-up	14.7-13.6	13.5-12.3	12.2-11.1	11.0-down
	Standard Scores	32-down	33-43	44-56	57-67	68-up
6th Grade Girls	Raw Scores	15.4-up	15.3-14.1	14.0-12.8	12.7-11.4	11.3-down
	Standard Scores	32-down	33-43	44-55	56-68	69-up

*Note - Raw scores in reverse order due to the time factor (in seconds) in this event.

TABLE XII

PERFORMANCE STANDARDS IN TERMS OF RAW AND STANDARDS SCORES
FOR EACH TEST GROUP - VERTICAL JUMP

TEST GROUP		POOR	FAIR	GOOD	EXCELLENT	SUPERIOR
4th Grade Boys	Raw Scores*	6"-down	7"-9"	10"-11"	12"-13"	14"-up
	Standard Scores	31-down	32-49	50-60	61-72	73-up
4th Grade Girls	Raw Scores	6"-down	7"-8"	9"-10"	11"-12"	13"-up
	Standard Scores	33-down	34-45	46-57	58-69	70-up
5th Grade Boys	Raw Scores	7"-down	8"-9"	10"-11"	12"-13"	14"-up
	Standard Scores	35-down	36-46	47-57	58-68	69-up
5th Grade Girls	Raw Scores	6"-down	7"-9"	10"-11"	12"-13"	14"-up
	Standard Scores	32-down	33-47	48-58	59-68	69-up
6th Grade Boys	Raw Scores	7"-down	8"-10"	11"-13"	14"-16"	17"-up
	Standard Scores	32-down	33-45	46-58	59-71	72-up
6th Grade Girls	Raw Scores	7"-down	8"-9"	10"-12"	13"-14"	15"-up
	Standard Scores	34-down	35-44	45-58	54-68	69-up

*Raw Score ranges recorded in terms of inches.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary. The purpose of this study was to measure the motor skill performance of 850 boys and girls in the fourth, fifth and sixth grades of four Kalispell Public schools by using six of the seven items from the Latchaw study.

A review of the literature indicated that motor ability measurement was not a recent development in physical education. The use of motor skill performance tests to measure student achievement had been used since the early part of the 1900's. This area of measurement was improved upon by the works of Brace, McCloy, Neilson and Cozens, and Larson in their studies. However, the majority of the motor skill tests developed and standardized in the past half century were carried out at the college and high school level. Because the survey of the literature indicated that little had been done in measuring motor skill performance of intermediate grade students and since motor skill tests are effective means of measuring and classifying student abilities, grading, predicting achievement, and evaluating a physical education program, at any grade level, the investigator found that additional research was needed.

Of the three levels (basic elements, fundamental skills, and sport skills) which are needed to measure motor skills, only the level of fundamental skills was used. Six of the seven motor skill test items

of the Latchaw study were selected since they included the basic skills of running, jumping, striking, throwing, catching and kicking. Another reason for using selected Latchaw test items was the fact that most of the statistical criteria were satisfactorily met and were economical in terms of time, space and equipment. The selected items were as follows: soccer wall volley, volleyball wall volley, basketball wall pass, standing broad jump, shuttle run and vertical jump.

To determine a valid method of rating individual motor skill performance in these elementary grades it was first necessary to ascertain the amount of difference that existed between the performance abilities of the population tested by grade and by sex. After establishing this difference it would then be possible to establish the needed rating scales.

The critical ratio technique was the method employed to find the significant differences in motor skill performance between students by grade and sex. The .01 level of confidence was the standard used to determine if the difference between paired groups was real or due to chance. After the differences were determined, rating scales were established for the purpose of analyzing individual performance in the test items. These scales presented a means of assigning a grade to each student by interpreting the raw scores which were arranged into classification limits (categories) of poor, fair, good, excellent and superior.

Standard scores were also computed since they offered an available means of translating raw scores into comparable units.

In the analysis of the soccer wall volley performances, there was evidence of progression in the mean scores from grades four to six

for both sexes. The least significant difference was shown in the mean scores between the fifth grade boys and sixth grade girls. Two comparisons, fourth grade boys and fifth grade girls, sixth grade boys and sixth grade girls reached the .02 level of confidence. The rest of the comparisons were more significant.

