MOTOR ABILITY PERFORMAMCE OF SEVENTH GRADE STUDENTS IN A COEDUCATIONAL INDUSTRIAL ARTS PROGRAM

Thesis for the Degree of M. A.

MICHIGAN STATE UNIVERSITY

James S. Levande

1966

THESIS

APPROVAL SHEET

Title of Thesis: Motor Ability Performance of Seventh Grade Students in a Coeducational Industrial Arts Program

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Date Approved: May 20, 1966

ABSTRACT

MOTOR ABILITY PERFORMANCE OF SEVENTH GRADE STUDENTS IN A COEDUCATIONAL INDUSTRIAL ARTS PROGRAM

by James S. Levande

The use of manipulative activities as a means of instruction in industrial arts requires insight into the performances of students in existing programs. Knowledge about the motor ability performances of industrial arts students could then be used to help up-grade and develop programs that take cognizance of these performances. A more realistic approach to the use of manipulative activities in industrial arts would result from this knowledge of motor ability performance.

Motor abilities have a broad application depending upon such variables as age, acquired skills, and physical condition. In an attempt to narrow this field so its usefulness could be applied to the teaching of industrial arts this study limited its investigation to the nature and extent of motor ability of seventh grade boys and girls in a coeducational industrial arts program. To stay within these limits this study concerned itself with the following hypothesis:

> Seventh grade girls are at a higher level of motor ability performance in industrial arts manipulative activities than are seventh grade boys.

The basis for this study was the theory that motor ability performance is different for boys and girls and that physical development is related to performance. Research in fields outside of industrial education indicated this line of development.

The student sample consisted of 80 students, 39 boys and 41 girls. At the time of the study the sample was enrolled in a seventh grade coeducational general shop program.

Four tests were administered to measure distinct factors of motor ability performance. All of the tests had been used in past research. This past research indicated that the tests were reliable and that each test measured a distinct factor of motor ability performance. The tests consisted of two pencil and paper instruments and two apparatus instruments. The pencil and paper instruments were a tapping test and a two-hand coordination test. The first apparatus instrument used was a marble board test, the second was a hand dynamometer.

As a result of the data analysis the hypothesis appeared to be supported and the following conclusions were drawn.

1. Girls are at a higher level of performance in the areas of eye-hand coordination and two-hand coordination.

2. Boys are at a higher level of performance in complex coordination of fingers, hand, wrist, arm, and shoulder.

3. Girls and boys are at about the same level of performance in wrist-finger speed.

4. Girls are at a more advanced level of physical development in the area of height.

5. Girls and boys are at about the same level of physical development in the area of weight.

Recognizing the limitations of the scope of this study, the findings do suggest that:

1. Motor ability performance factors be considered as a means for determining levels of ability for girls and boys in industrial arts manipulative activities.

2. Each factor of motor ability must be measured by a distinct and seperate test of performance.

3. The level of motor ability performance for seventh grade girls is higher and different than that of seventh grade boys in industrial arts manipulative activities.

4. Motor ability performance factors be considered as part of the upgrading and development of industrial arts programs.

5. Motor ability factors can be related to specific industrial arts activities as in the case of the Hand Dynamometer Test.

6. Coeducational industrial arts programs should consider the use of manipulative

activities that are suitable for both boys and girls.

7. The design of future industrial arts programs should consider the special motor abilities of girls and boys.

Further research is needed to provide accurate and useful information on sex related performance at all levels and ages, factors of ability that differentiates between the sexes and the isolation of these factors, types of ability required to perform the activities used in industrial arts, and the development of tests to measure abilities related to industrial arts activities. Other research is also needed to examine the role of social conditioning on motor ability performance and the inter-relationships of mental ability, motor ability performance, and sex in coeducational industrial arts programs.

MOTOR ABILITY PERFORMANCE OF SEVENTH GRADE STUDENTS IN A COEDUCATIONAL INDUSTRIAL ARTS PROGRAM

by

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Secondary Education and Curriculum
(Industrial Education)
College of Education

1966

ACKNOWLEDGEMENTS

Sincere appreciation is expressed to those people who contributed to the development of this study.

A special thanks to Dr. C. Blair MacLean, Jr. for his criticism and guidance throughout the preparation of this problem and to Dr. John A. Fuzak for his suggestions and the use of his hand dynamometer.

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CHAPTER I

THE PROBLEM

Introduction

Industrial arts, by its use of machines to teach about our industrial society, contributes in a special way to the curriculum of the nation's schools. In the process of using tools and machines the industrial arts teacher enables his students to become involved in many activities that are not found in the regular classroom. These activities are directed toward exploring the world of industry.

Activities, in the form of manipulative actions, are part of the industrial arts program. These manipulative actions are used to direct the student's development. As a means of instruction they guide the student's explorations. In order to make the best use of manipulative activities in the industrial arts program the teacher should have some insight into the capabilities of his students. The development, direction, and presentation of industrial arts programs requires knowledge about the students' ability to perform in the shop or laboratory.

Need

Knowledge about the motor ability of individuals in industrial arts programs is almost non-existent.[1] On the other hand, activities involving motor ability are used to provide experiences in industrial arts activities. Investigations that explore motor ability of industrial arts students can contribute knowledge to the field of industrial arts education by (1) establishing some indication of performance in manipulative activities used in present programs and (2) by setting up guides for the development of new programs.

Purpose

Motor abilities have a broad application depending upon such variables as age, acquired skills, and physical condition. In an attempt to narrow this field of motor ability so its usefulness can be applied to the teaching of industrial arts the purpose of this study is to investigate the nature and level of motor ability of seventh grade girls and boys in a coeducational industrial arts program.

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[1]W. P. Spence, "Research in Industrial Education - A Look at the Past," *Industrial Arts and Vocational Education*, LIII (December, 1964), 57.

Hypothesis

In order to provide more knowledge about motor ability and to limit this investigation to a reasonable scope of the subject, this study is concerned with the following general hypothesis:

> Seventh grade girls are at a higher level of motor ability performance in industrial arts manipulative activities than are seventh grade boys.

Assumptions

The following assumptions were made in the process of developing the above hypothesis.

1. Motor ability is used in industrial arts manipulative activities.

2. Knowledge about motor ability performance of girls and boys is required in developing and presenting industrial arts programs that meet the needs of the individual.

3. Tests used in measuring student performance are valid and reliable tests of motor ability performance.

Theory

There are a number of factors to consider in the area of motor ability performance.

1. Motor ability performance is at a different level for girls than boys at given times in their schooling.

2. The level of physical development in seventh grade students is related to motor ability performance.

3. Research can be used to determine the level of motor ability performance.

Difference in levels. - Espenschade[1], Moore[2], Whipple[3], and Wooley[4] state that there are differences in the motor ability performance of boys and girls. Their studies point out that girls and boys differ in eye-hand coordination and gross motor performance. Tuckman[5] and Archer[6] found that girls and women have faster hand travel in tasks requiring quick movement. In rotary pursuit tests, Ammons[7] and Noble[8] both

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[1] A. Espenschade, Motor Performance in Adolescence (Washington, D.C.: Society for Research on Child Development, National Research Council, 1940).

[2] J. E. Moore, "A Test of Eye-Hand Coordination," Journal of Applied Psychology, 21:668-72 (1937).

[3] G. M. Whipple, Manual of Mental and Physical Tests, Part I: Simpler Processes (Baltimore: Warwick and York, Inc., 1924).

[4] H. T. Wooley, An Experimental Study of Children (New York: The Macmillan Company, 1926).

[5] J. Tuckman, "Norms for the MacQuarrie Test of Mechanical Ability of High School Students," Occupations, 25:94-6 (1946).

[6] E. J. Archer and L. E. Bourne, "Inverted Alphabet Printing as a Function of Intertrial Rest and Sex," Journal of Experimental Psychology, 52:322-28 (1956).

[7] R. B. Ammons, S. I. Alprin and C. H. Ammons, "Rotary Pursuit Performance as Related to Sex and Age of Pre-adults," Journal of Experimental Psychology, 49:127-33 (1955).

