A STUDY OF THE RELATIONSHIP BETWEEN A KINESTHETIC TRAINING PROGRAM AND ARM PLACEMENT IN THE PERFORMANCE OF SELECTED SWIMMING STROKES

by

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A THESIS

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by

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ABSTRACT

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The purpose of this study was to determine if a body awareness training program would improve the performance of arm placement on the elementary back stroke and breast stroke in college women.

The subjects for this study were twenty-nine college women at Sam Houston State University, Huntsville, Texas. The subjects were those students who were non-swimmers and enrolled in beginning swimming classes during the 1970 spring semester.

The subjects were divided into a control group and an experimental group. Each subject in both the expermental and control group was given the Roloff Test Battery, which is a battery for measureing kinesthesis in college women. The battery was composed of balance stick, arm raising, weight shifting, and arm circling. The control group participated in the required beginning swimming program. The experimental group participated in a body awareness training program in addition to the required swimming course. The training program for the experimental group consisted of fifteen-minute sessions during each class period for six weeks. It was composed of tasks selected from the Purdue Perceptual-Motor Survey by Eugene G. Roach, Indiana University, and Newell C. Kephart,

Glen Haven Achievement Center, Ft. Collins, Colorado, The Slow Learner in the Classroom by Newell C. Kephart, and from Experiments in Movement Behavior and Motor Learning by Bryant J. Cratty and Robert S. Hutton. Tasks selected were the walking board, angels-in-the-snow, imitation of movements, and instruction in kinesthetic practices.

During the six-week period both the experimental group and the control group was given equal instructions for the execution of the elementary back stroke and the breast stroke. The strokes were taught according to the methods prescribed by the American Red Cross for swimming and water safety programs.

At the completion of the six-week period each subject in both experimental and control groups was re-tested on the Roloff Test Battery. The comparisons of the pre-and post-test results showed only one test, the balance stick test, having significant improvement at the .05 level of confidence for the experimental group. This improvement suggests that the selected training program which included the balance beam contributed to improvement in this area.

Swimming proficiency was determined by three Red Cross Water Safety Instructors who observed and rated the swimming performance and arm placement of each subject. Four rating sessions were held at approximately two week intervals. The instructors were not aware as to which students had received training to heighten body awareness. They attempted to eval-

uate group differences in arm placement during the performance of the elementary back stroke and the breast stroke.

A comparison of the initial test scores for arm placement of the elementary back stroke showed no significant improvement at the .05 level of confidence. Yet, the Water Safety Instructors agreed that the experimental group showed better action on arm movements and more precise placement of the arms during performance of the stroke than did the students of the control group. The results of the comparison of the initial test scores for arm placement of the breast stroke showed significant improvement at the .05 and .01 levels of confidence for the experimental group.

The results of the final ratings conducted by the Water Safety Instructors in both the elementary back stroke and breast stroke were not significant, although the results of the elementary back stroke scores showed a noticable improvement over the first rating. The Water Safety Instructors had commented that although the breast stroke was normally more difficult for the student to learn, the experimental group looked better in arm placement during its performance. Instructors commented that until the final rating session the experimental group had looked and performed much better than the control group in relation to arm placement.

It appears that within the limitations of this investigation, that the kinesthetic program had some effect on improving arm placement of the selected swimming strokes. The

improvement was more noticeable at the time the stroke was first introduced to the students. The results indicate that the program is worthy of further investigation.

Approved:

Coralie Ann Emmons
Supervising Professor

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CHAPTER I

INTRODUCTION

Importance of this Study

Only a few physical education studies have been attempted in order to improve kinesthetic awareness. Roloff (21:210) points out that the presence of the kinesthetic sense has often been considered as one of the factors contributing to the ability of an individual to learn an activity or skill. Stevens(43:2) stated that kinesthesis is most pertinent to the acquisition of motor skills since the awareness of movement is essential to successful performance. Many other writers(2)(4)(13)(23) have recognized the importance of kinesthetic awareness and its relation to the learning of skills. Yet, Roloff(21:210) states that much information is still needed concerning the nature and function of kinesthetic awareness.

We have no direct information concerning spatial relationships in our environment. All of our information concerning body localization comes to us through some cue which has to be interpreted to give us concepts of space. Our most direct information is in the field of kinesthesis or muscle sense which tells us the degree of relaxation or tension in

our muscles.(9:91) According to Cratty(3:110) the "feel of a movement" after completion, whether awkward, smooth, or jerky, probably is dependent upon kinesthetic sensitivity. In addition, the formation of accurate body awareness is related intimately to kinesthetic sensations from various receptors.

The most direct clue to space is movement. We move our hand until it comes in contact with an object. Through kinesthesis we estimate how far we had to move to make contact with the object.(9:98) Stevens(43:2) points out that without adequate body awareness information is lacking as to where a limb begins movement. Once the movement gets underway the limb's progress would not be known nor would the subject know where to stop the limb without kinesthetic guidance.

Persons with a keen kinesthetic sense apparently remember correct motor movements easily because of vivid position sensations. In sports activities the ease and skill with which the individual is able the execute particular movements is dependent upon his level of kinesthesis. The individual with a high level of kinesthesis will be able to repeat a track stance, or an intricate dive, a cartwheel, or the complex movement of a swimming stroke. He must develop a "feel" for the correct way to swing, to throw, or to jump. In most situations instruction or training is necessary in order to effect the initial performance.(13:296) Counsilman(2:187) has said that a swimmer can practice movements and positions

out of the water that will make him more aware of his movements in the water. He should develop a feel for what he must do in the water. This practice can be drills or exercises that are similiar to movements involved in a swimming stroke.

The swimmer has to rely primarily on the sensations of touch and kinesthesia when he is in the water. Cratty (3:133) has said that some individuals perceive more easily through visual impressions and others receive most meaning from kinesthesia and touch. Since a person is able to swim with his eyes closed, it can be assumed that the eyes are not always needed to help analyze movements.(2:187) Since the amount of clearly distinguishable stimuli he receives from his eyes is limited in the water, the visual influence will not be treated as a significant factor in this study.

The question is presented as to whether a body awareness training program will improve the performance of the breast stroke and the elementary back stroke. If the training program could develop this nebulous quality of "feel for the water," the swimmer could possibly perceive sensations more easily, impart meaning to them, and adjust his stroke pattern accordingly. Such insight should provide the physical educator with a valuable aid for improving instructional techniques of swimming classes.

Statement of the Problem

The purpose of this study is to determine if a body awareness training program will improve the performance of arm placement on the elementary back stroke and breast stroke in college women.

More specifically the sub-problems are:

1. To determine if there are any significant differences between the groups in arm placement on the elementary back stroke at the end of the six week training program.

2. To determine if there are any significant differences between the groups in arm placement on the breast stroke at the end of the six week training program.

3. To determine if there are any significant differences between the groups in kinesthetic awareness at the end of the six week period.

4. To determine if there are any significant differences within the experimental and control groups in kinesthetic awareness at the end of the six week training program.

5. To determine if there are any significant differences within the experimental and control groups in arm placement on the elementary back stroke. The raw scores will be computed at two two-week intervals and at the end of the six week training program.

6. To determine if there are any significant differences within the experimental and control groups in arm placement on the breast stroke. The raw scores will be com-

puted at two two-week intervals and at the end of the six-week training program.

Hypotheses

1. The experimental group will show significant improvement over the control group in arm placement of the elementary back stroke.

2. The experimental group will show significant improvement over the control group in arm placement of the breast stroke.

3. The experimental group will show significant improvement in kinesthetic awareness at the end of the six-weeks training program.

Basic Assumptions

1. Students who registered for beginning swimming will afford a reasonable random sampling of college women from Sam Houston State University, City of Huntsville, State of Texas.

2. Administration of the kinesthetic tests will give an acceptable measure of each student's level of kinesthetic abilities.

3. The rating by water safety instructors on the swimming ability and arm placement of the elementary back stroke and breast stroke will give an acceptable measure of each student's level of swimming ability.

4. Comparison of the pre-test and post-test scores of the kinesthetic tests will reveal any signigicant differences between the control group and the experimental group in the area of kinesthetic ability.

5. Comparison of the rating scores by the water safety instructors will reveal significant differences between the control group and experimental group in arm placement of the elementary back stroke and breast stroke.

6. Comparison of the pre-test and post-test scores of the kinesthetic tests will reveal any significant differences within the groups in the area of kinesthetic ability.

7. Comparison of the rating scores by the water safety instructors will reveal any significant differences within the groups in the area of arm placement of the elementary back stroke and breast stroke.

Limitations of the Study

Because of various factors, there are certain limitations in this study. They are:

1. The study was limited to a six week period of time, fifteen minutes a day, two days per week.

2. The study was limited to twenty-nine college women.

3. There is a possibility that some of the subjects may practice the swimming skills and training items other than during the required time period.

4. There is a possibility that some of the subjects in the control group may learn some of the training skills

from those subjects in the experimental group and practice these skills on their own time.

5. The testers who administered the kinesthesis battery were physical education majors at Sam Houston State University and possessed only a limited knowledge of testing procedures.

Definition of Terms

The following terms and definitions will be used in this study:

1. Body Awareness- a heightened awareness of various parts of the body for clearer movements and exploration of space.(3:104)

2. Control Group- those subjects who will be enrolled in beginning swimming and a course sequence for swimming classes as outlined by the American Red Cross.