The volleyball wall volley test item showed a greater rate of progression in mean scores for the boys and the girls from grades four to five than it did for the boys and the girls from grades five to six. Only one comparison showed no significant difference between mean performances (fifth grade boys-sixth grade girls), the remainder of the differences were significant.

In the basketball wall pass the rate of progression was as constant for the boys as it was for the girls from the fourth grade to the sixth grade. The comparison of the fifth grade boys and sixth grade girls, as previously found in the soccer wall volley and volleyball wall volley, again revealed the least significant difference of the paired groups.

The mean scores for the boys and girls in the standing broad jump paralleled each other with the boys having higher mean scores than the girls. However, in the vertical jump, while the rate of progression was evident from the fourth grade to the sixth grade for both sexes, there was a greater increase between the mean scores of the fifth grade boys and sixth grade boys than between the fourth grade boys and fifth grade boys.

The standing broad jump and vertical jump had fewer comparisons reaching the .01 level than any of the other events. It was interesting to note that the sixth grade boys and sixth grade girls' comparison failed

to reach the necessary critical ratio requirement in the standing broad jump, while in the vertical jump the fourth grade boys and fourth grade girls and the fifth grade boys and fifth grade girls comparisons showed no real difference in their performances.

In the shuttle run, the progression of mean scores was indicated for the boys as well as for the girls from grade four through six. Three comparisons, fourth grade boys and fifth grade girls, fifth grade girls and sixth grade girls, fifth grade boys and sixth grade girls were not considered to be significant at the .01 level. In this event the comparison of the fourth grade girls and sixth grade boys revealed for the sixth time a clear significance between mean performances.

Evidence from the findings in this study showed that; (1) 16 out of 90 possible comparisons had insignificant critical ratios, (2) the boys' scores were better than the girls' scores for each grade level and in each test item, (3) the sixth grade boys' performance as compared with those of the fourth grade girls showed the greatest significant difference in every test item, (4) the mean scores were progressively higher in each test item from grades four to six for the boys as well as the girls, (5) the various groups did not vary as much in jumping ability as in the other test items, (6) in five of the six test items there were fewer significant differences between the performances of fifth grade boys and sixth grade girls than was found between any of the other paired groups.

Conclusions. It can be generally concluded in this study that most of the evidence supports the hypothesis that a significant difference in motor skill performance does exist between boys and girls of the

fourth, fifth and sixth grades.

From the population tested in this study, some specific conclusions can be made; (1) rating scales for each grade and sex group should be established because only 17.7% of the paired groups failed to reach the necessary .01 level of confidence, (2) the rate of progression from grade to grade in all the test items implies that a quality program of physical education is being offered to the students at all three grade levels, (3) the boys scored higher than the girls in each test item and in each grade and achieved a higher level of motor skill performance, (4) there is an indication of stability of leg power development at these grade levels, (5) the fifth grade boys and sixth grade girls reached approximately the same level of achievement in five of the six motor skill test items used in this study.

Recommendations

1. A continuous program of motor skill measurement be undertaken as a means of evaluating pupil progress at the various grade levels.

2. That a study of achievement of groups and individuals in the various motor skills components be completed to provide the teacher with an analysis of the specific needs of the students.

3. That a study be conducted to determine if the factors of age, height and weight or the factors of grade and sex are the most satisfactory means of equating groups for rating achievement in motor skills.

4. A composite score be obtained to establish a means of rating total motor ability.

5. Comparative studies need to be carried on at these grade levels to determine the statistical validity of the test battery and specific test items.

6. A standardized test of motor ability with national norms adapted to the ability of boys and girls in grades four, five and six should be developed to evaluate pupil achievement, teaching effectiveness, and program content.

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APPENDIXES

APPENDIX A. TEST DIRECTIONS FOR ASSISTANTS AND STUDENTS

The general procedure used to inform the assistants and their preliminary instruction periods and the students prior to the administration of the test items was as follows: a verbal explanation of the test item was given, a short demonstration was conducted, and, finally, time was allowed for the assistants and students to ask questions regarding the administration of the test items.

SOCCER WALL VOLLEY INSTRUCTIONS

Purpose (to be read to the assistants and students): To measure the student's ability to kick a soccer ball.