[8] C. E. Noble, J. E. Fuchs, D. P. Robel and R. W. Chambers, "Individual Versus Social Performance on Two Perceptual-Motor Tasks," Perceptual Motor Skills, 8:131-34 (1958).

report sex related differences in performance. Bennett and Cruikshank[1] indicated that in tests of manual performance, when dexterity is involved, women showed a slight superiority. These studies all showed sex related differences in motor ability performance that usually favors women and girls.

Levels of physical development. - Research shows that motor ability is related to age, weight and height during elementary and junior high school years.[2] These factors, when known, indicate the motor ability performance of students up to about sixteen years of age.

Determining levels of performance. - A number of studies showed that motor ability performance can be measured and in some cases be related to manipulative activities. A majority of these studies are concerned with measuring gross motor performance and the relationship of performance to activities in physical education. In separate pieces of research for the Air Force Fleishman[3] and

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[1] G. K. Bennett and R. M. Cruikshank, "Sex Differences in the Understanding of Mechanical Problems," *Journal of Applied Psychology*, 26:121-27 (1942).

[2] Espenschade, *op. cit.*

[3] E. A. Fleishman, *Predicting Success in Certain Aircraft Maintenance Specialties by Means of Manipulative Tests* (Lackland Air Force Base, Texas: Air Force Personnel and Training Research Center, September, 1955). (Research Report AFPTRC-TN-56-23)

Adams[1] both explored the use of tests for motor ability performance and for prediction of success in training personnel for maintenance jobs; their results showed success in measuring factors of motor ability performance. Fuzak[2] in studying the motor ability performance of boys in relation to industrial arts manipulative activities showed positive relationships between tests of motor ability performance and industrial arts activities.

Experimental use of one of Fuzak's tests supported the notion that girls may have equal ability in the use of both hands. Bilodeau[3] in a study of complex motor skill and its components reported that there is a strong relationship between performance with both hands and the performance of the separate hands. He also suggests that this interaction may influence performance in other motor abilities.

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[1] J. A. Adams, _An Evaluation of Test Items Measuring Motor Abilities_ (Lackland Air Force Base, Texas: Air Force Personnel and Training Research Center, May, 1956). (Research Report AFPTRC-TN-56-55)

[2] J. A. Fuzak, _The Role of Physical Maturation in Determining the Ability of Junior High School Boys to Perform Complex Finger Coordination Activities in Industrial Arts and an Index to Level of Ability_ (Chicago: American Technical Society, 1956).

[3] E. A. Bilodeau, "The Relationship Between a Relatively Complex Motor Skill and Its Components," _American Journal of Psychology_, 70:49-50 (1957).

The point of departure for the hypothesis formulation of this study is the indicated differences between boys and girls in performing motor activities as suggested by Moore[1], Tuckman[2], Archer[3], and Bennett and Cruikshank[4]. The examination of motor ability performance will be based on the relationships indicated in Espenschade[5], Moore[6], Whipple[7], and Wooley[8]; and on the relationships and instruments in the studies of Adams[9], Fleishman[10], and Fuzak[11].

Limitations

The examination of individual differences can be classified into three groups. These groups are: (1) The nature and extent of differences. (2) The conditions affecting the stability and modification of differences. (3) The relationships among the differences. In attempting to limit the scope of the examination of differences in motor ability the study will focus on the nature and extent of motor

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[1]Moore, _op_. _cit_.

[2]Tuckman, _op_. _cit_.

[3]Archer, _op_. _cit_.

[4]Bennett and Cruikshank, _op_. _cit_.

[5]Espenschade, _op_. _cit_.

[6]Moore, _Ibid_.

[7]Whipple, _op_. _cit_.

[8]Wooley, _op_. _cit_.

[9]Adams, _op_. _cit_.

[10]Fleishman, _op_. _cit_.

[11]Fuzak, _op_. _cit_.

ability performance in seventh grade girls and boys.

The availability of coeducational industrial arts programs limits this investigation to the study of one coeducational industrial arts program.

The number of cases used to determine the results of the study will be kept small in order to impose control on the variability of instruction and activity.

Definitions

The similarity and complexity of the terms used in studying motor ability performance requires that a clarification and statement of terms and definitions be made. The following terms and definitions are stated for this purpose.

Ability, motor: the ability to perform activities that require muscular coordination, such as manipulating instruments or machinery.[1]

Activity, motor: movement accomplished by the contraction and relaxation of the muscles.

Capacity, motor: the ultimate limit of ability in motor performance.

Coordination, eye-hand: ability to use the eyes and hands together in such acts as fixating, grasping, and manipulating objects.

Coordination, motor: use of the muscles in such a manner that

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[1] C. V. Good (ed.), Dictionary of Education (New York: McGraw-Hill Book Co., Inc., 1945). All definitions are from this source except as cited.

they work together effectively, rather than hinder one another.

Development, motor: the sequences of maturation in postural, locomotor and manipulatory responses.

Finger-dexterity: the ability to make skillful, controlled manipulations with the fingers.[2]

Industrial arts manipulative activities: activities which involve the use of hand tools and machines and activities that require the manipulation of materials in industrial arts classes.

Manipulation: the act of handling object in a constructive, exploratory, or exploitive way; implies changing the form or position of the object or material by use of the hands.

Manual dexterity: the ability to make skillful, controlled arm-hand manipulations of larger objects.[2]

Other hand: the hand that the subject indicates as not normally being used for performing tasks demanding the use of one hand.

Performance: actual accomplishment as distinguished from potential ability.

Performance level: the stage of performance that the average child attains at successive points in time.

Preferred hand: the hand that the subject indicates as normally being used for performing tasks demanding the use of one hand.

Test, dexterity: a test of the speed with which a person can perform a routine motor task.

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[1]E. A. Fleishman, A Factorial Study of Psychomotor Abilities (Lackland Air Force Base, Texas: Air Force Personnel and Training Research Center, May, 1954). (Research Report AFPTRC-TR-54-15), p. 33.

[2]Ibid.

Test, motor ability: a test designed to determine, measure and evaluate physical abilities.

Test, performance: a test in which the subject responds by an overt action.

Summary

Knowledge about the individual differences in motor ability performance of industrial arts students is almost non-existent. Past research, from other disciplines, suggests that girls are at a higher level of performance in motor ability; in the foregoing chapter a research hypothesis was formulated to study this possibility. Assumptions were stated, theory outlined, limitations set down, and terms defined in order that the question could be investigated.

CHAPTER II

REVIEW OF LITERATURE

Overview

Literature used to develop the theory of this study will be cited to show the nature and levels of motor ability performance in both sexes. Literature concerning the definition of motor ability performance, related factors and areas will be reviewed. The problem of developing instruments for examining motor ability performance will be reviewed as a basis for the development of instruments used in this study.

Nature and Extent of Abilities

The nature and extent of motor ability has been the concern of physical educators. Sex related differences have been noted by the physical educators and psychologists for purposes of evaluation, classification, placement, and psychomotor research.

Glassow's review of motor development stated that physical educators have examined the area for their own purposes.[1] This research showed age, weight, and height influence performance and suggested that these factors are incorporated in the results and analysis of any motor performance test. This indicated that motor abilities are strongly influenced by the range of maturity and variability of the physical growth rate. The earlier maturity of girls could be an indication that in late childhood and early adolesence their motor abilities surpass those of boys.

The majority of research in motor ability completed by physical educators has dealt with performance in activities requiring the use of the entire musculature. Tests, such as those of Johnson[2], Brace[3], McCloy[4], and Rogers[5], all incorporate the use of the entire body in activities such as set-ups, balance, jumping and throwing. These activities do not correspond to motor ability performance in industrial

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[1]R. B. Glassow, "Motor Development," Encyclopedia of Educational Research, ed. by C. W. Harris (3rd ed.; New York: The Macmillan Company, 1960).

[2]D. G. Johnson, Modern Body Building (London: Faber and Faber, 1957).

[3]D. K. Brace, Measuring Motor Ability (New York: A. S. Barnes, 1927).

[4]C. H. McCloy, Tests and Measurements in Health and Physical Education (New York: Appleton-Century, 1942).