3. Directionality- the projection of the right-left discrimination within the body to objects outside of the body. (32:11)

4. Experimental Group- those subjects who will receive a six week training period in the body awareness training program. The subjects will follow a course sequence for swimming classes as outlined by the American Red Cross.

5. Goniometer- instrument used for measuring the joint angles. It consists of a 180-degree protractor.(45:81)

6. Kinesthesia- the sense by which motion, weight, and the position of the various parts of the body are deter-

mined.(2:179)

7. Kinesthesis- the sense which enables the person to perceive the position or movement of the total body and of its parts.(14:390)

8. Kinesthetic Awareness- the awareness of the position of the body parts and of the whole body in relation to its surroundings and space.(46:2)

9. Kinesthetic Sense- the feel or awareness of body position and body movement.(13:290)

10. Kinesthetic Perception- the conscious awareness of the individual of the position of the parts of the body during voluntary movement.(20:456)

11. Laterality- an internal awareness of the two sides of the body and their difference.(32:12)

12. Motor Skill- the performance of movements implying the development of a high degree of precision and accuracy. (32:14)

13. Motor Learning- a rather permanent change in motor performance brought about through practice.(32:13)

14. Movement- to change a position, place, or posture. (32:14)

15. Roloff Test Battery- the test battery selected for use in this study which is a measure for kinesthetic awareness. (21:310)

16. Spatial Awareness- awareness of objects and bodily orientations in space.(4:98)

17. Training Activities- the body awareness training tasks performed by the experimental group.

Careful consideration was given to the use of the numerous terms and an attempt was made to discriminate among them. Authorities refer to the following terms and use them synonymously. The terms which did not apply were omitted from the study. For the purpose of this study these terms which have been defined will be used synonymously: 1. Body Awareness, 2. Kinesthesia, 3. Kinesthesis, 4. Kinesthetic Awareness, 5. Kinesthetic Sense, 6. Kinesthetic Perception.

CHAPTER II

SURVEY OF RELATED LITERATURE

Research in kinesthesis has been primarily limited to studies dealing with measurement, motor learning, and its relation to development of motor skills. Each author has investigated kinesthesis from different approaches allowing small "bits" of information to constitute a whole.

Studies Dealing with the Definition and Nature of Kinesthesis

Within the muscle sense lies the most important contribution of physical activity to the mind of man. Each activity that we engage in contributes to the formation of the kinesthetic sense whether we recognize it specifically of not. Oxendine(13:29) defines kinesthesis as the "muscle sense or motor sense. In addition it has been called the sixth sense." He considered it to be the "feel or awareness of body position." A person must be guided by his own sensory clues in order to perform consistently and correctly. An instructor can enhance a performer's body awareness, however, the person must remember the sensations of the movement in order to duplicate it at a subsequent time.

Oxendine gives the following example:

> An individual when learning to type develops an early awareness of what it feels like to touch each of the keys. Once this sensation has been established he can thereafter depress the correct key with the proper finger without looking.(13:296)

In sports activities the same ease and skill is developed in swimming positions and is evidence of the level of kinesthesis. Some people can sense the degree of accuracy when executing a sport skill. Others are unable to tell if the movement has been awkward or graceful.(42:2)

During skilled motor performance the individual must be aware of body position and must be able to control the body and the body parts. Cherny(30) did an experimental study of the effect of training on kinesthetic positioning. The subjects for the study were twenty-eight undergraduate women living in one housing unit at Smith College, Northampton, Massachusetts. She selected four items from Young's battery(27) to measure kinesthetic positioning. These were the Arms Side Raising Ninety Degrees, the Arms Forward Raising Ninety Degrees, the Side Leg Raising Twenty Degrees, and on the Back Leg Raising Sixty Degrees. Following the administration of the tests the subjects participated in a five week training program. At the end of the training period the subjects were retested. The research indicated that kinesthesia may be developed through the development of an awareness of body parts. Bowdlear(17:100) performed an experiment in kinesthetic learning which involved a group of high school boys learning to do an up-start on the

parallel bar. The study is centered around determining to what extent perception of bodily movement in space could be developed. His purposes of the study were to determine (1) whether the kinesthetic sense could be developed, (2) whether kinesthetic perception could be improved, and (3) what method should be applied to facilitate this improvement. The author concluded that kinesthetic perception could be developed and improved.

Counsilman(2:179) has defined kinesthesia as "the sense by which motion, weight, and the position of the various parts of the body are determined." This sense helps us to realize the amount of tension in muscles and joints and the relationship of one part of the body to the other.

Scott and French(14:390) defined kinesthesis as "that sense which enables the person to perceive the position of movement of the total body and of its parts." An individual takes the procedure for granted and is not really aware of the actual process.

Wilson(46) conducted a study of the literature pertaining to kinesthesia and movement with special emphasis on the application of these to the teaching of sports skills. She summarized that kinesthesis is responsible for: (1) perception of own bodily movement, whether active or passive, (2) an awareness of the position of the body parts and of the whole body, (3) determination and distinction of weight and pressure, (4) awareness of the body in relation to its surroundings, (5) ability to recognize and hold a specific position,

(6) coordination of movement, and (7) partial aid in maintenance of balance.

Another study by Best and Taylor(1:304) suggested that kinesthesis is the awareness by which we are made conscious of bodily positions.

An individual must be aware of body position and must be able to control the body and the body parts. Studies have been summarized on the effects of training on kinesthetic positioning. The research indicated that kinesthesia may be developed through the development of an awareness of body parts.

Studies Dealing with the Relationship of Kinesthesis to Motor Learning

Many studies have been attempted in order to disclose the relationship between motor learning and positional measures of kinesthesis. Phillips and Summers(20:456) investigated learning and kinesthetic perception in 1954. They classified 115 college women as fast and slow learners on the basis of improvement in bowling scores. A kinesthetic test involving positional measures was administered to all subjects. The authors found that kinesthesis was related to learning a motor skill but more so in the early learning stages. They also reported a difference in kinesthetic perception between the preferred arms.

Ensign(33) stressed the importance of body awareness during the learning stages of a skill. The acquirement of skill takes place much quicker when the movements can be

consciously recognized and understood. Physical education is striving to develop this type of understanding of body awareness.

Wells(15) stressed the importance of body awareness to positioning movement, and the intensity of muscular action. The consciousness of sensations helps us to judge the correctness of our movements.

Oberteuffer(12:206) realizes the value of kinesthetic awareness in the learning of motor skills. This type of learning involves doing and feeling. The individual with a keen kinesthetic sense can "feel" each shot or stroke and "sense" the smoothness and accuracy of muscular performance. "Getting the feeling of a motor situation is often the crucial element which breaks the 'log jam' of confusion and frustration and sends the learning curve zooming upward in evidence of marked improvement."(12:206)

Much of one's ability to learn a skill quickly depends upon his kinesthetic receptivity. Becky Sisley(42) performed a study in 1963 for the purpose of determining if a relationship existed between kinesthesis and the level of skill in basketball, bowling, and tennis. A test battery designed by Roloff was used as the measure of kinesthetic sensitivity. Sixty-one subjects were selected on the basis of their skill level, and the kinesthetic battery was administered to all of these subjects. According to the study she found no relationship between kinesthesis and skill level in basketball, bowling, and tennis. The tennis group had the largest range of

scores as well as the highest score.

Many studies have been attempted to reveal the relationship between motor learning and positional measures of kinesthesis. It is evident that the acquirement of skill takes place much quicker when the movements can be consciously recognized and understood. Physical education is striving to develop this type of understanding of body awareness.

Studies Dealing with the Measurement of Kinesthesis

Research in the area of measurement of kinesthesis has revealed a great deal concerning the nature of the kinesthetic sense. The earlier investigations were directed toward validating selected test items. Stevens(43) performed the first of more recent attempts to measure kinesthesis. The purposes of her study were to find if there were certain tests that would differentiate between individuals in kinesthetic awareness, if there is any difference in the kinesthetic ability of the trained or the untrained and if the highly skilled performers show more body awareness than do the less skilled performers who have had comparatively the same amount of motor training. She selected thirty-six test items from a survey of all kinesthesis tests. They were administered to a small group, and the results were intercorrelated. Certain tests were T scored and combined into a battery to establish a criterion measure of kinesthesis. Correlations between the criterion measure and each of the individual tests it included

were found. Predictive indices of kinesthesis were determined once multiple correlations and multiple regression equations were found. The six item battery included: sidearm 90° (R), sidearm 90° (L), arm pull 15 lbs. (R), arm pull 15 lbs. (L), arm lift 130° (R), leg force 20 lbs. (L), and had a multiple correlation of .923. The five item battery had a correlation coefficient of .912. It included the leg force 20 lbs. (L). The four item battery further deleted the sidearm 90° (L), and three item battery was composed of only sidearm 90° (R), arm pull 15 lbs. (L), and arm lift 130° (R). Their multiple correlation coefficients were .892 and .937, respectively.

Scott(23) attempted to establish tests for the measurement of kinesthesis. She selected one hundred college women and they were given twenty-eight measures of kinesthesis and two of motor ability. Later, a second group was given sixteen measures of kinesthesis. An analysis was made of the quality of the test items and of the interrelationship of the tests given both groups. The low correlations found leads to the assumption of specificity of function. Most of the tests were adequate in reliability. There was no single item related high enough to the criteria employed to be useful alone as a measure of kinesthesis, though several combinations gave fair validity. It is concluded that kinesthesis is composed of a series of specific functions.