Equipment (to be made known to the assistants): Regulation soccer ball, and stop watch.

Markings: On a flat wall space, mark a target 4 feet wide by $2\frac{1}{2}$ feet high which extends to the floor. Mark a similar area on the floor which extends from and is parallel to the target. The 4 foot line farthest from the target is extended 1 foot on each side and becomes the restraining line.

Test Item Instructions (to be read to the assistants and students):

The ball is placed behind the restraining line. On a signal "Go" the student repeatedly kicks the ball into the target area, and as it rebounds he continues to kick it until the command "Stop" is given. If the ball gets out of control, the ball is retrieved and brought back to the restraining line and started again. If the ball stops within the rectangular floor target area the student must remove the ball by using

the foot, otherwise hands may be used to retrieve or place the ball.

To constitute a fair hit, the ball must be kicked from in back of the restraining line, and must land between the lines that bound the wall target. Line balls are not fair hits.

Scoring (to be read to the assistants and students): One point is given for each successful hit. The student is given a short practice trial. After the practice trial, four fifteen second trials are given. The total number of points is recorded for each trial. The best of the four trials is the final score for the test.

VOLLEYBALL WALL VOLLEY INSTRUCTIONS

Purpose (to be read to the assistants and students): To measure the student's ability to strike or volley a volleyball with the hands.

Equipment (to be made known to the assistants): Regulation volleyball, and stop watch.

Markings: On a flat wall space, mark a target area 8 feet wide, 4 feet high at a distance 3 feet from the floor. A restraining line 8 feet long is drawn on the floor 4 feet from the wall and parallel to the target.

Test Item Instructions (to be read to the assistants and students): The student stands at any position behind the restraining line. On the signal "Go" he tosses the ball against the wall target and continues to strike or volley the ball repeatedly against the wall. The ball may be tossed against the wall when it is necessary to start it again. Whenever the ball gets out of control the student may retrieve the ball, come back to the restraining line and continue striking the ball against

the wall until the command, "Stop" is given.

A successful hit must be clearly volleyed into the target area from behind the restraining line. The ball must be volleyed or struck with the hands and not thrown or pushed in order to score a point. Line balls do not count.

Scoring (to be read to assistants and students): One point is given for each successful hit. The student is given a short practice trial. After the practice trial, four fifteen second trials are given. The total number of points is recorded for each trial. The best of the four trials is the final score for the test.

BASKETBALL WALL PASS INSTRUCTIONS

Purpose (to be read to the assistants and students): To measure the student's ability to throw a basketball successfully into a given target.

Equipment (to be made known to the assistants): Regulation basketball and stop watch.

Markings: On the wall, mark a target 8 feet wide, 4 feet high at a distance 3 feet from the floor. A restraining line 8 feet long is drawn on the floor 4 feet from the wall and parallel to the target.

Test Item Instructions (to be read to the assistants and students): The student stands at any position behind the restraining line. On the signal "Go" he throws the ball against the wall target in any manner he chooses, and continues successive throws until the signal "Stop" is given.

A successful throw is one that is thrown into the target and is made from behind the restraining line. Line balls do not count. The

ball may be caught on a bounce and need not be caught from the rebound off the wall in order to constitute a successful throw.

Scoring (to be read to the assistants and students): One point is given for each successful throw. The student is given a short practice trial. After the practice trial, two fifteen second trials are given. The total number of points are recorded for each trial. The better of the two trials is the final score for the test.

STANDING BROAD JUMP INSTRUCTIONS

Purpose (to be read to the assistants and students): To measure the ability of the student to jump for distance from a standing position.

Equipment (to be made known to the assistants). Open area for jumping, measuring tape and a take off line.

Test Item Instructions (to be read to the assistants and students):

The student stands with both feet (toes) touching the restraining line that marks the take off area, and from this standing position jumps as far forward as he can. Arm swing is allowed but any preliminary movement must be executed with some part of both feet in contact with the take off area.

Scoring (to be read to the assistants and students): The student is given three successive trials and measurement is recorded in feet and inches. The distance is measured from the take off line to the nearest contact made on the landing. (This is usually to the first heel mark made on landing, but if the subject loses balance, falls backward and catches himself with his hand or body, the mark nearest the restraining line is used in measuring the distance of the jump). The best of three trials is the score for the test.