[5]F. R. Rogers, Physical Capacity Tests (New York: A. S. Barnes, 1931).

arts manipulative activities.

Moore[1], in the development of an eye-hand coordination test, states that girls were consistently faster than boys in performance on this test. This could be an indication of one measureable factor in motor ability performance that favors girls.

Bennett and Cruikshank[2], in a review of sex differences in understanding mechanical problems, point out that tests of manual performance show slight superiority for women if dexterity is involved. They suggest that social pressure is the cause for poor performance on the part of girls and women in tests of ability.

Tuckman[3] reports higher scores for girls on the dotting sections for the MacQuarrie Test of Mechanical Ability. More recent research[4] shows that dotting tests are a measure of another factor of motor ability performance, wrist-finger speed.

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[1] J. E. Moore, "A Test of Eye-Hand Coordination," _Journal of Applied Psychology_, 21:688-72 (1937) and "The Standardization of the Moore Eye-Hand Coordination and Color Matching Test," _Education and Psychological Measurement_, 10: 119-27 (1950).

[2] Bennett and Cruikshank, _op. cit_.

[3] Tuckman, _op. cit_.

[4] Adams, _op. cit_.

In still another test of motor ability, the Purdue Pegboard, Tiffen and Asher[1] report that the means for this test were higher for women than men. This test is another instrument used to test factors of motor ability performance.

Researching the rate of travel in printing, Archer and Bourne[2], indicate that in the speed of travel women excel men. This seems to suggest that arm movement is faster for women than men.

In all of the above research the findings seem to indicate the fine movements of fingers, hands and arms are different for girls and women than for boys and men. Fuzak[3], in his study of motor ability and industrial arts activities, concluded that these movements and industrial arts manipulative activities are positively related.

Motor Performance and Related Factors

In defining and isolating factors of motor ability industrial and military testers have been active in recent research. The findings of the military, in particular, have clarified and refined many of the past studies on the factors

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[1]J. Tiffen and E. J. Asher, "The Purdue Pegboard," Journal of Applied Psychology, 32:234-47 (1948).

[2]Archer and Bourne, op. cit.

[3]Fuzak, op. cit.

involved in motor ability performance.

Drake[1], in a study of personnel selection with standard tests, points out that individual differences in motor ability are known, measurable, and related to performance.

He classifies these differences as follows:

1. General finger dexterity.
2. Bilateral hand coordination.
3. Dual hand coordination.
4. Dual hand-and-one-foot coordination.
5. General coordination, including ambulatory speed and dexterity.
6. Rhythm, in motor and possibly perceptual areas.
7. Perceptual ability specialized with respect to sensory areas, such as visual, auditory, tactal, etc.[2]

The first three points in the above list suggest a relationship to industrial arts manipulative activities. The remaining points also contain factors that could be partially related to manipulative activities.

In a study for the Air Force, Fleishman[3], isolated and defined a number of factors in psychomotor performance. One of the major purposes of this study was to break down psychomotor coordination into basic ability categories. The

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[1]C. A. Drake, Personnel Selection by Standardized Job Tests (New York: McGraw-Hill, 1942).

[2]*Ibid.*, p. 16.

[3]Fleishman, *op. cit.*

factors isolated and defined were:

1. Wrist-finger speed
2. Finger dexterity
3. Rate of arm movement
4. Manual dexterity
5. Steadiness
6. Reaction time
7. Aiming (eye-hand coordination)
8. Psychomotor coordination
9. Postural discrimination
10. Spatial relations.[1]

Wrist-finger speed, finger dexterity, manual dexterity, and aiming or eye-hand coordination were defined in terms of muscle use in fingers, hand, wrist, arm and shoulder. The use of the indicated muscles in performing manipulative activities suggested that these factors should be examined in determining motor ability performance.

The similarity in the factors described by Drake[2] and those isolated by Fleishman[3] indicated that the factors involving the use of the muscles in the fingers, hand, wrist, arm, and shoulder are part of motor ability and should be considered in performance tests and ratings.

Development of Instruments

Research in the development of instruments of motor

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[1]Fleishman, *op. cit.*, p. 33.

[2]Drake, *op. cit.*, p. 16.

[3]Fleishman, *op. cit.*, p. 33.

ability performance involves the measurement of single factors, predictive value of the instrument, and the relationship of the tests to a specific area of activities. Studies completed for the military have been able to designate instruments that measure single factors in motor ability performance; they have also been able to use these tests to some extent for predictive purposes. Certain tests have been related to specific areas by the Air Force. The relationship of motor ability performance tests to industrial arts has not been studied to any great extent.

Fleishman[1] was able to obtain, with the use of a technique of analysis called centroid factor loadings, information on tests that measured each of his isolated factors of ability. This information showed that each factor could be measured by a single test. For the factors that closest resemble industrial arts manipulative activities the loadings and reliabilities are shown in Table 2.1. These loadings and reliabilities suggested that tests can be used for the measurement of single factors in motor ability performance.

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[1]Fleishman, op. cit., pp. 22-43.

TABLE 2.1

FACTOR LOADINGS AND RELIABILITIES FOR MOTOR ABILITY TESTS[1]

Factor	Loading	Test	Rel. Coef.
Wrist-finger speed	.74	Large Tapping	.94
Finger dexterity	.61	Purdue Pegboard	.70
Aiming (eye-hand coordination)	.68	Pursuit Aiming	.93

In determining predictive value of tests measuring factors of wrist-finger speed, finger dexterity, and aiming Fleishman obtained the reliabilities shown in Table 2.2.

TABLE 2.2

RELIABILITIES OF PREDICTIVE VALUE FOR TESTS OF MOTOR ABILITY[2]

Factor	Test	Reliability
Wrist-finger speed	Large Tapping	.89
Finger dexterity	Purdue Pegboard	.77
Aiming (eye-hand coordination)	Pursuit Aiming	.89

[1]Fleishman, op. cit. The information in this table was extracted from the text of this report, pages 22-43.

[2]Ibid.

In a recent study of motor ability related to industrial arts activities Fuzak[1] used a hand dynamometer as a predictive device for what he termed complex finger coordinations. The definition given for this was:

> "Performances of the fingers requiring simultaneous control of fingers, wrist, elbow, and shoulder through coordinations of the muscles involved; mainly flexor sublimis, digitorum, flexor prefundis digitorum, flexor longus pollicics, the four lumbricales, abductor pollicis, abductors minis digitorum, biceps, and triceps."[2]

This definition of complex finger coordinations described muscle activity that is similar to the muscle activity used in the tests that Fleishman developed to isolate singular factors of motor ability.

In addition to measuring the same muscle activities that Fleishman's tests measure, the hand dynamometer measured motor ability that was related to industrial arts activities as indicated by the positive correlations shown in Table 2.3.

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[1]Fuzak, _op_. _cit_.

[2]_Ibid_., p. 4.

TABLE 2.3

CORRELATIONS OF INDUSTRIAL ARTS ACTIVITIES TESTS WITH HAND DYNAMOMETER TEST[1]

Test	Correlation Coefficient
Scribing Test	.897
Marking Gauge Test	.882
Tracing Test	.742
Screw Box Test	.877

The combined correlation for the tests shown in Table 2.3 with the dynamometer test was .91.[2] The similarity of these four tests to activities in industrial arts shows that simple motor ability tests can be used in industrial arts programs to determine motor ability performance.

Summary

The research reviewed in this chapter indicates three basic points:

1. There are indicated differences in many factors of motor ability performance for boys and girls, and these factors are related to physical maturity.

2. Factors of motor ability performance are

[1]Fuzak, op. cit., p. 53

[2]Ibid., p. 53

defined, isolated, and measureable.

3. Instruments are available for measuring motor ability performance and these instruments can measure factors which are an intergal part of industrial arts manipulative activities.

CHAPTER III

DESIGN OF STUDY

Sample

The sample for this study was taken from East Lansing Junior High School, East Lansing, Michigan. Students from four coeducational industrial arts classes made up the sample. All the students were at the seventh grade level; they numbered 80, 39 boys and 41 girls. The total seventh grade enrollment at East Lansing Junior High School was 328, 172 boys and 156 girls.