Witte, Russell, and Wiebe attempted studies to measure kinesthesis. In Russell's study(40) she performed a

preliminary factor analysis of the intercorrelations of fifteen tests of kinesthesis as administered by Scott. These were the items which made up three batteries administered at the State University of Iowa during 1952, 1953, and 1954. The Thurstone multiple group factoring technique was used to analyze intercorrelations between tests in each of the batteries. A number of factors emerging from Russell's study "sustain the hypothesis that kinesthesis can be divided into distinguishable functions that do not operate in all tasks that involve response to kinesthetic stimuli."(40:55) The following factors were tentatively suggested: awareness of the extent of muscular contraction in the arm, a factor that operates in arm movements, arm positioning on the horizontal plane, balance, leg positioning, orientation of the body in space, and arm positioning on the vertical plane.

Witte(47) attempted to explore the nature of several tests designed to measure kinesthesis. She analyzed the intercorrelations between the tests in an effort to answer the following questions: "(a) what are the factors basic to the kinesthetic sense, (b) which of the tests is the best measure of each factor, and (c) what is the factorial composition of the tests?"(47:n.p.) Seven factors were identified as basic to the thirty tests. Kinesthesis cannot be thought of as a general trait. The factors identified were: force of muscular contraction of the arm, leg positioning, arm positioning for short arm movements on the vertical plane, arm posi-

tioning in long arm movements on the vertical plane, extent and force of muscular contraction of the arm on the horizontal plane and force of muscular contraction of the leg.

In 1954, Wiebe(45) administered twenty-one different tests of kinesthesis to fifteen college varsity athletes and fifteen college men who had never earned letters in high school varsity sports. He found the athletes significantly superior to the non-athletes in kinesthetic reponse. Fifteen of the tests had reliability coefficients which could permit their use as testing instruments although none had a validity coefficient high enough to warrant its use as a single test. The combination of tests which appeared to measure kinesthesis in college men best included balance lengthwise, leg raise, vertical space, and separate feet.

In 1956 further investigation by Wiebe(26) attempted to clarify the nature of the factors listed in Russell's study. He utilized a factor analysis technique to determine the nature of a battery of tests of kinesthesis. The selection of the battery was governed by the factors which were hypothesized by the author to be common to the tests in the battery. Eight common factors emerged when the multiple group method of factoring was carried out on a battery of forty-four measures. The four kinesthetic factors isolated were in partial agreement with Wiebe's hypothesis.

Roloff(21) developed a battery of tests recommended as a measure of kinesthesis in college women. The reliabil-

ities of twelve tests selected from Young, Fisher, Scott, and the Victory Through Fitness report were computed. Each of the eight tests were intercorrelated with the other seven and reliabilities were determined. The T score of all eight tests was used as a criterion for computing the validities on each test. Multiple correlations and the Doolittle Method were used to determine the best set of items. The following battery of tests was recommended as a measure of kinesthesis in college women: balance stick, arm raising, weight shifting, and arm circling. The regression equation used for this study was: .75 balance stick-arm circling plus 50. The coefficient of multiple correlation was .88.

The Roloff battery was examined in 1963 by Sisley(42) who studied kinesthesis in relation to the skill level in basketball, bowling, and tennis. She used Roloff's battery of tests and found it a satisfactory measure of kinesthesis in college women. Prior to the testing of her subjects she administered the battery to determine the reliability of the test items. The subjects selected to be given the kinesthesis battery were sixty members of two volleyball classes taught by the author during the second semester, 1962-63. For the purposes of determining the reliability, the Pearson-Product-Moment of Correlation was used and stepped up by the Spearman-Brown Prophecy Formula. The reliabilities of the four items on the battery were: balance stick .8135, weight shifting .7804, arm raising .8375, and arm circling .7722. She con-

cluded that the four item kinesthesis battery was a reliable measure as administered in her study.

Henry(19) and Slater-Hammel(24)(25) have also dealt with the measurement of kinesthesis. Henry has considered kinesthesis as one of the most vital areas for research in physical education. With respect to accuracy of response, two types of kinesthetic adjustment were studied. Twelve male subjects were selected for the study. Data obtained showed a fairly close relationship between the adjustment and perception measures.

Slater and Hammel(24)(25) attempted two studies dealing with measurement of kinesthesis. The earlier study was a comparison of reaction time measures to a visual stimulus and arm movement. Analysis of data revealed that a moderate relationship existed between the two measures. In 1957 he described a technique for using muscle potential changes as a measure of the kinesthetic perception of muscular force. He found no significant differences in the groups.

A wide variety of tests have been suggested in the literature. The major shortcoming of many of the investigations was the inadequate number of subjects. All findings point toward specificity and diversity of the component factors of kinesthesis.

Studies Dealing With the Relationship of Kinesthesis to Motor Ability

The definitions of kinesthesis tend to suggest a close relationship with motor ability. In 1945, Fisher(34) dealt with the relationship of kinesthesis to general motor ability and to general motor capacity in high school girls. Obtaining tests to measure kinesthesis was a problem. Tests were selected for her battery from the Victory Through Fitness report, from Young(27), and from tests she devised. She concluded that (1) the reliability coefficients were for the most part very high, (2) the correlations between the kinesthetic tests and those of general motor ability were positive and low, but close to the point of significance, (3) the results were consistent with Young's study.

Young(27) studied kinesthesis in relation to gymnastics and sports activities. She selected thirty-seven college women from physical education majors. They took various movement tests involving throwing, kicking, hitting, grip, arm and leg movements, and balance. In all, a battery of nineteen tests, most of which she devised for the study were administered to the subjects. Only two tests, the sideward arm raise 45° and the balance test correlated significantly with the criterion of general motor ability. The coefficient of correlation obtained led the author to believe that there was no real relationship between the tests of kinesthesis and the Scott Motor Ability Test. The tests failed to achieve desired results.

Stevens(43) compared the kinesthetic discrimination of two extreme groups as determined by scores on the Scott Motor Ability Test. One group measured low and one high. The groups contained one hundred non-majors and forty physical education majors. Those who scored highest on the Scott Motor Ability Test did not show a more highly developed kinesthetic sense than those scoring low on the Scott Test.

One problem involved in Roloff's(21) study was determining if a relationship exists between kinesthesis and general motor ability. She administered the Scott Motor Ability Test and a battery of four kinesthesis tests to nine physical education classes at the State University of Iowa. The correlation of the kinesthesis scores was determined by the previously mentioned regression equation. The correlation of .43 was found to be significant at the one per cent level, and was higher than any heretofore mentioned.

Norrie(39) hypothesized that a positive relationship exists between kinesthetic awareness and motor performance. The subjects were chosen from a group of four hundred students registered for physical education at the University of California. The subjects were chosen on the basis of their ability to learn and perform skills. There was a "good" group and a "poor" group, each containing thirty members. A battery of seven measures of kinesthesis was administered to both groups. Significance of the difference between the groups was determined by the Chi-Square technique. It was concluded that there was a

significant positive relationship between measures of kinesthesis and motor performance.

According to the studies mentioned it appears that kinesthesis does show a relationship to motor ability. These studies carried out by physical educators have helped in the isolation of several general kinesthetic qualities, but much more research is needed in order to know the exact role that kinesthesis plays in the control of skilled movements.(4:73)

Studies Dealing With Swimming

Studies dealing with swimming and its relation to kinesthetic awareness are very limited. Several unpublished theses and dissertations were examined. The following studies deal with methods of learning and teaching swimming strokes, and are not directly related to the purposes of this investigation. The material does contain excellent information on the research that has been completed in methods of instruction and therefore it may be considered relevant to the background of this study.

In 1967, Margaret C. Buck(29) studied the effects of two practice techniques on selected swimming strokes at Indiana University. Her subjects were eighty-five college men and forty-seven women who enrolled in seven intermediate swimming classes. All subjects participated in water practice drills for the front crawl and breast stroke. One third of the subjects also practiced the drills mentally and one third parti-

cipated in land drills for these techniques. The Fox Power Tests for the front crawl and breast stroke were administered four times. All groups improved significantly. Mental practice and land practice did not cause any greater improvement than additional time in the water spent on the practice of different activities. Speed and form of the two strokes seemed to be more closely related than speed and power or form and power.

A similiar study was performed at the University of Oregon by Sheldon.(41) He investigated the relative effects of mental practice and physical practice in improving the efficiency of the breast stroke.

In 1968, Goodwin(35) studied the effects of presenting a specific order of visual and auditory instructions on the learning of the front crawl stroke. Twenty-eight subjects were randomly selected at the University of Western Ontario. They were divided into four groups, each receiving different orders of instructional presentations. Each group received eight instructional sessions with each session including five repetitions of the instructional presentations. This instruction was followed respectively by one-minute practice periods in the water. In the fifth through the eighth sessions, three randomly selected subjects from each of the four groups were given specific corrections following each practice period. The four groups increased in their ability to imitate the crawl stroke over the three test periods. There was no difference in the imitative abilities of the subjects in the four groups. No difference was found in imitative ability between

the subjects receiving correction and those not receiving correction.

Clayton(31), University of Oregon, performed a study on the efficacy of the land-drill implicit rehearsal and water-practice methods in teaching the breast stroke and the crawl stroke to college men. He selected fifty-six college male subjects who participated in a eight week program. They were divided into three groups equated in motor ability, motor fitness, swimming ability, and confidence in the water. One group practiced entirely in the water, and the other two groups were given land drills or implicit rehearsal before receiving the same instruction. Analysis of covariance showed no significant differences between groups. The three methods of instruction appeared equally effective.