SHUTTLE RUN INSTRUCTIONS

Purpose (to be read to the assistants and students): To measure the student's ability to run rapidly between two given marks, necessitating quick stops and changes of direction.

Equipment (to be made known to the assistants): Stop watch, calibrated in 10th of seconds.

Markings: Two 12 inch lines are marked on the floor, parallel to each other and at a distance of 20 feet apart. Beyond each line there should be an area that is free from obstruction to give the runner an opportunity for checking his speed on the turns and finish the run with a dash across the finish line.

Test Item Instructions (to be read to the assistants and students):

The student stands with the toe of his forward foot on the starting line. On the signal "Go" he runs to the opposite line (or behind it) with one or both feet and comes back to the starting line. This constitutes one trip. The student does not stop but continues to make three trips or a total of 120 feet. If the student fails to touch the line he is stopped and no score is recorded. Each student will be given a short rest period between trials.

Scoring (to be read to the assistants and students): The time is recorded in 10th of a second from the start of the shuttle run to the crossing of the finish line (also starting line) upon completing the third trip. Two trials are given. Each trial score is recorded and the better of the two trials is the score for this test item.

VERTICAL JUMP INSTRUCTIONS

Purpose (to be read to the assistants and students): To measure the ability of the student to jump for height from a standing position.

Equipment (to be made known to the assistants): A vertical jump board calibrated in inches attached to the wall or suspended from a horizontal bar.

Test Item Instructions (to be read to the assistants and students):

The student stands with both feet on the floor under the vertical jump board and reaching upward with one hand he touches the board, this is recorded as the "standing reach". The student jumps from a stationary position and touches the board as high as possible. He may jump from a crouch position but cannot take any steps or preliminary bounces.

Scoring (to be read to the assistants and students): Three jumps are allowed and each jump is recorded. The final score is the difference in inches between the height of the reach and the height of the best jump.

APPENDIX B - SCORE SHEET

NAME		GRADE		SCHOOL		
AGE	HEIGHT	WEIGHT				
TEST ITEM	TRIALS					COMMENTS
	1	2	3	4	BEST SCORE	
SOCCER WALL VOLLEY (TIMES)						
VOLLEYBALL WALL VOLLEY (TIMES)						
BASKETBALL WALL PASS (TIMES)						
STANDING BROAD JUMP (FT. - IN.)						
SHUTTLE RUN (SECONDS)						
VERTICAL JUMP (INCHES) STANDING REACH (INCHES)						

APPENDIX C. TABLES OF STATISTICAL DATA AND TABLES OF STANDARD
SCORES FOR EACH TEST ITEM

TABLE XIII

SOCCER WALL VOLLEY DATA

GROUP	NUMBER	RANGE	MEAN	STANDARD DEVIATION	STANDARD ERROR
4th Grade Boys	144	3-15	9.33	2.15	.18
4th Grade Girls	143	2-14	7.89	1.98	.17
5th Grade Boys	136	4-16	10.12	2.27	.19
5th Grade Girls	176	3-14	8.74	2.05	.15
6th Grade Boys	152	5-18	10.92	2.28	.18
6th Grade Girls	116	6-16	10.19	2.48	.23

TABLE XIV

VOLLEYBALL WALL VOLLEY DATA

GROUP	NUMBER	RANGE	MEAN	STANDARD DEVIATION	STANDARD ERROR
4th Grade Boys	145	0-17	5.09	3.16	.26
4th Grade Girls	152	0-12	4.03	2.79	.23
5th Grade Boys	150	1-20	8.69	4.52	.37
5th Grade Girls	168	1-20	6.69	4.06	.31
6th Grade Boys	140	1-20	10.17	4.76	.40
6th Grade Girls	119	0-22	8.58	4.90	.45

TABLE XV

BASKETBALL WALL PASS DATA

GROUP	NUMBER	RANGE	MEAN	STANDARD DEVIATION	STANDARD ERROR
4th Grade Boys	149	7-20	13.74	2.57	.21
4th Grade Girls	152	7-18	12.21	2.51	.20
5th Grade Boys	152	10-23	16.47	2.70	.22
5th Grade Girls	170	9-23	14.88	2.83	.22
6th Grade Boys	141	13-24	18.62	2.37	.20
6th Grade Girls	121	11-23	17.18	2.85	.26