The ages of the participants ranged from twelve to thirteen years ten months in age. The mean age of the boys was 156.95 months with a standard deviation of 4.8 months. The mean age for the girls was 154.19 months with a standard deviation of 4.1 months.

The group varied in height from four feet seven inches to five feet six inches. The mean height for the boys was 59.91 inches with a standard deviation of 2.66 inches. The mean height for the girls was 61.28 inches with a standard deviation of 3.12 inches.

The weights within the sample varied from 145 pounds to 71 pounds. The mean weight for the boys was 97.19 pounds with a standard deviation of 15.3 pounds. The mean weight for the girls was 101.63 pounds with a standard deviation of 16.7 pounds.

The effect of manipulative skills training in music on motor ability performance seemed likely because of the number of students in the sample and the nature of the school community. Information about length of time in training manipulative skills on a musical instrument was obtained with the use of a questionnaire. (See Appendix A) Seventy-six out of the eighty students in the study responded to the questionnaire, thirty-seven boys and thirty-nine girls. The results of the questionnaire will be described in Chapter Four.

Instrumentation

The selection of instruments that measure factors of motor ability performance was based on a set of criteria that would enable application of the tests in the classroom. The criteria used for the selection were:

1. The administration time was to be short enough to allow the test to be used in the classroom without interfering with normal instruction time.

2. The equipment was to be as minimal as

possible. It was felt that as the amount of equipment grew so would the chance of variance in resultant data.

3. The scoring for each test was to be clearcut and without the factor of personal judgement in scoring.

4. The directions for each of the tests were to be minimal and simple to eliminate confusion in administration.

5. Each test was to measure a factor of motor ability performance distinct from the other tests. It was felt that this would isolate factors in which boys and girls differed.

6. Each test was to be reliable in measuring the ability it was intended to measure.

It was assumed that each of the tests selected would be valid in its measurement of motor ability performance. Four tests were choosen with the above criteria as a guide, two pencil and paper tests and two apparatus tests. The selection of the tests was also based on factors of motor ability performance. The factors were those indicated in past research as being distinct and measurable. The relationship of these factors to manipulative activities in industrial arts was considered as part of this selection. The distinctiveness of each factor was based on the validity of the tests used to measure the factor and the relationship of these tests to other measures of motor ability performance as indicated in linear correlations and factor loading.

The factors and the tests decided upon for use in this study were:

1. Eye-hand coordination as measured by the Marble Board Test.

2. Wrist-finger speed as measured by the Large Tapping Test.

3. Two-hand coordination as measured by the Two-Hand Coordination Test.

4. Complex coordination of the fingers, hand, wrist, arm, and shoulder as measured by the Hand Dynamometer Test.

The Marble Board and the Hand Dynamometer Tests were both apparatus tests. The Large Tapping and the Two-Hand Coordination Tests were both pencil and paper tests.

Marble Board Test. - The Marble Board Test is a test where the student places marbles, one at a time, into a series of holes. The test consists of a 13 1/2 inch by 22 inch base in which there is four rows of 7/8 inch in diameter holes, 3/4 inches deep. There are eight holes in each row and the holes are on two inch centers. At the end of each row there is a 2 1/2 inch by 3 1/4 inch space in which the marbles are kept until the students needs them. All of the compartments and each row of holes are separated by 1/2 inch wide by 1/4 inch deep spacers. The perimeter of the working area is 3/4 inch wide by 1/4 inch deep; this trim, as well as the spacers, keeps the marbles from rolling off the board.

The object of the test was to take the marbles, one at a time, from the compartment at the end of each row and place them in the holes, starting with the hole nearest the compartment and working toward the farthest hole. When one row was finished the next row was started in the same manner until all the holes on the entire board were filled. The student was asked to use his preferred hand and to work as fast and as accurately as possible. The score for this test was the amount of time, in seconds, that it took to fill the entire number of holes. Each student was given one practice row of eight holes to check for misinformation in folowing directions.

In administering the test the tester explained and showed how to place the marbles in the holes. The student was then told that he would be given one practice row and to wait for the signal to begin. The signal was "ready," "set," "go." On the word "go" the tester activated a stop watch; when the last hole was filled he stopped the watch. If there were any mistakes in following directions these were corrected. The marbles were returned to the compartment at the end of the row and the trial for the record was initiated using the same directions as for the practice row. In this record trial all four rows were filled before the watch was stopped.

The board was placed on a level table top 29 inches above the floor with the marbles on the students left. The student took the test seated in front of the board.

Large Tapping Test. - The Large Tapping Test was a paper and pencil test made up of a series of 1/2 inch diameter circles on 3/4 inch centers in which the student placed three dots in each circle. The score for this test was the number of circles dotted in a 15 second time period. The student worked from left-to-right, top-to-bottom in the same fashion as he would write.

The test was administered at the student's desk. Each student was given a pencil and a copy of the test. The students were then asked to read the directions for the test. When this was done the tester asked for questions and explained the procedure, demonstrating on the chalkboard. The students were then told they would receive one practice row of circles. They were told to wait for the signal to begin. The signal was "ready," "set," "go." On the word "go" the tester activated a stop watch for a five second practice. On the word "stop" he stopped the watch and corrected mistakes and answered questions about directions. The same signal was given for the start of the first trial for the record and the watch was allowed to run for 15 seconds before the stop signal was given. All the papers were collected at this point and a new set of tests was passed out. A second trial for the record was given in the same manner, with the exception that there was no five second practice period for this trial.

Two-Hand Coordination Test. - The item for this printed test consisted of two pairs of parallel lines set at right angles to each other. Each pair of parallel lines was 1/8 inch apart and 1/2 inch long. The student held a pencil in each hand and his task was to draw a line through the pair of vertical lines with the left-hand pencil and a line through the horizontal lines with the right-hand pencil. Both penciled lines had to be placed within the double line and both hands had to draw at the same time. The score for this test was the number of items completed in a 30 second time period. The student worked from left-to-right, top-to-bottom in the same fashion as he would write.

The test was administered at the student's desk. Each student was given two pencils and a copy of the test. They were asked to read the directions for the test. When this was done the tester asked for questions and explained procedure, demonstrating on the chalkboard. The students were told they would receive one practice row. They were told to wait for the signal to begin. The signal was "ready," "set," "go." On the word "go" a stop watch was activated for a ten second practice. On the word "stop" the watch was stopped and mistakes were corrected and questions on directions answered. The same signal was given for the start of the first trial for the record and the stop watch allowed to run for 30 seconds. After the stop signal at the end of the trial all papers were collected and a new set of tests passed out. A second trial for the record was given in the same manner with the exception that there was no ten second trial period.

Hand Dynamometer Test. - The Hand Dynamometer Test consists of an elliptical spring with a rachet attached to the spring, and two pointers. One of the pointers moves the second pointer across a face calibrated in kilograms, as pressure is exerted against the spring. As pressure is released, the first pointer returns to the original position; the second pointer remains at the point of its farthest travel, until it is returned manually to the starting position.

The test was administered to individual students and trials observed carefully. Administration was in the presence of other students so that motivation from competition could be used in obtaining optimum readings. Mis-trials were controlled through observation. If the instrument slipped, or something interfered with the trial, that trial was stopped and repeated.

Each student was tested while standing. Three consecutive trials and readings were taken on the preferred hand and the three consecutive trials were taken on the other hand. The arithmetic mean of the readings for each hand was retained for the record. The mean was choosen because students readings varied from one trial to the next. Fatigue entered into each consecutive trial. Using the mean was a method of reducing variance in the readings for each student.

As the student took the test he was instructed to squeeze the instrument with about half of his strength to get the feel of the dynamometer. After this initial trial the next three trials were taken for the record. On the trials for the record the student was instructed to squeeze the instruement as hard as he could.

Statistical Hypothesis

Major Hypothesis. - The hypothesis proposed for the study of motor ability performance of seventh grade industrial arts students was:

Seventh grade girls are at a higher level of motor ability performance in industrial arts manipulative activities than are seventh grade boys.