A comparison of two stroke progressions in teaching the breast stroke was made by Hohl(36) at the University of Washington. She selected fifty-three women from four swimming classes. Two instructors each taught one class using the progression of elementary back, side and breast stroke and one class with the back, breast, and side stroke progression. All subjects spent the first six (of twenty) fifty-minute periods adjusting to the water and learning the dog paddle and elementary back stroke. Fifteen minutes of the next six periods was spent in instruction on the side or breast stroke and equal time in the next periods on the breast stroke or side stroke as appropriate. The remaining time in each period

was spent reviewing previous strokes and learning other skills. The Stroke Count Test developed by Kilby was used initially to test subjects able to swim a length of the pool and after each stroke was considered "learned." Kilby's revision of the Stop Watch Test for buoyancy by Cureton was also given, but showed little correlation with ability in the back, side, or breast strokes. Ability to swim one or two lengths of the pool with the side or breast stroke developed more rapidly in whichever stroke was learned last by the subject. A more efficient and stronger breast stroke resulted when it was learned before the side stroke. Learning the side stroke before the breast stroke did not appear to foster the use of a "scissor type" kick in the breast stroke.

In 1966 Musley(38) compared two methods of teaching the elementary back stroke. Students of the University of North Dakota "Upward Bound" project volunteered as experimental subjects. They were placed in two groups and one was taught the whole method of instruction while the other was taught the same stroke using the part method. The subjects attended ten instructional sessions after which they were rated by a committee of four judges on performance of the prescribed stroke. The whole method proved to be better than the part method in teaching the elementary back stroke.

James Counsilman(2), coach of the 1964 Olympic Swimming Team, has recently written a very informative book, The Science of Swimming. The book contains excellent discussions

on teaching techiques. He includes a section on perceptive ability and learning and is the only author of the literature reviewed who has mentioned the importance of body awareness and "feel" for the water. Counsilman states that a swimmer is dependent upon feelings of touch, pressure, and kinesthetic sensations to inform him of his body position.

At one point Counsilman(2:180) did a study on the sensitivity of swimmer's hands to pressure changes in the water. He used a test which measured the ability of the person to perceive these changes of pressure on his palms by testing them with varying weights. The subject would express whether each subsequent weight was lighter, heavier, or the same as the preceding one. His swimmers were two Olympic team members and two beginning swimmers who were having difficulty learning to swim. His results were encouraging because the good swimmers' scores were much higher than those of the non-swimmers. There may be more ability among good natural swimmers to distinguish pressure changes on their hands, but further research is necessary to substantiate this finding.

In 1968, Alseth(28) studied pressure reception ability as related to athletic performance in swimming the crawl stroke. His subjects were ten college swimmers who had completed their regular swimming season. Each subject was asked to judge weight and a total of three tests were given consisting of one hundred trials each. Weights were placed on the palm of each hand and the subjects were asked to select the heavier

one. The test results indicated that there was no significant relationship between pressure perception ability and swimming ability.

John Faulkner(7), University of Michigan, has prepared the book, What Research Tells the Coach About Swimming. It contains information on physical and physiological characteristics of swimmers, water resistance and energy expenditure, and sociological aspects of swimming. The measurement of water resistance and pressure in swimming has involved much research. Tremendous improvement in world records indicates that new investigations of stroking efficiency are necessary. The effectiveness of training programs of different intensity and duration should also be investigated.

Counsilman(2:180) feels that the swimmer may not be consciously aware of the kinesthetic sensations without knowing what he is doing in terms of actual stroke mechanics.

Many research studies have been investigated in regard to learning situations in swimming. Yet, if the kinesthetic sense is lacking in a beginning swimmer it would be virtually impossible for him to impart meaning and correct his stroke patterns accordingly. Further research will be necessary to learn what methods develop this awareness in swimmers.

CHAPTER III

METHODS AND PROCEDURES

Overview

The subjects for this study were twenty-nine college women at Sam Houston State University, Huntsville, Texas. The subjects were those students who are non-swimmers and enrolled in beginning swimming classes during the 1970 spring semester.

The subjects were divided into a control group and an experimental group. Each subject in both the experimental and control group was given the Roloff Test Battery, which is a battery for measuring kinesthesis in college women. The battery was composed of balance stick, arm raising, weight shifting, and arm circling. The experimental group participated in a body awareness training program. The training program for the experimental group consisted of fifteen-minute sessions during each class period for six weeks. It was composed of tasks selected from the Purdue Perceptual-Motor Survey by Eugene G. Roach, Indiana University, and Newell C. Kephart, Glen Haven Achievement Center, Ft. Collins(9), The Slow Learner in the Classroom by Newell C. Kephart(9), and from Experiments in Movement Behavior and Motor Learning by Bryant J. Cratty

and Robert S. Hutton(5). Tasks selected were the walking board, angels-in-the-snow, imitation of movements, and instruction in kinesthetic practices.

During the six-weeks period each group was given equal instructions for the execution of the elementary back stroke and the breast stroke. The strokes were taught according to the methods prescribed by the American Red Cross for swimming and water safety programs.

At the completion of the six-weeks period each subject in both experimental and control groups was re-tested on the Roloff Test Battery. The difference between the means of the pre-test and post-test within the groups was subjected to the t-ratio to determine significance at the .05 and .01 levels of confidence. The difference between the means of the pre-test and post-test between the groups was also subjected to the t-test.

Swimming proficiency was determined by three Red Cross Water Safety Instructors who observed and rated the swimming performance and arm placement of each subject. Four rating sessions were held at approximately two week intervals. The instructors were not aware as to which students had received training to heighten body awareness. They attempted to evaluate group differences in arm placement during the performance of the elementary back stroke and the breast stroke.

Source of Data

Arrangements. The data for this study were obtained during the 1970 spring semester by testing twenty-nine college women enrolled at Sam Houston State University in the City of Huntsville, Walker County, State of Texas.

In September of 1969 the initial request to conduct this study was made of Dr. Mary Ella Montague, Chairman of the Health and Physical Education Department for Women at Sam Houston State University. Permission was granted to use the students who would enroll in the spring swimming classes. Dr. Coralie Emmons agreed to serve as Chairman of this thesis committee. In December of 1969 the ideas and procedure of this study were evaluated by the graduate faculty and staff of the Health and Physical Education Department for Women, at Sam Houston State University. The investigator was instructed to proceed with the study.

The pre-testing was held February 10,1970, during the regularly scheduled class period for each group. On February 12, the training and instructional period of six weeks started, and on April 8, the final administration of the test battery was given.

All of the instruction and training conducted by the investigator was administered at the college swimming pool, Sam Houston State University.

Selection of Kinesthesis Battery. It was necessary to review the attempts at measuring kinesthesis in order to

select the kinesthesis battery used for this study. A review of the literature revealed specificity and diversity of the factors composing kinesthesis.

Witte(47) identified seven factors basic to kinesthesis, but did not devise a battery to measure them. From a battery of forty-four measures of kinesthesis, Wiebe(45) identified eight common factors. These factors were suggested as good reference tests. No test battery was developed.

Stevens(43) in 1950 was one of the first to actually devise a test battery to establish a criterion measure of kinesthesis. She suggested four batteries containing three, four, and five items. Her multiple correlations ranged from .837 to .923. The five item test battery had the highest correlation.

Roloff(21), in 1953, devised a battery of tests for measuring kinesthesis in college women. She selected twelve tests from Young(27), Fisher(34), Scott(23), and the Victory Through Fitness Report. Batteries consisting of five-item, four-item, and three-item sets were devised through the use of the Doolittle Method of multiple correlation.

The four item battery containing balance stick, arm raising, weight shifting, and arm circling was used for the Roloff study. Roloff states, "It was considered satisfactory and no five-item battery was found to be enough better to warrant the additional test item."(42:49) The regression equation used was: .75 balance stick-arm raising-weight shifting plus 4.7-arm circling plus 50. Its coefficient of

multiple correlation was .88. Two hundred college women were used as subjects for Roloff's study. The items mentioned in the battery were mentioned as specific testing items used by Scott(23), Stevens(43), Wiebe(45), and Russell(40).

Becky Sisley(42) used the Roloff Battery in 1963 in a study of kinesthesis and skill level. To determine the reliability she administered the battery to volleyball classes containing sixty-one subjects during the spring semester 1962-63. To determine the reliability the Pearson-Product-Moment of Correlation was used and stepped up by the Spearman-Brown Prophecy Formula. The same procedure was used on each item in the battery. She found the battery to be a satisfactory measure of kinesthesis.

The four item battery was selected for use in this study on the basis of (1) the indication that this battery is a satisfactory measure of general kinesthetic sensitivity, (2) the large number of subjects used when the data was gathered in developing the battery, (3) the feasibility of administration of the battery and (4) availability of information concerning the nature of the battery.

Selection of Subjects and Groups. The subjects for this study were twenty-nine college women at Sam Houston State University, Huntsville, Texas. The subjects were those students who are non-swimmers and enrolled in beginning swimming classes during the 1970 spring semester.

Each subject was given pre-and post-tests from the Roloff Test Battery, which is a battery for measuring kines-

thesis in college women. The battery is composed of balance stick, arm raising, weight shifting, and arm circling. A complete description of the tasks is included in Appendix A.