TABLE XVI

STANDING BROAD JUMP DATA

GROUP	NUMBER	RANGE	MEAN	STANDARD DEVIATION	STANDARD ERROR
4th Grade Boys	147	3'3"-6'1"	4.63	.69	.06
4th Grade Girls	147	3'-5'10"	4.25	.74	.06
5th Grade Boys	146	3'4"-6'	5.03	.71	.06
5th Grade Girls	157	3'2"-6'5"	4.76	.73	.06
6th Grade Boys	142	3'10"-6'8"	5.13	.71	.06
6th Grade Girls	125	3'3"-6'7"	4.92	.77	.07

TABLE XVII

SHUTTLE RUN DATA

GROUP	NUMBER	RANGE*	MEAN	STANDARD DEVIATION	STANDARD ERROR
4th Grade Boys	151	16.7-12.0	13.75	.93	.08
4th Grade Girls	161	16.9-12.2	14.23	.99	.08
5th Grade Boys	143	16.4-11.0	13.32	1.15	.10
5th Grade Girls	155	16.7-11.5	13.71	1.02	.08
6th Grade Boys	141	15.8-11.1	12.92	1.04	.09
6th Grade Girls	119	16.6-11.3	13.38	1.11	.10

*Note - Range is in reverse order.

TABLE XVIII

VERTICAL JUMP DATA

GROUP	NUMBER	RANGE	MEAN	STANDARD DEVIATION	STANDARD ERROR
4th Grade Boys	145	5-14	10.07	1.72	.14
4th Grade Girls	152	5-14	9.70	1.67	.14
5th Grade Boys	150	7-17	10.53	1.81	.15
5th Grade Girls	164	4-15	10.30	1.93	.15
6th Grade Boys	142	7-18	11.93	2.28	.19
6th Grade Girls	119	6-16	11.10	2.05	.19

TABLE XIX

STANDARD SCORES BY GRADE AND SEX - SOCCER WALL VOLLEY

RAW SCORES (TIMES)	4th GRADE BOYS Z-SCORES	4th GRADE GIRLS Z-SCORES	5th GRADE BOYS Z-SCORES	5th GRADE GIRLS Z-SCORES	6th GRADE BOYS Z-SCORES	6th GRADE GIRLS Z-SCORES
18	-	-	-	-	81	-
17	-	-	-	-	77	-
16	-	-	76	-	72	73
15	76	-	71	-	68	69
14	72	81	67	76	64	65
13	67	76	63	71	59	61
12	62	71	58	66	55	57
11	58	66	54	61	50	53
10	53	61	49	56	46	49
9	48	56	45	51	42	45
8	44	51	41	46	37	41
7	39	46	36	42	33	37
6	35	40	32	37	28	33
5	30	35	27	32	24	-
4	25	30	22	27	-	-
3	21	25	-	22	-	-

TABLE XX

STANDARD SCORES BY GRADE AND SEX - VOLLEYBALL WALL VOLLEY

RAW SCORES (TIMES)	4th GRADE BOYS Z-SCORES	4th GRADE GIRLS Z-SCORES	5th GRADE BOYS Z-SCORES	5th GRADE GIRLS Z-SCORES	6th GRADE BOYS Z-SCORES	6th GRADE GIRLS Z-SCORES
23	-	-	-	-	-	79
22	-	-	-	-	75	77
21	-	-	-	-	73	75
20	-	-	75	83	71	73
19	-	-	73	80	69	71
18	-	-	71	78	66	69
17	88	-	68	75	64	67
16	85	-	66	73	62	65
15	81	-	64	70	60	63
14	78	-	62	68	58	61
13	75	-	60	66	56	59
12	72	79	57	63	54	57
11	69	75	55	61	52	55
10	66	71	53	58	50	53
9	62	68	51	56	48	51
8	59	64	48	53	45	49
7	56	61	46	51	43	47
6	53	57	44	48	41	45
5	50	53	42	46	39	43
4	47	50	40	43	37	41
3	43	46	37	41	35	39
2	40	43	35	38	33	37
1	37	39	33	36	31	35
0	34	36	31	33	29	32