The hypothesis was stated statistically as follows:

The girls mean performances will exceed the boys mean performances.

H: $Mg > Mb$, Mg - girls mean, Mb - boys mean

Sub-Hypotheses. - Alternate Hypothesis 1:

No difference will be found in the girls mean performances and the boys mean performances.

H: $Mg = Mb$

Alternate Hypothesis 2:

The boys mean performances will exceed the girls mean performances.

H: $Mb > Mg$

Analysis

The analysis of the data gathered in the administration of the motor ability performance tests was based on the following points:

1. A comparison of the mean performances on each of the tests for both groups.
2. Linear correlations of the performances on the Marble Board, Tapping, and Two-Hand Coordination tests to the performance on the Hand Dynamometer Test.
3. Linear corrleations of age, height, and

weight with performances on each test.

4. A comparison of mean performances of each group to mean age, height, and weight of each group.

5. A check on the influence of playing musical instruments on the performances of both groups.

The check on the relationships of the Marble Board, Tapping, and Two-Hand Coordination tests to the Hand Dynamometer Test was for the purpose of determining the usefulness of these three tests in relation to a test[1] used in the determination of industrial arts motor ability performance.

In preparing the points for analysis it was assumed that age, height, and weight, along with performance on musical instruments, might affect the outcome of the study. The inclusion of these factors in examining relationships was made to eliminate error in drawing conclusions from the data.

Statistical Analysis

Test of Means. - A standard error of the differences between two means was used to determine whether there was any significant difference between the girls mean performances and the boys mean performances, or whether the difference, if any,

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[1] Fuzak, *op. cit.*

was due to chance.

Correlations. - In order to measure the associations between the various tests used in the study and the associations of the other factors involved in motor ability performance the technique of linear correlation was used. The product moment method was used to calculate all correlations.

Summary

In this chapter the sample was described giving complete information on location, age, weight, height, grade level and background. All the tests used in the study were described and information on administration and scoring was presented. The hypothesis was restated in statistical form and points for analysis were set down to enable the hypothesis to be tested.

CHAPTER IV

ANALYSIS OF RESULTS

The data on the motor ability performance of seventh grade industrial arts students is presented below in tabular form. Included in this data are the means for the test performances, age, height and weight; standard deviations for test performances, age, height and weight; linear correlations between test performances, age, height and weight; and other information related to influencing factors in this study.

The analysis will follow the outline presented in Chapter III of this study.

1. Comparison of mean test performances.
2. Linear correlation of the Hand Dynamometer Test with other tests.
3. Linear correlation of age, height and weight with test performances.
4. Comparison of age, height and weight means.
5. Influence of playing a musical instrument on test performance.

Test Performance Means

The hypothesis to be tested in this category was that the mean performances of the girls would exceed the mean performances of the boys. Symbolically stated: $Mg > Mb$. Alternate hypotheses to be considered were: the mean would be statistically equal, $Mg = Mb$, and; the boys mean would statistically exceed the girls, $Mb > Mg$. The following Table 4.1 is the analysis of the mean performances by test.

Large Tapping Test. - This test was used to measure wrist-finger speed. Table 4.1 shows the mean performance of the girls to be greater than the mean performance of the boys. At the 0.05 level of significance, with t-values of .379 for trial one and .205 for trial two, the performances, for both trials, were considered equal and the hypothesis rejected. The alternate hypothesis of $Mg = Mb$ was accepted on the basis of the indicated values.

Marble Board. - Eye-hand coordination was the factor measured by this test. Table 4.1 shows that the girls mean performance time was faster than that of the boys. A t-value of 2.13 was calculated for the data. This value at the 0.05 level of significance was considered high enough to accept the hypothesis as stated, $Mg > Mb$.

Dynamometer Test. - This test was used as a measure of the complex coordination of the fingers, hand, wrist, arm and

TABLE 4.1

MEANS AND STANDARD DEVIATIONS FOR ALL MOTOR ABILITY PERFORMANCE TESTS

	Boys N = 39		Girls N = 41	
	Mean	Standard Deviation	Mean	Standard Deviation
Large Tapping Test - Trial 1	17.97	2.55	18.28	4.49
Large Tapping Test - Trial 2	20.51	4.96	20.90	5.59
Marble Board Test	29.18 sec.	2.62 sec.	27.78 sec.	3.15 sec.
Dynamometer - Preferred Hand	21.42 kg.	4.72 kg.	17.12 kg.	5.63 kg.
Dynamometer - Other Hand	20.92 kg.	4.80 kg.	17.66 kg.	5.01 kg.
Two-Hand Coordination Test - Trial 1	19.68	5.67	24.08	7.41
Two-Hand Coordination Test - Trial 2	24.92	6.44	29.66	9.15

shoulder. Table 4.1 shows that the mean performance of the boys was greater than that of the girls. A t-value of 3.64 was calculated for the preferred hand scores and a value of 2.94 for the other hand scores. These values, at the 0.05 level of significance, indicate that the hypothesis, as stated, should be rejected. The alternate hypothesis of $Mb > Mg$ was accepted on the basis of the indicated values.

Two-Hand Coordination Test. - The simultaneous use of both hands was the factor measured with this test. Table 4.1 shows the girls mean scores on both trials to exceed the boys mean scores. The calculated t-values for these two trials were 2.89 and 2.60 respectively. At the 0.05 level of significance the values supported the acceptance of the hypothesis as stated, $Mg > Mb$. This held true for both trials.

Correlation of Dynamometer Test and Other Tests

Shown in Table 4.2 is the linear correlations for the Hand Dynamometer Test and the other tests used in this study. The comparison of the Dyanmometer Test, a test used as a possible index of coordination, and the other tests was included to determine the usefulness of these other tests as predictors of industrial arts motor ability performance.

The correlation coefficients were not large enough, positively or negatively, to indicate a relationship between

TABLE 4.2

LINEAR CORRELATIONS: DYNAMOMETER TEST AND OTHER TESTS OF MOTOR ABILITY PERFORMANCE

	Boys		Girls	
	Preferred Hand	Other Hand	Preferred Hand	Other Hand
Large Tapping Test - Trial 1	.208	.425	.144	-.580
Large Tapping Test - Trial 2	.201	.269	.133	.195
Marble Board Test	-.259	.549	.574	.643
Two-Hand Coordination Test - Trial 1	.300	.374	.277	-.565
Two-Hand Coordination Test - Trial 2	.575	.558	.296	.171

the factors measured by the Dynamometer Test and the factors measured by the other tests.

Correlation of Age, Height and Weight with Test Performance

The data in Table 4.3 revealed no definite pattern in the relationship of physical development, as indicated by age, height or weight and performances on the motor ability tests. There were instances of negative and positive correlations but, the lack of a consistent pattern excluded drawing conclusions from this data.

Age, Height and Weight Means

The purpose of this part of the analysis was to determine if factors of age, height and weight were of significance in the differences between the two groups. The hypothesis to be tested was $Mg > Mb$. Alternate hypotheses were: $Mg = Mb$ and $Mb > Mg$.

Table 4.4 shows that the mean height and weight of the girls exceeded the mean height and weight of the boys The mean age of the boys, as the table shows, did exceed the mean age of the girls. The t-values for the means were calculated to be the following: age, .974; height, 2.54; weight, 1.63. At the 0.05 level of significance the values indicated the acceptance of the hypothesis as stated for the

TABLE 4.3

LINEAR CORRELATIONS: AGE, HEIGHT, WEIGHT, AND TEST PERFORMANCE

Boys/Girls	Age	Height	Weight
Large Tapping Test - Trial 1	-.919/-.989	.411/ .784	.582/ .556
Large Tapping Test - Trial 2	-.393/-.535	-.782/ .885	.124/ .349
Marble Board	.284/-.081	-.362/-.856	-.375/-.158
Dynamometer Test - Preferred Hand	-.477/-.901	.360/ .269	.588/ .653
Dynamometer Test - Other Hand	.966/-.831	.445/-.256	.794/ .634
Two-Hand Coordination Test - Trial 1	.163/ .908	.783/-.085	.523/ .146
Two-Hand Coordination Test - Trial 2	.210/-.086	.937/ .031	.668/ .297

TABLE 4.4

MEANS AND STANDARD DEVIATIONS FOR AGE, HEIGHT, AND WEIGHT

	Boys		Girls	
	Mean	Standard Deviation	Mean	Standard Deviation
Age	156.95 months	4.8 months	154.19 months	4.1 months
Height	59.91 inches	2.66 inches	61.28 inches	3.12 inches
Weight	97.19 pounds	15.3 pounds	101.63 pounds	16.7 pounds

factor of height, Mg$>$Mb. Alternate hypothesis Mg = Mb was accepted for age and weight.