The subjects were divided into a control group and an experimental group. The experimental group participated in a body awareness training program which was composed of training tasks from the Purdue Perceptual-Motor Survey by Eugene G. Roach and Newell C. Kephart(9), The Slow Learner in the Classroom by Newell C. Kephart(9), and Experiments in Movement Behavior and Motor Learning by Bryant J. Cratty and Robert S. Hutton(5).

Selection of Water Safety Instructors. Three water safety instructors were selected to rate each subject in swimming proficiency in the control and experimental groups. The purpose of the first rating session was to determine if all subjects were non-swimmers and equal in ability in the water. Other rating sessions by the water safety instructors were held approximately two weeks apart and on the day that instruction was first given for the elementary back stroke and breast stroke. The final rating session was held by the instructors at the end of the six week period.

Selection of Training Tasks. Various training programs were examined for the use in developing kinesthetic awareness. Specific tasks that were water-oriented were not found for the training of body awareness. Tasks were then examined that consisted of similiar movements involved in the designated swimming strokes. Training tasks for the study were selected from

the Purdue Perceptual-Motor Survey by Eugene G. Roach, Indiana University, and Newell C. Kephart, Glen Haven Achievement Center, Ft. Collins, Colorado(9), The Slow Learner in the Classroom by Newell C. Kephart(9), and from Experiments in Movement Behavior and Motor Learning by Bryant J. Cratty and Robert S. Hutton(5). The tasks were for use in gross-motor development. Tasks selected were the walking board, angels-in-the-snow, imitation of movements, and instruction in kinesthetic practices.

The selected training tasks have been used by Kephart and others for motor development of children and slow learners. However, the use of these training tasks is justified by the Valett Psychoeducational Resource Program. This program suggests that angels-in-the-snow and imitation of movements be used as advanced activities for use as gross-motor and sensory-motor development and were not related to chronological development. The training tasks were considered adequate for college-age subjects. Imitative and exploratory exercises were selected to provide adequate body-spatial awareness. These tasks should furnish the student with additional body awareness and control of movement in space. The exercises are designed to help the student learn laterality and to increase her awareness of body image. The walking board is a training task that is also recommended for use in the learning of laterality and directionality. It is suggested as a middle stage activity in developing sensory-motor integration in the Valett Program. To maintain balance on the board requires and accurate know-

ledge of the difference between the right and left sides of the sides of the body. Added to the experiences of right and left in maintaining balance are the experiences of forward and backward in progress across the board. Directionality is very important in gross-motor development. When the backward direction is introduced, difficult spatial orientation and spatial projections are required by the individual. Even though the walking board is a modification of a childhood game, it presents the explanations for improvement in the stages of gross-motor development.

Administration and Description of Kinesthesis Tests

The pre-test of the Roloff Battery was administered to twenty-nine subjects the first week in February, 1970. The testing took place in the locker-rooms at the Sam Houston State University swimming pool. Graduate students and physical education majors acted as judges, timers, and assistants. Stations were set up in the various rooms and the subjects progressed from room to room for each test.

The balance stick test had a total of twelve trials. The subject was asked to stand on one foot and hold her balance as long as possible. The subject was timed from the moment she lifted her foot and closed her eyes until her balance was lost. The total score was recorded in seconds. At the next station the arm raising test was administered. The degrees of variation from the horizontal were measured twice

raising the right arm and twice raising the left arm. The total score is the sum of deviations on the four trials and is recorded in degrees. A score of zero is a perfect score. Weight-shifting was performed at the next station. The subject was asked to place one-half of her weight on the scale. The score on the test is the sum of the deviations of the right foot and the left foot from the required weight. The score is given in pounds. At the last station arm circling was performed. The subject tried to circle her arms in complete circles but in opposite directions so that one arm makes a complete circle going forward while the other arm makes a complete circle going backward. A rating scale was used for this test. Each of the tests was done in a closed area so that subjects who had yet to take them were not able to observe, therefore were not aware of what was expected of them. The post-test was administered in the same area and followed the same procedures.

The Training Program

The kinesthetic awareness training program was held for the experimental group the first fifteen minutes of the total class time two days a week for a six-week period. It was composed of four different tasks for the use in gross-motor development. The activities selected from the Purdue Perceptual-Motor Survey and The Slow Learner in the Classroom are the walking board, angels-in-the-snow, and imitation of movements. Experiments from Cratty and Hutton(5) consist of

practice in kinesthetic instruction. Only a brief description of the progression and administration of the training tasks were given by the authors, therefore, it was left to the discretion of the writer to program the information. Following is a brief outline of the training program. For detailed instruction as to the progression and administration of the training tasks refer to Appendix B.

Program:

I. First Week

A. Walking Board
B. Imitation of Movements

II. Second Week

A. Angels-in-the-snow
B. Walking Board

III. Third Week

A. Imitation of Movements
B. Angels-in-the-snow

IV. Fourth Week

A. Angels-in-the-snow
B. Kinesthetic Practice

V. Fifth Week

A. Angels-in-the-snow
B. Kinesthetic Practice

VI. Sixth Week

A. Walking Board
B. Imitation of Movements

The schedule was constructed so that the subjects would have received portions of each training task by the time they were rated for the first time on performance of the elementary back stroke and breast stroke. After the fifteen minute training

program the experimental group was given lessons following American Red Cross standards. The control group did not receive any instruction in the training tasks, but simply followed a learning sequence in swimming as recommended by the standards of the American Red Cross.

The Swimming Program

During the six-week period the control group and experimental group were given equal instruction for the execution of the elementary back stroke and the breast stroke. The strokes followed a learning sequence as prescribed by the American Red Cross for swimming and water safety programs. The first two weeks of the program were devoted to activities for adjustment to the water which involved bubble-blowing, rhythmic breathing, prone floating, back floating, finning, and the armstroke for the American Crawl. The elementary back stroke was introduced two weeks after the training program began which allowed for some transfer of learning. The whip kick was taught to the students first and then the arm stroke was introduced. After several trials on each the coordination of the stroke was taught. The students received instruction and practice on the elementary back stroke for two weeks and then the breast stroke was presented. The whip kick was also used for the breast stroke, but some adjustment was needed to perform the kick in the prone position. The arm stroke was introduced next and then the coordination of the stroke. The breathing was not introduced at this time. A detailed

outline of the instruction and practice schedule of the class is included in Appendix C.

Equality of groups in swimming proficiency was determined by three Red Cross Water Safety Instructors at the beginning of the program. A checklist to rate quality of performance was used by the instructors. The differences between the means of the groups were subjected to the "t-ratio" and there was no significant differences in the groups in swimming ability at the beginning of the study.

Other rating sessions by the water safety instructors were held approximately two weeks apart and on the days that instruction was first given for the elementary back stroke and breast stroke. It was felt by the author that an observable difference in arm placement possibly would be more apparent during the first periods of instruction for each stroke. Therefore, individual practice of the strokes was not a definite limiting factor.

At the end of the six week period a final rating was held by the instructors to determine if there was any overall differences in the arm placement of the elementary back stroke and breast stroke between the control group and the experimental group. Comments by the instructors and the mean scores of the groups from each rating were used to determine the differences in performance of the groups. The results of all water safety instructor ratings are listed in Appendix G and Appendix H.

CHAPTER IV

INTERPRETATION OF DATA

This chapter contains the comparison of the control and experimental groups at the beginning of the study and the results of the training program. In addition, it presents a comparison of the two groups in arm placement during the performance of the elementary back stroke and the performance of the breast stroke.

Comparison of the Groups at the Beginning of the Study

At the beginning of the study, all of the students were administered the Roloff Test Battery individually. The final test scores were used for equating the groups. A complete record of the raw scores collected for the individuals in the groups at the beginning of the study is in Appendix D.

Table I gives each group's total raw score, mean, difference of the means, and standard deviation for the Balance Stick Pre-Test of the Roloff Test Battery.

TABLE II

COMPARISON OF THE PRE-TEST FOR
THE WEIGHT-SHIFTING TEST

Group	No.	Raw Score	Mean Score	Diff.	S.D.
Control	14	261.50	18.68	1.15	18.75
Experimental	15	344.50	19.83		

The experimental and control group appear to be equal in ability on the Weight Shifting Test after examination of the raw score totals. The results were submitted to the *t*-test in order to determine if they were statistically equal at the beginning of the study.(See Table V)

Table III contains test scores for all subjects on the Arm Circling Pre-Test of the Roloff Battery. Each group's total Raw score, mean score, mean difference, and standard deviation for the raw scores is included in this table.

TABLE III

COMPARISON OF THE PRE-TEST FOR
THE ARM CIRCLING TEST

Group	No.	Raw Score	Mean Score	Diff.	S.D.
Control	14	96	6.60	0.26	2.38
Experimental	15	99	6.86		

The raw score totals and mean scores from the experimental and control groups have been examined in Table III. Showing a mean difference of only 0.26 the groups appear to be equal in ability on the Arm Circling Test at the beginning of the study.

Table IV gives each group's total raw score, mean score, mean difference, and standard deviation for the raw scores on the Arm Raising Pre-Test of the Roloff Test Battery. The results were used in equating the groups at the beginning of the study.