TABLE XXI

STANDARD SCORES BY GRADE AND SEX - BASKETBALL WALL PASS

RAW SCORES (TIMES)	4th GRADE BOYS Z-SCORES	4th GRADE GIRLS Z-SCORES	5th GRADE BOYS Z-SCORES	5th GRADE GIRLS Z-SCORES	6th GRADE BOYS Z-SCORES	6th GRADE GIRLS Z-SCORES
24	-	-	-	-	73	-
23	-	-	74	79	68	70
22	-	-	70	75	64	67
21	-	-	67	72	60	63
20	74	-	63	68	56	60
19	70	-	59	65	52	56
18	67	-	56	61	47	53
17	63	73	52	57	43	49
16	59	69	48	54	40	46
15	55	65	45	50	35	42
14	51	61	41	47	31	39
13	47	57	37	43	26	35
12	43	53	33	40	-	32
11	39	49	30	36	-	28
10	35	45	26	33	-	-
9	32	41	-	29	-	-
8	28	37	-	-	-	-
7	24	33	-	-	-	-
		29				

TABLE XXII

STANDARD SCORES BY GRADE AND SEX - STANDING BROAD JUMP

RAW SCORES (FEET- INCHES)	4th GRADE BOYS Z-SCORES	4th GRADE GIRLS Z-SCORES	5th GRADE BOYS Z-SCORES	5th GRADE GIRLS Z-SCORES	6th GRADE BOYS Z-SCORES	6th GRADE GIRLS Z-SCORES
6' 8"	-	-	-	-	76	-
6' 7"	-	-	-	-	75	78
6' 6"	-	-	-	-	74	77
6' 5"	-	-	-	79	72	76
6' 4"	-	-	-	78	71	74
6' 3"	-	-	-	77	69	73
6' 2"	-	-	-	75	68	72
6' 1"	-	-	-	74	66	71
6' 0"	76	-	66	72	65	69
5' 11"	74	-	65	71	64	68
5' 10"	73	76	64	70	62	67
5' 9"	71	75	62	68	61	65
5' 8"	70	74	61	67	59	64
5' 7"	68	72	59	66	58	63
5' 6"	67	71	58	64	57	61
5' 5"	66	70	57	63	55	60
5' 4"	64	68	55	62	54	59
5' 3"	62	67	54	60	52	58
5' 2"	61	66	52	59	51	56
5' 1"	60	64	51	57	50	55
5' 0"	58	63	50	56	48	54
4' 11"	57	61	48	55	47	52
4' 10"	55	60	47	53	45	51
4' 9"	54	59	45	52	44	50
4' 8"	52	57	44	51	43	48

TABLE XXII (Continued)

RAW SCORES (FEET- INCHES)	4th GRADE BOYS Z-SCORES	4th GRADE GIRLS Z-SCORES	5th GRADE BOYS Z-SCORES	5th GRADE GIRLS Z-SCORES	6th GRADE BOYS Z-SCORES	6th GRADE GIRLS Z-SCORES
4' 7"	51	56	43	49	41	47
4' 6"	50	55	41	48	40	46
4' 5"	48	53	40	46	38	45
4' 4"	47	52	38	45	37	43
4' 3"	45	51	37	44	35	42
4' 2"	44	49	35	42	34	41
4' 1"	42	48	34	41	32	39
4' 0"	41	47	32	40	31	38
3' 11"	39	45	31	38	30	37
3' 10"	38	44	30	37	28	35
3' 9"	37	43	28	35	-	34
3' 8"	35	41	27	34	-	33
3' 7"	34	40	26	33	-	32
3' 6"	32	39	24	31	-	30
3' 5"	31	37	23	30	-	29
3' 4"	29	36	21	29	-	28
3' 3"	28	34	-	27	-	26