Test Performance and Use of Musical Instruments

It was felt that motor performance could be affected by the training obtained in manipulating a musical instrument. Information from a questionnaire (Appendix A) on this factor was obtained and tabulated. Tables 4.5 and 4.6 show the number of boys and girls playing musical instruments and the amount of time spent studying and in practice.

Table 4.6 shows the percentages for each group and the number of months or years spent in obtaining instruction. The number of boys and girls in each stage of training was nearly equal. The possibility that one group had more training than the other was rejected because of the near equality in each group as indicated by the percentages shown. At one time or another, 82.1% of the girls and 86.5% of the boys had some form of training on a musical instrument.

Summary

Presented in Table 4.7 are the hypotheses tested along with the calculated t-values and statements of acceptance or rejection. Included in the table are all the accepted hypotheses either the original or the alternate.

TABLE 4.5

NUMBER OF BOYS AND GIRLS PLAYING MUSICAL INSTRUMENTS

	Boys	Girls
Students playing instruments at the time of the study.	14 (37.9%)	20 (51.3%)
Students who played instruments in the past.	18 (48.6%)	12 (30.8%)
Students who never played instruments.	5 (13.5%)	7 (17.9%)
Totals	37	39

TABLE 4.6

LENGTH OF TRAINING ON MUSICAL INSTRUMENTS FOR STUDENTS WITH MUSICAL TRAINING

	Boys		Girls	
Length of Training	Playing	Have Played	Playing	Have Played
0 - 6 months	3 (21.4%)	5 (27.8%)	-	3 (25.0%)
7 - 12 months	-	3 (16.7%)	-	4 (33.3%)
13 - 24 months	-	8 (44.5%)	-	-
25 - 36 months	9 (64.2%)	2 (1.0%)	3 (15.0%)	1 (9.4%)
36 months and up	2 (14.4%)	-	17 (85.0%)	4 (33.3%)
Totals	14	18	20	12

TABLE 4.7

HYPOTHESES TESTED, t-VALUES, STATEMENT OF ACCEPT OR REJECT, AND ACCEPTED HYPOTHESIS

	Hypothesis Tested	t-Value		Accepted Hypothesis
Large Tapping Test - Trial 1	$M_g > M_b$	.379	Reject	$M_g = M_b$
Large Tapping Test - Trial 2	$M_g > M_b$	.205	Reject	$M_g = M_b$
Marble Board	$M_g > M_b$	2.13	Accept	$M_g > M_b$
Dynamometer - Preferred Hand	$M_g > M_b$	3.64	Reject	$M_g < M_b$
Dynamometer - Other Hand	$M_g > M_b$	2.94	Reject	$M_g < M_b$
Two-Hand Coordination Test - Trial 1	$M_g > M_b$	2.89	Accept	$M_g > M_b$
Two-Hand Coordination Test - Trial 2	$M_g > M_b$	2.60	Accept	$M_g > M_b$
Age	$M_g > M_b$	.974	Reject	$M_g = M_b$
Height	$M_g > M_b$	2.54	Accept	$M_g > M_b$
Weight	$M_g > M_b$	1.63	Reject	$M_g = M_b$

The only area where the girls performance was less than that of the boys was in the area of ability measured by the Hand Dynamometer Test. In all other areas of motor ability performance the mean performances for the girls were greater than or equal to the mean performances for the boys. Based on the above indicated levels of performance the following hypothesis was accepted:

> Seventh grade girls are at a higher level of motor ability performance in industrial arts manipulative activities than are seventh grade boys.

CHAPTER V

SUMMARY AND CONCLUSIONS

The intent of this study was to obtain some knowledge about the motor ability performance of seventh grade students in an industrial arts program. The use of activi-- ties involving motor ability in industrial arts programs suggested investigation of this topic.

Knowledge about differences in motor ability performance of industrial arts students, especially in coeducational classes, was almost non-existant. Although, as cited in Chapter II, research in motor ability performance has been conducted by other disciplines. These studies indicated that differences in performance were related to many factors and that these factors were measurable. In addition, it was apparent that these factors were related to activities which are an intergal part of industrial arts programs.

This study was premised on the theory that boys and girls are at different levels of physical development. The hypothesis under investigation was:

Seventh grade girls are at a higher level of motor ability performance in industrial arts manipulative activities than are seventh grade boys.

A battery of tests was selected to determine the level of motor ability performance in a number of distinct areas. The factors of motor ability and the tests used to measure them were:

1. Wrist-finger speed as measured by the Large Tapping Test.

2. Eye-hand coordination as measured by the Marble Board Test.

3. Simultaneous use of both hands as measured by the Two-Hand Coordination Test.

4. Complex coordination of fingers, hand, wrist, arm, and shoulder as measured by the Hand Dynamometer Test.

All of the tests had been used in previous investigation of motor ability. This research had established these tests as reliable measures of motor ability performances. One test, the Hand Dynamometer Test, had been used to establish a relationship between motor ability performance and industrial arts activities. In this study the tests were administered to a group of seventh grade students in a coeducational industrial arts program. Analysis of the test data indicated that girls were at a higher level of performance in their motor ability.

Knowledge of the performance levels, in each of the factors measured, can be used (1) to gain insight concerning

present industrial arts programs, (2) to keep abreast with student development and interest and (3) to organize new industrial arts programs.

Conclusions

On the basis of the hypothesis tested and the results of statistical analysis on test performances the following conclusions were made:

1. Girls are at a higher level of performance in the areas of eye-hand coordination and two-hand coordination.

2. Boys are at a higher level of performance in complex coordination of fingers, hand, wrist, arm and shoulder.

3. Girls and boys are at about the same level of performance in wrist-finger speed.

4. Girls are at a more advanced level of physical development in the area of height.

5. Girls and boys are at about the same level of physical development in the area of weight.

Discussion

The results of this study indicated that motor ability performance should be considered as a factor in the operation and development of coeducational industrial arts programs. This should not exclude the factors of mental development and social conditioning as guide posts in operating and preparing industrial arts programs. Neither do the results indicate that advanced levels of motor ability performance are necessary for participation in industrial arts activities.

The results of this study further indicate that girls are at a higher level of motor ability performance. This higher level of performance suggests for consideration the possibility of special activities and/or programs for girls in industrial arts. The factors discussed below tend to provide a basis for this consideration of types and degrees of difficulty of industrial arts activities.

Eye-Hand Coordination. - The tested hypothesis in this area of motor ability performance showed that girls were at a higher level of performance. Developers of eye-hand coordination tests indicated that this might be the case as is evidenced in the research conducted by Moore.[1] The 4.4 second difference in mean performances and the high probability that this difference is due to the factor of eye-hand coordination is an indication that consideration should be given to this type of performance in coeducation indus-

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[1] J. E. Moore, "A Test of Eye-Hand Coordination," Journal of Applied Psychology, 21:668-72 (1937) and "The Standardization of the Moore Eye-Hand Coordination and Color Matching Test," Educational and Psychological Measurement, 10:119-27 (1950).

trial arts classes where motor performance is used as an activity.

Two-Hand Coordination. - It has been known that dual or two-hand coordination is a factor in determining individual differences in motor ability. Drake indicates this as one of his criteria in the field of personnel selection.[1] The performance of the girls in exceeding the performance of the boys in this study gives us one more area to consider in the performance of manipulative activities in the industrial arts laboratory. Understanding and insight into this type of performance can help to guide the student in a positive direction in his or her exploration in the world of industry.