TABLE IV

COMPARISON OF THE PRE-TEST FOR THE ARM RAISING TEST

Group	No.	Raw Score	Mean Score	Diff.	S.D.
Control	14	237	16.93	3.06	8.56
Experimental	15	208	13.87		

The raw score totals and mean scores from the experimental and control groups are reasonably close together and it appears that the groups would be equal in performance of the Arm Raising Test. The results of the pre-test for Arm Raising Test were submitted to the *t*-ratio to determine if there were any statistical significant differences in the groups at the beginning of the study.(See Table V)

Table V gives the results of the mean scores of the experimental and control group which were submitted to the t-ratio statistical measurement. The test indicated the degree of difference between the experimental and control groups at the beginning of the study.

TABLE V

A TEST OF SIGNIFICANT DIFFERENCE OF THE RESULTS OF THE PRE-TEST OF THE ROLOFF BATTERY

Group	No.	Test Item	Mean Diff.	t-ratio*
Control	14	Balance Stick	2.38	.136
		Weight Shifting	1.15	.166
Experimental	15	Arm Circling	0.26	.292
		Arm Raising	3.06	.964

*2.05 indicates significance at the .05 level of confidence.

Discussion of Results. The beginning swimming classes were chosen with the idea of equating them as to number of subjects, length of class time, and kinesthetic ability. The Roloff Test Battery was selected as an adequate measure of kinesthetic ability. The test results of the battery were submitted to the t-ratio. There was no significant differences between the experimental and control groups at the beginning of the study as determined by the t-ratio statistical measurement.

Comparison of the Groups Progress Over the Training Period

A comparison of the Pre-Test and Post-Test scores of the Roloff Test Battery was given to see if any improvement was made by each individual group. In order to determine the changes in performance for the control and the experimental groups *t*-ratios were determined by differences between pre-test and post-test scores for each group. This data for the Balance Stick Test of the Roloff Battery is presented in Table VI. The table includes the mean scores, differences in mean scores, standard deviation and *t*-ratio as a comparison of the pre-test to post-test scores.

TABLE VI

COMPARISON AND A TEST OF SIGNIFICANT DIFFERENCE OF THE BALANCE STICK PRE-TEST TO THE POST-TEST SCORE OF EACH GROUP

Group	Mean	Diff.	S.D.	*t*-ratio
Control				
Pre-test	78.03			
Post-test	109.21	31.18	85.14	.984*
Experimental				
Pre-test	80.41			
Post-test	229.96	149.55	177.02	2.280*

*2.05 indicates significance at the .05 level of confidence.

The mean scores of the Balance Stick Test for the post-test were higher than those of the pre-test. The difference between the mean scores of the experimental group is extremely large. In comparing the results of the t-ratio to the table of t the Balance Stick Test Scores for the control group were not significant. However, the experimental group results were significant at the .05 level of confidence.

Table VII presents Pre-Test and Post-Test scores for the Weight Shifting Test of the Roloff Battery. The table includes the mean scores, difference in means, standard deviations and the t-ratio as a comparison of pre-test and post-test scores.

TABLE VII

COMPARISON AND A TEST OF SIGNIFICANT DIFFERENCE OF THE WEIGHT SHIFTING PRE-TEST TO THE POST-TEST SCORE OF EACH GROUP

Group	Mean	Diff.	S.D.	t-ratio*
Control				
Pre-Test	18.68	4.04	8.29	.606*
Post-Test	14.64			
Experimental				
Pre-Test	19.83	9.96	17.33	1.550*
Post-Test	9.87			

*2.05 indicates significance at the .05 level of confidence.

The mean scores for the post-test were lower than those of the pre-test and especially in the experimental group. The lower scores indicate improvement for this test. Yet, in comparing the results of the t-ratio to the table of t, the results were not significant at the .05 level of confidence.

Table VIII includes the mean scores, difference in mean scores, standard deviations, and the t-ratio as a comparison of pre-test and post-test scores for the Arm Circling Test of the Roloff Battery.

TABLE VIII

COMPARISON AND A TEST OF SIGNIFICANT DIFFERENCE OF THE ARM CIRCLING PRE-TEST TO THE POST-TEST SCORE OF EACH GROUP

Group	Mean	Diff.	S.D.	t-ratio
Control				
Pre-test	6.86	0.14	1.93	0.20*
Post-test	6.72			
Experimental				
Pre-test	6.60	1.14	2.23	1.37*
Post-test	7.74			

*2.05 indicates significance at the .05 level of confidence.

The mean scores of the post-test for the experimental group were considerably higher indicating marked improvement. After submitting the results of the test to the t-ratio sta-

tistical measure there was no significant difference at the .05 level of confidence.

Table IX presents pre-test and post-test scores from the Arm Raising Test of the Roloff Battery. The mean scores, difference in mean scores, standard deviations and the *t*-ratio are presented in Table IX.

TABLE IX

COMPARISON AND A TEST OF SIGNIFICANT DIFFERENCE OF THE ARM RAISING PRE-TEST TO THE POST-TEST SCORE OF EACH GROUP

Group	Mean	Diff.	S.D.	*t*-ratio
Control				
Pre-test	16.93	1.86	8.26	.606
Post-test	15.07			
Experimental				
Pre-test	13.87	0.94	7.11	.755
Post-test	12.93			

*2.05 indicated significance at the .05 level of confidence.

Discussion of Results. The mean scores for the post-test of arm raising were lower than those of the pre-test which indicated some improvement for this test. In comparing the results of the *t*-ratio to the table of *t*, the results were not significant at the .05 level of confidence.

In every instance the mean scores for the post-test scores of each individual test of the Roloff Battery were higher than those of the pre-test. Yet, in comparing the results of the t-ratio statistical measurement, only the Balance Stick Test scores were significant at the .05 level of confidence.

Comparison of the Group's Post-Test Scores

After the control group completed the six weeks course work and the experimental group completed six weeks of course work and body awareness training, they were again given the Roloff Test Battery. A complete record of the raw scores collected for the individuals in the groups at the beginning of the study is in Appendix E.

Table X includes each individual group's raw score, mean score, differences of mean score, and standard deviation of the post-test scores for the Balance Stick Test of the Roloff Test Battery.

TABLE X

COMPARISON OF THE POST-TEST FOR THE BALANCE STICK TEST

Group	No.	Raw Score	Mean Score	Diff.	S.D.
Control	14	1638.00	109.22	120.74	197.24
Experimental	15	3449.40	229.96		

The mean score for the post-test of the experimental group is extremely higher than the control group. It appears that there is significant improvement in this test, yet, scores were submitted to the t-ratio to determine if a significant difference exist.(See Table XIV)

Table XI gives each group's total raw score, mean score, difference of mean scores, and standard deviation for the Weight Shifting Post-Test of the Roloff Battery.

TABLE XI

COMPARISON OF THE POST-TEST FOR THE WEIGHT SHIFTING TEST

Group	No.	Raw Score	Mean Score	Mean Diff.	S.D.
Control	14	205	14.64	4.77	8.95
Experimental	15	148	9.87		

The raw scores, mean scores, mean difference, and standard deviation have been examined in Table XI. The scores for the experimental group are lower indicating improvement. The results of the post-test of the Weight Shifting Test were submitted to the t-ratio to determine if a significant difference was present.(See Table XIV)

The data in Table XII presents the results of the Arm Raising Test of the Roloff Battery. Included on the table are the raw score totals, mean scores, mean difference, and standard deviations.

TABLE XII

COMPARISON OF THE POST-TEST FOR THE ARM RAISING TEST

Group	No.	Raw Score	Mean Score	Mean Diff.	S.D.
Control	14	211	15.07	2.14	6.64
Experimental	15	194	12.93		

From examination of this table it appears that no significant difference exists in the post-test scores, although there was some improvement in the experimental group.

Table XIII includes the post-test scores of the Arm Circling Test of the Roloff Battery for the control and the experimental group.

TABLE XIII

COMPARISON OF THE POST-TEST FOR THE ARM CIRCLING TEST

Group	No.	Raw Score	Mean Score	Mean Diff.	S.D.
Control	14	94	6.71	1.02	1.63
Experimental	15	116	7.73		

The mean scores of the experimental group are only slightly higher indicating some improvement. It appears that it will not be significant at the .05 level of confidence when submitted to the t-ratio statistical measurement.

Table XIV presents the results of the post-test comparisons of the Roloff Test Battery. The test scores were submitted to the t-ratio statistical measurement.

TABLE XIV

A TEST OF SIGNIFICANT DIFFERENCE OF THE RESULTS OF THE POST-TEST OF THE ROLOFF BATTERY

Group	No.	Test Item	Mean Diff.	t-ratio
Control	14	Balance Stick	120.74	1.65
		Weight Shifting	4.77	1.38
Experimental	15	Arm Raising	2.14	0.86
		Arm Circling	1.02	1.68

Discussion of Results. In comparing the groups the post-test scores were higher than the pre-test scores indicating a improvement for all groups with the experimental group making a greater improvement. The balance stick and arm circling test had the most improvement, yet, the improvement has not exceeded the .05 level of confidence in any of the tests of the Roloff Battery.

Comparison of Groups in Elementary Swimming Ability at the Beginning of the Study

At the beginning of the study, all of the students were rated in swimming ability. Since no test battery exists to actually measure beginning swimming skills, it was necessary to use a rating of proficiency by three water safety instructors. Four rating sessions were held at approximately two week intervals. The instructors were not aware as to which students had received training to heighten body awareness. They attempted to evaluate group differences in arm placement during the performance of the elementary back stroke and the breast stroke. The mean and standard deviation of each group was compared to determine if the groups were equal. A complete record of the raw scores collected for the individuals in the groups at the beginning of the study is in Appendix F. The *t*-ratio was used to determine the degree of difference between the groups at the beginning of the study.