TABLE XXIII

STANDARD SCORES BY GRADE AND SEX - SHUTTLE RUN

RAW SCORES (SECONDS)	4th GRADE BOYS Z-SCORES	4th GRADE GIRLS Z-SCORES	5th GRADE BOYS Z-SCORES	5th GRADE GIRLS Z-SCORES	6th GRADE BOYS Z-SCORES	6th GRADE GIRLS Z-SCORES
11.0	-	-	70	-	-	-
11.1	-	-	69	-	68	-
11.2	-	-	68	-	67	-
11.3	-	-	68	-	66	69
11.4	-	-	67	-	65	68
11.5	-	-	66	72	64	67
11.6	-	-	65	71	63	66
11.7	-	-	64	70	62	65
11.8	-	-	63	69	61	64
11.9	-	-	62	68	60	63
12.0	69	-	61	67	59	62
12.1	68	-	61	66	58	62
12.2	67	71	60	65	57	61
12.3	66	69	59	64	56	60
12.4	64	68	58	63	55	59
12.5	63	67	57	62	54	58
12.6	62	66	56	61	53	57
12.7	61	65	55	60	52	56
12.8	60	64	55	59	51	55
12.9	59	63	54	58	50	54
13.0	58	62	53	57	49	53
13.1	57	61	52	56	48	53
13.2	56	60	51	55	47	52
13.3	55	59	50	54	46	51
13.4	54	58	49	53	45	50
13.5	53	57	48	52	44	49

TABLE XXIII (Continued)

RAW SCORES (SECONDS)	4th GRADE BOYS Z-SCORES	4th GRADE GIRLS Z-SCORES	5th GRADE BOYS Z-SCORES	5th GRADE GIRLS Z-SCORES	6th GRADE BOYS Z-SCORES	6th GRADE GIRLS Z-SCORES
13.6	52	56	48	51	43	48
13.7	51	55	47	50	42	47
13.8	49	54	46	49	42	46
13.9	48	53	45	48	41	45
14.0	47	52	44	47	40	44
14.1	46	51	43	46	39	44
14.2	45	50	42	45	38	43
14.3	44	49	41	44	37	42
14.4	43	48	41	43	36	41
14.5	42	47	40	42	35	40
14.6	41	46	39	41	34	39
14.7	40	45	38	40	33	38
14.8	39	44	37	39	32	37
14.9	38	43	36	38	31	36
15.0	37	42	35	37	30	35
15.1	36	41	35	36	29	35
15.2	34	40	34	35	28	34
15.3	33	39	33	34	27	33
15.4	32	38	32	34	26	32
15.5	31	37	31	33	25	31
15.6	30	36	30	32	24	30
15.7	29	35	29	31	23	29
15.8	28	34	28	30	22	28
15.9	27	33	28	29	21	27
16.0	26	32	27	28	-	26
16.1	25	31	26	27	-	25
16.2	24	30	25	26	-	25
16.3	23	29	24	25	-	24

TABLE XXIII (Continued)

RAW SCORES (SECONDS)	4th GRADE BOYS Z-SCORES	4th GRADE GIRLS Z-SCORES	5th GRADE BOYS Z-SCORES	5th GRADE GIRLS Z-SCORES	6th GRADE BOYS Z-SCORES	6th GRADE GIRLS Z-SCORES
16.4	22	28	23	24	-	23
16.5	21	27	-	23	-	22
16.6	20	26	-	22	-	21
16.7	18	25	-	21	-	-
16.8	-	24	-	-	-	-
16.9	-	23	-	-	-	-

TABLE XXIV

STANDARD SCORES BY GRADE AND SEX - VERTICAL JUMP

RAW SCORES (INCHES)	4th GRADE BOYS Z-SCORES	4th GRADE GIRLS Z-SCORES	5th GRADE BOYS Z-SCORES	5th GRADE GIRLS Z-SCORES	6th GRADE BOYS Z-SCORES	6th GRADE GIRLS Z-SCORES
18"	-	-	-	-	77	-
17"	-	-	86	-	72	-
16"	-	-	80	-	68	74
15"	-	-	75	74	63	69
14"	73	76	69	69	59	64
13"	67	70	64	64	55	59
12"	61	64	58	59	50	54
11"	55	58	53	54	46	50
10"	50	52	47	48	42	45
9"	44	46	42	43	37	40
8"	38	40	36	38	33	35
7"	32	34	30	33	28	30
6"	26	28	-	28	-	25
5"	21	22	-	23	-	-
4"	-	-	-	17	-	-