Complex Coordination. - The performance of the boys in this area of motor ability performance was greater than that of the girls. In the only available industrial arts research in the field of motor ability, Fuzak indicated that this type of motor performance was related to industrial arts manipulative activities.[2] The use of this factor as a predictor of ability appears to be a good choice because of its positive relationship to industrial arts activities. The performances in the areas of two-hand and eye-hand coordination

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[1] Drake, *op. cit.*

[2] Fuzak, *op. cit.*

tend to refute this choice. In these two latter cases girls performances are at higher levels. The indication here is that each of these factors is different and that more than one test must be used in predicting levels of ability for students in coeducational industrial arts programs.

Wrist-Finger Speed. - This was the only factor of motor ability performance where girls and boys performances were at the same level. All research reviewed for this study indicated that this was a factor to consider in the performance of motor ability. As a factor of differentiation between performances of the sexes wrist-finger speed proved to be inconclusive. The use of this factor should be considered in the light of being something that involves performances of the same degree from all students.

Implications

In the above discussion it was indicated that the motor ability performance of an individual in an industrial arts program is related to many factors within the area of motor ability. Recognizing the limitations of the scope of this study, the findings do suggest that;

1. Motor ability performance factors be considered as a means for determining levels of ability for girls and boys in industrial arts manipulative activities.

2. Each factor of motor ability must be measured by a distinct and separate test of performance.

3. The level of motor ability performance for seventh grade girls is higher and different than that of seventh grade boys in industrial arts manipulative activities.

4. Motor ability performance factors be considered as part of the upgrading and development of industrial arts programs.

5. Motor ability factors can be related to specific industrial arts activities as in the case of the Hand Dynamometer Test.

6. Coeducational industrial arts programs should consider the use of manipulative activities that are suitable for both boys and girls.

7. The design of future industrial arts programs should consider the special motor abilities of girls and boys.

Implications for Further Research

This investigation points out two areas for further study: (1) continued research within the area of motor ability performance and (2) research in the area of the relationships of motor ability and other areas of human development.

Research within the area of motor ability performance, requires examination of:

1. Sex related motor performance at all levels and ages.

2. Factors of motor ability performance that differentiate between the sexes, including the isolation of these factors.

3. The types of motor ability required to perform the manipulative activities used in industrial arts programs, including the development of tests to measure abilities related to industrial arts activities.

Research in the area of the relationships of motor ability and other areas of human development requires examination of:

1. The role of social conditioning, as indicated by past research, on the ability to perform motor tasks related to industrial arts manipulative activities in coeducational and sex segregated programs.

2. The inter-relationships of mental ability and motor ability performance and sex in coeducational industrial arts programs.

APPENDIX A

MUSICAL INSTRUMENT QUESTIONNAIRE

NAME______________________________

AGE________years_________ months

YES NO

1. ☐ ☐ Do you now play a musical instrument? (If your answer is Yes check one of the following.)

How long have you been playing this instrument?

☐ Less than 6 months.

☐ More than 6 months but less than 1 year.

☐ More than 1 year but less than 2 years.

☐ More than 2 years but less than 3 years.

☐ More than 3 years.

YES NO

2. ☐ ☐ Have you played a musical instrument in the past? (If your answer is Yes check one of the following.)

How long did you play this instrument?

☐ Less than 6 months

☐ More than 6 months but less than 1 year.

☐ More than 1 year but less than 2 years.

☐ More than 2 years but less than 3 years.

☐ More than 3 years.