Table XV gives the raw score totals, mean scores, mean differences, standard deviations, and the results of the t-ratio statistical measurement.

TABLE XV

COMPARISON AND A TEST OF SIGNIFICANT DIFFERENCE OF THE PRE-TEST FOR BEGINNING SWIMMING ABILITY

Group	Raw Score	Mean Score	Mean Diff.	S.D.	t-ratio*
Control	567	40.50	2.44	105.04	.063*
Experimental	644	42.94			

*2.05 indicates significance at the .05 level of confidence.

Discussion of Results. Subjects chosen for the study were chosen on the basis of enrollment in beginning swimming classes. When comparing the groups to the t-ratio, there was no significant difference between the groups. This low degree of significance indicates that the groups were equal in performance of beginning swimming skills at the beginning of the study.

Comparison of the Groups on Arm Placement During Performance of the Elementary Back Stroke

The investigator felt that additional water safety instructor rating sessions should be given in order to test for improvement. Difference in improvement of the control and the experimental groups in arm placement during performance of the elementary back stroke and the breast stroke might be more noticeable on the day the stroke was first introduced to the groups. After allowing time for practice this difference could possibly be diminished, therefore additional rating sessions were scheduled. The second session was given on the day that the elementary back stroke was first introduced to the students. The mean scores were submitted to the t-test to see if any significant difference was present in the groups.

Table XVI gives each group's raw score, mean score, mean difference, and standard deviation from the rating sessions. The raw scores were submitted to the t-ratio to determine significance at the .05 level of confidence.

TABLE XVI

COMPARISON AND A TEST OF SIGNIFICANT DIFFERENCE OF ARM PLACEMENT DURING PERFORMANCE OF THE ELEMENTARY BACK STROKE

Group	Raw Score	Mean Score	Mean Diff.	S.D.	t-ratio
Control	84	8.40	1.37	3.66	.895*
Experimental	127	9.77			

*2.05 indicates significance at the .05 level confidence.

Discussion of Results. The water safety instructors felt that the experimental group had more precise movements in arm placement during performance of the elementary back stroke. However, after comparing the groups to the t-ratio statistical measurement, there was no significant difference indicated during the performance of the elementary back stroke.

Comparison of the Groups on Arm Placement During Performance of the Breast Stroke

During the third session the water safety instructors rated the groups on arm placement during the performance of the breast stroke. The students were rated on their performance on the first day that the stroke was introduced. Table XVII includes the results of this rating session. The t-ratio

was used to determine if any significant differences exist between the groups.

TABLE XVII

COMPARISON AND A TEST OF SIGNIFICANT DIFFERENCE OF ARM PLACEMENT DURING PERFORMANCE OF THE BREAST STROKE

Group	Raw Score	Mean Score	Mean Diff.	S.D.	t-ratio*
Control	197	15.15	6.43	6.73	5.97*
Experimental	259	21.58			

*2.05 indicates significance at the .05 level of confidence.

Discussion of Results. The results of the t-ratio indicates a very high level of significance between the groups in arm placement during the performance of the breast stroke. The water safety instructors commented that the experimental group had much better action on arm movements. They also indicated that the arm actions were more exact in their placement of coming to shoulder level.

Comparison of the Groups on Arm Placement During the Final Performance of the Elementary Back Stroke

The final water safety instructor rating sessions were given after the students had received additional instruction and practice for the elementary back stroke. The mean scores

from the ratings were submitted to the t-test to determine if any significant difference exists between the groups in arm placement during the performance of the elementary back stroke. Table XVIII gives the results of this rating session. The table includes the raw score total, mean scores, mean difference, standard deviation, and the results of the t-ratio statistical measurement.

TABLE XVIII

COMPARISON AND A TEST OF SIGNIFICANT DIFFERENCE OF THE GROUPS ON ARM PLACEMENT DURING THE FINAL PERFORMANCE OF ELEMENTARY BACK STROKE

Group	Raw Score	Mean Score	Mean Diff.	S.D.	t-ratio *
Control	142	11.83	1.60	3.61	1.12*
Experimental	188	13.43			

*2.05 indicates significance at the .05 level of confidence.

Discussion of Results. The scores for the experimental group were higher and some improvement was noted in the performance of the experimental group over the control group. However, the t-ratio of the results of the final rating were not significant at the .05 level of confidence.

Comparison of the Groups on Arm Placement During the Final Performance of the Breast Stroke

Arm placement of the breast stroke was rated by the water safety instructors during the final session. There had been two weeks of instruction and practice since the last session. Table XIX gives the raw total scores, mean scores, mean difference, and standard deviation of the scores from the rating. The mean scores were submitted to the *t*-test to determine if any significant difference exist between the groups in arm placement.

TABLE XIX

COMPARISON AND A TEST OF SIGNIFICANT DIFFERENCES OF THE GROUPS ON ARM PLACEMENT DURING THE FINAL PERFORMANCE OF THE BREAST STROKE

Group	Raw Score	Mean Score	Mean Diff.	S.D.	*t*-ratio*
Control	145	12.08	0.70	3.696	.482*
Experimental	179	12.78			

*2.05 indicates significance at the .05 level of confidence.

Discussion of Results. The extremely low *t*-ratio for arm placement of the breast stroke indicates no significant differences in the groups. The water safety instructors commented that until this rating session the experimental group

had looked much better in placement of the arms during performance of the breast stroke.

Summary

This study was designed to compare two groups: one group receiving a six-weeks training program of tasks to heighten kinesthetic awareness in addition to the requirements of a beginning swimming course and the other group simply completing the requirements of the beginning swimming course offered at Sam Houston State University. The study involved the Roloff Test Battery to measure kinesthesis and the rating sessions by water safety instructors to measure performance in the water. It was the intent of the investigator to determine to what degree the designed training program would heighten kinesthetic awareness and in turn improve arm placement of the elementary back stroke and the breast stroke.

The groups were administered the Roloff Test Battery at the beginning of the spring, 1970 semester. A comparison of the final test scores of the groups indicated that there was no significant difference in the groups and they were equal on the factors measured by the battery at the beginning of the study.

Each pre-test of the Roloff Battery was compared to the corresponding post-test. These comparisons showed only the Balance Stick Test for the experimental group to have significant improvement at the .05 level of confidence. This improvement suggests that the selected training program which

included the balance beam contributed to improvement in this area.

The groups were also compared by water safety instructors at sessions on the day the elementary back stroke and breast stroke were introduced to determine any differences in performance of the strokes. No significant differences were observed between the experimental and control groups in ratings on arm placement during performance of the elementary back stroke. Yet, after observing during the first session the water safety instructors agreed that the experimental group had better action on arm movements and more precise placement during performance of the stroke. The scores of the breast stroke were submitted to the t-test. The results indicated significance at the .05 and .01 levels of confidence for the experimental group. The instructors rating the groups had several comments. The arms during performance of the breast stroke were more exact coming to shoulder level, but the student did not pull downward in the proper manner. This could have been a result of the training tasks which required a straight arm pull to shoulder level. All water safety instructors agreed that the experimental group had better arm action while performing the strokes.

The results of the final ratings of the elementary back stroke and breast stroke were not significant, although the results of the elementary back stroke scores showed a noticable improvement over the first rating. The t-ratio for the breast stroke was surprisingly low. It was .482 and a

a 2.05 level of confidence was necessary for the score to be significant. The water safety instructors had commented that although the breast stroke was normally more difficult for the student to learn, the experimental group looked better in arm placement during its performance. Instructors commented that until the final rating session the experimental group had looked and performed much better than the control group in relation to arm placement.

The explanation for these results could be multifold. There had been recent changes by the American Red Cross in the teaching of the placement of arms during performance of the elementary back stroke and breast stroke. All of the instructors had attended a renewal session in which they were taught these changes. The investigator also explained to the instructors in detail the teaching method applied in this study, yet, it is probable that each instructor was "hazy" in his own judgement of the correct position for arm placement.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study is to determine if a body awareness training program will improve the performance of arm placement on the elementary back stroke and the breast stroke.

Procedures

Thirty students participating in beginning swimming classes were selected as subjects for this study. The subjects were students at Sam Houston State University who had registered for the class during the spring semester, 1970.

At the beginning of the spring semester, all of the subjects were divided into a control group and experimental group. The groups were given the Roloff Test Battery for measuring kinesthesis in college women. The final test scores were used for equating the groups.

At the completion of the Roloff Test Battery the experimental group began a six week training program designed to heighten body awareness. The training program for the experimental group consisted of fifteen-minute sessions during each class period for six weeks. It was composed of tasks

from the Purdue Perceptual-Motor Survey by Eugene G. Roach, Indiana University, and Newell C. Kephart, Glen Haven Achievement Center, Ft. Collins, Colorado, and from Experiments in Movement Behavior And Motor Learning by Bryant J. Cratty and Robert S. Hutton. Tasks selected were the walking board, angels-in-the-snow, imitation of movements, and instruction in kinesthetic practice.

During the six-weeks period each group was given equal instructions for the execution of the elementary back stroke and the breast stroke. The strokes were taught according to the methods prescribed by the American Red Cross for swimming and water safety programs.