3. What musical instrument or instruments have you played or are you playing at the present time?

____

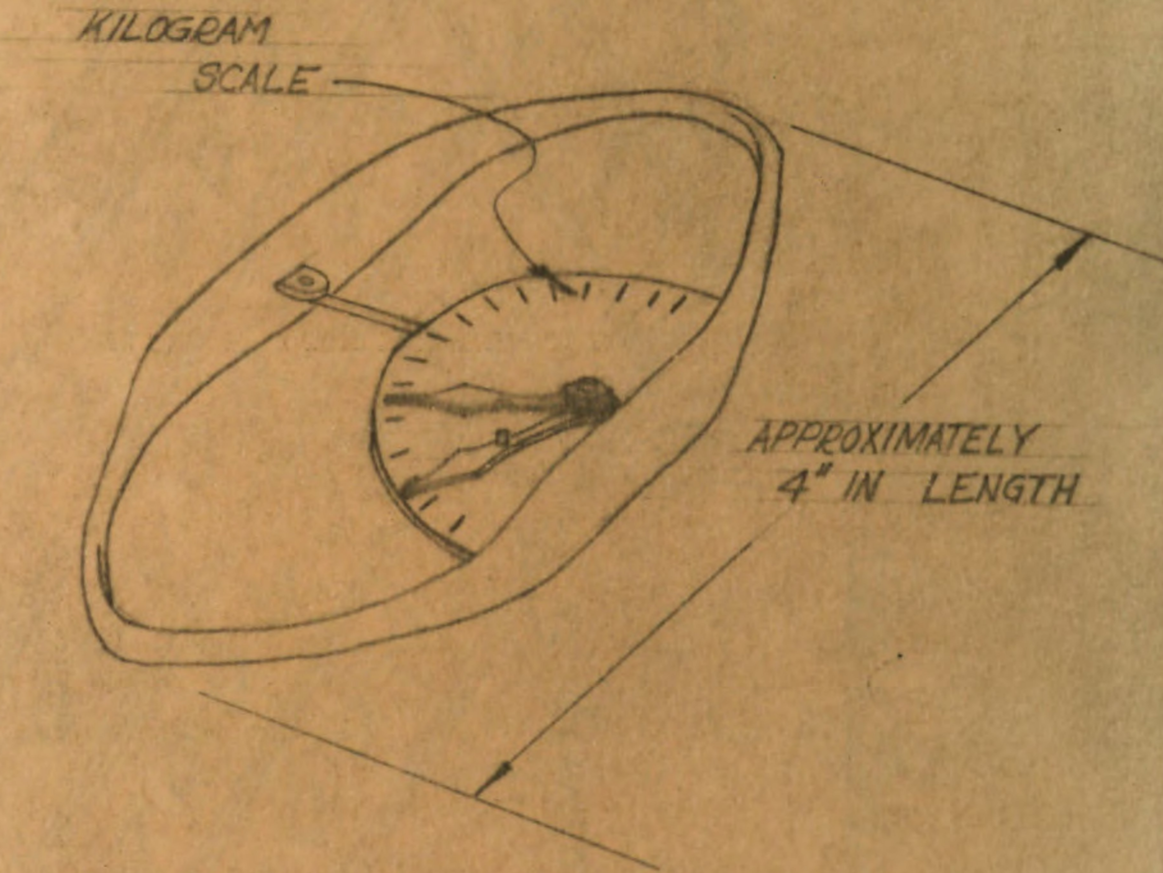
____

____

APPENDIX B

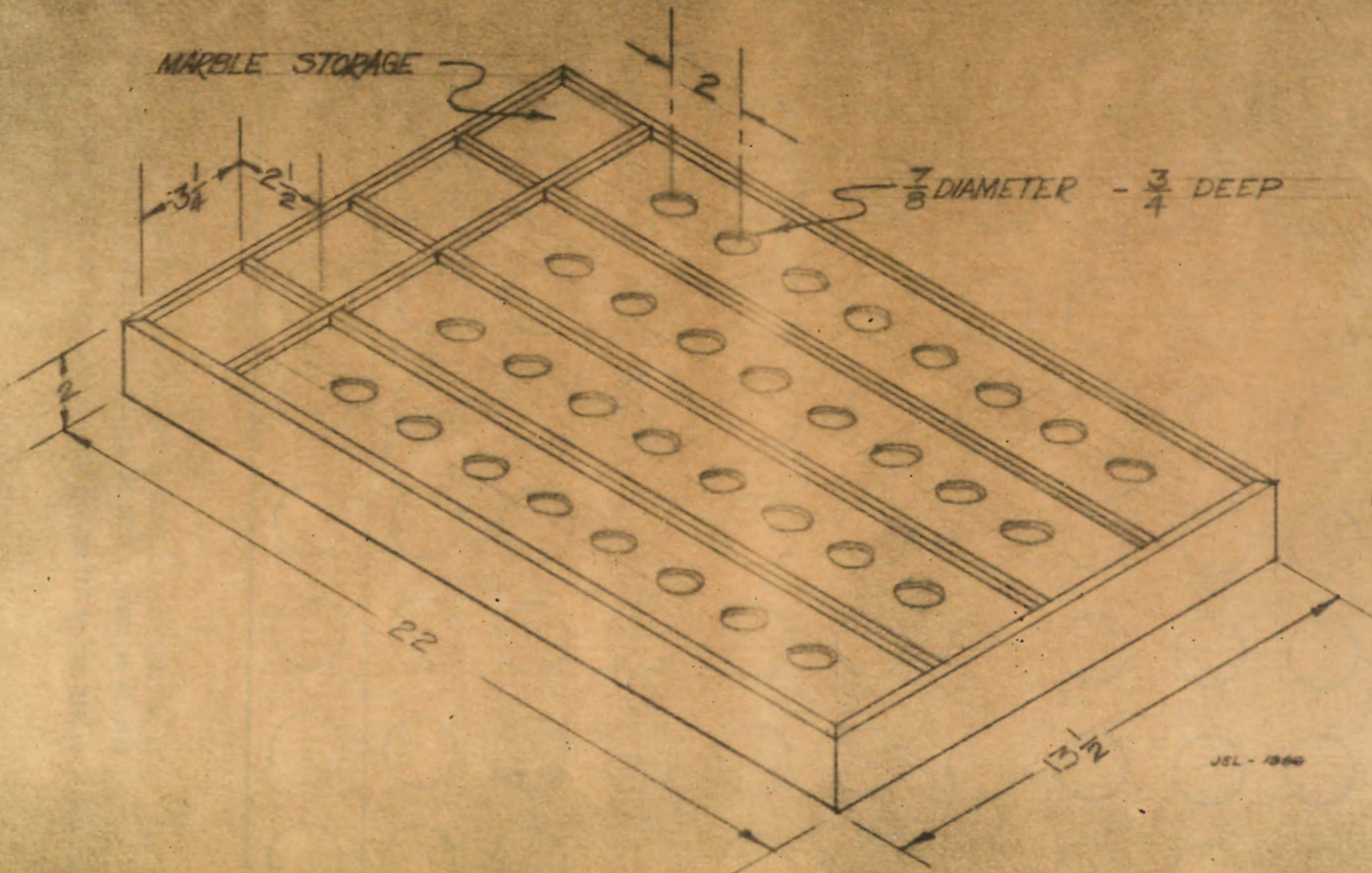
TESTS OF MOTOR ABILITY PERFORMANCE

HAND DYNAMOMETER TEST



JSL – 1966

MARBLE BOARD TEST



[redacted]

LARGE TAPPING

NAME ______________________

PERIOD ________ TRIAL ________

SCORE ________

DIRECTIONS ON THIS TEST YOU WILL USE YOUR PENCIL TO PLACE THREE DOTS IN EACH CIRCLE.

WAIT FOR THE SIGNAL TO BEGIN THE TEST; THEN PLACE THE DOTS IN EACH CIRCLE. STOP PLACING THE DOTS IN THE CIRCLES WHEN THE SIGNAL TO STOP IS GIVEN. WORK RAPIDLY.

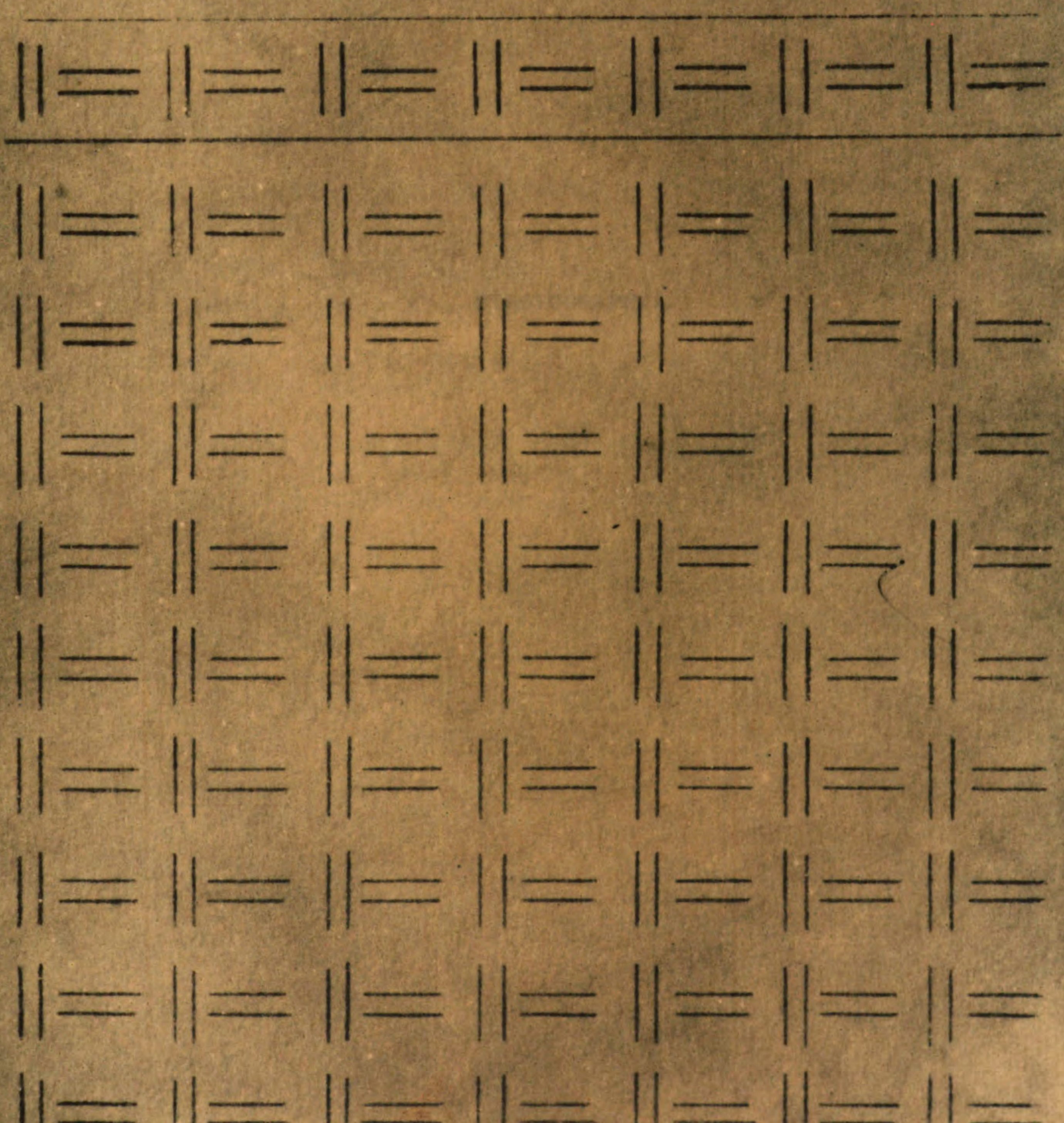
TWO-HAND COORDINATION

NAME ______________________

PERIOD __________ SCORE __________

TRIAL __________

DIRECTIONS FOR THIS TEST YOU WILL USE TWO PENCILS. YOU ARE TO DRAW A LINE THROUGH THE VERTICAL LINES WITH THE LEFT-HAND PENCIL AND A LINE THROUGH THE PAIR OF HORIZONTAL LINES WITH THE RIGHT-HAND PENCIL. BOTH PENCILED LINES MUST BE PLACED WITHIN THE DOUBLE LINES AND BOTH HANDS MUST DRAW AT THE SAME TIME. WAIT FOR THE SIGNAL TO BEGIN THE TEST. STOP WHEN THE SIGNAL TO STOP IS GIVEN. WORK RAPIDLY.



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