At the completion of the six-weeks period each subject in both experimental and control groups was re-tested on the Roloff Test Battery. The results of these tests were compared to determine if there were significant differences within the groups. The difference between the means of the pre-test and post-test between the groups were also subjected to the t-test. In all comparisons the five per cent level of confidence was chosen to determine if any of the tests were significant.

Swimming proficiency was determined by three Red Cross Safety Instructors who observed and rated the swimming performance and arm placement of each subject. Four rating sessions were held at approximately two week intervals. The instructors were not aware as to which students had received training to heighten body awareness. They attempted to evaluate group

differences in arm placement during the performance of the elementary back stroke and the breast stroke.

Results

The results of the investigation were:

1. There was no significant differences between the experimental and control groups on the initial comparisons of the Roloff Test Battery.

2. There was no statistically significant differences between the pre-test and post-test scores within the control group on the arm circling, arm raising, weight shifting, or balance stick tests of the Roloff Test Battery.

3. There was no statistically significant differences between the pre-test and post-test scores within the experimental group on the arm circling, arm raising, weight shifting tests of the Roloff Test Battery.

4. There was significant improvement at the .05 level of confidence between the pre-test and post-test scores within the experimental group on the balance stick tests of the Roloff Test Battery.

5. There was no statistically significant differences between the post-test scores of the experimental and control groups on the arm circling, arm raising, weight shifting, or balance stick tests of the Roloff Test Battery.

The results of the swimming rating scores:

1. There was no significant differences between the experimental and control group in the initial comparison made

by the Water Safety Instructors.

2. There was no statistically significant differences in the groups between the scores for arm placement of the elementary back stroke on the initial rating session.

3. There was significant improvement at the .01 level of confidence between the scores for arm placement of the breast stroke of the experimental group on the initial rating session.

The result of the final swimming rating scores:

1. There was no statistically significant differences between the experimental and control groups for arm placement of the elementary back stroke.

2. There was no statistically significant differences between the experimental and control groups for arm placement of the breast stroke.

Conclusions

Within the limitations of this investigation it appears that the following conclusions can be made:

1. The body awareness training program demonstrated very little effect in improving the kinesthetic ability of an individual after six weeks of training.

2. It appears that tasks from the body awareness training program demonstrated some effect in improving the balancing ability of an individual after six weeks of training.

3. The body awareness training program demonstrated

very little effect in improving the arm placement during performance of the elementary back stroke.

4. The body awareness training program demonstrated some effect in improving the arm placement during performance of the breast stroke.

Recommendations for Further Study

Considerably more research is needed to investigate the effects of body awareness training upon the effects of arm placement during performance of selected swimming strokes. A weakness in this study was in the designed procedures which did not allow enough time for the training program to take effect. The procedure which the study was designed to follow did not allow enough time for the beginning swimming skills to be learned properly before attempting the more advanced strokes.

Other areas of possible study are:

1. Future studies should be conducted using the same length of training period, but allowing more time for the instruction of beginning swimming skills before introducing the selected swimming strokes for rating by the instructors.

2. Future studies should be considered using the same length of training period, but allowing more time for administration of the training program to the group before introducing the selected swimming strokes for rating by the instructors.

3. Future studies similar to the one reported should

be conducted with consideration given to any effects that body fat and bouyancy would have in the learning of selected swimming strokes.

4. Future studies similar to the one reported should be conducted with consideration given to arm and leg coordination.

SELECTED BIBLIOGRAPHY

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Books

1. Best, Charles N., and Taylor, N.B. The Physiological Basis of Medical Practice. 7th ed. Baltimore: Williams and Wilkins Co., 1961.

2. Counsilman, James. The Science of Swimming. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1968.

3. Cratty, Bryant J. Movement Behavior and Motor Learning. Philadelphia: Lea and Febiger, 1967.

4. _____. Movement Behavior and Motor Learning. 2nd ed. Philadelphia: Lea and Febiger, 1967.

5. _____, and Hutton, Robert S. Experiences in Movement Behavior and Motor Learning, Philadelphia: Lea and Febiger, 1969.

6. de Vries, Herbert A. Physiology of Exercises for Physical Education and Athletics. Dubuque, Iowa: WM. C. Brown Co., Publishers, 1966.

7. Faulkner, John A. What Research Tells the Coach About Swimming. Washington D.C.: American Association of Health and Physical Education and Recreation, 1967.

8. Garrett, Henry E., and Woodworth, R.S. Statistics in Psychology and Education. Longurans, Green, and Co., New York, 1960.

9. Kephart, Newell C. The Slow Learner in the Classroom. Columbus, Ohio: Charles E. Merrill Books, Inc.

10. Mathews, Donald K. Measurement in Physical Education. 3rd ed. Philadelphia: W.B. Saunders Co., 1968.

11. Metheny, Eleanor. Movement and Learning. New York: McGraw-Hill Book Co., 1968.

12. Oberteuffer, Delbert. Physical Education. New York: Harper and Brothers, Publishers, 1951.

13. Oxendine, Joseph B. Psychology of Motor Learning. New York: Appleton-Century-Crofts, 1968.

14. Scott, M. Gladys and French, Ester. Measurement and Evaluation in Physical Education. Dubuque, Iowa: WM. C. Brown Co., Publishers, 1959.

15. Wells, Katharine F. Kinesiology. 3rd ed. Philadelphia: W.B. Saunders Co., 1960.

16. Zoethout, Williams and Tuttle, W.W. Textbook of Physiology. 10th ed. C.V. Moseley Co., St. Louis, 1949

Periodicals

17. Bowdlear, Charles L. "An Experiment in Kinesthetic Learning." American Physical Education Review, 32: 100-105, 1927.

18. Fleishman, Edwin and Rich, Simon. "Role of Kinesthetic and Spatial-Visual Abilities in Perceptual-Motor Learning." Journal of Experimental Psychology.

19. Henry, Franklin M. "Dynamic Kinesthetic Perception and Adjustment." Research Quarterly, 24: 176-187, May, 1953.

20. Phillips, M. and Summers, D. "Learning Relation to Kinesthetic Perception." Research Quarterly, 25: 456, Dec., 1954.

21. Roloff, Louis L. "Kinesthesis in Relation to the Learning of Selected Motor Skills." Research Quarterly, 24: 310-317, May, 1953.

22. Ronco, Paul G. "An Experimental Quantification of Kinesthetic Sensation." Journal of Psychology, 55: 227-238, Jan., 1963.

23. Scott, M. Gladys. "Measurement of Kinesthesis." Research Quarterly, 26: 324-341, Oct., 1955.

24. Slater, and Hammel, A.T. "Comparisons of Reaction-time Measures to a Visual Stimulus Arm Movement." Research Quarterly, 28: 153-159, May, 1957.

25. _____. "Measurement of Kinesthetic Perception of Muscular Force with Muscle Potential Changes." Research Quarterly, 26: 470-479, Dec., 1955.

26. Wiebe, Vernon R. "A Study of Tests of Kinesthesis." Research Quarterly, 28: 153-159, May, 1957.

27. Young, Olive. "A Study of Kinesthesis in Relation to Selected Movements." Research Quarterly, 16: 277-287, Dec., 1945.

Unpublished Material

28. Alseth, Alfred R. "Pressure Reception Ability as Related to Athletic Performance in Swimming the Crawl Stroke." Unpublished Master's thesis, Washington State University, Pullman, Washington, 1968, pp. 23.

29. Buck, Margaret C. "The Effects of Two Practice Techniques on Selected Swimming Strokes." Unpublished Ph.D. dissertation, Indiana University, Bloomington, Indiana, 1967, pp. 102.

30. Cherny, Audrey J. "An Experimental Study of the Effect of Training on Kinesthetic Positioning." Unpublished Master's thesis, Smith College, 1964.

31. Clayton, Robert Donald. "The Efficiency of the Land-Drill, Implicit-Rehearsal, and Water-Practice Methods in Teaching the Breast Stroke and the Crawl Stroke to College Men." Unpublished Ph.D. dissertation, 1963, pp. 165.

32. Emmons, Coralie Ann. "A Comparison of Selected Gross-Motor Activities of the Getman-Kane and the Kephart Perceptual-Motor Training Programs and their Effects upon Certain Readiness Skills of First-Grade Negro Children." Unpublished Ph.D. dissertation, Ohio State University, 1968.

33. Ensign, Lois. "Awareness of Movement as an Objective in Physical Education." Unpublished Master's thesis, University of Wisconsin, Madison, 1944.(Micro Film)

34. Fisher, Rosemary B. "A Study of Kinesthesia in Selected Motor Movements." Unpublished Master's thesis, State University of Iowa, Iowa City, 1945.

35. Goodwin, Allison Borden. "The Effects of Presenting a Specific Order of Visual and Auditory Instructors on the Learning of the Front Crawl Stroke." Unpublished Master's thesis, University of Western Ontario, London, Ontario, 1968.

36. Hokl, Judy Ann. "The Comparison of Two Stroke Progression in Teaching the Breast Stroke to College Women." Unpublished Master's thesis, pp. 107, 1963.

37. Lindsay, Doreen. "Relationship Between Measures of Kinesthesia and the Learning of a Motor Skill." Unpublished Master's thesis, Berkeley, University of California, 1952.

38. Musley, Gordon S. "A Comparison of Two Methods of Teaching the Elementary Backstroke." Unpublished Master's thesis, pp. 37, 1966.

39. Norrie, Mary Lousie. "The Relationship Between Measures of Kinesthesis and Motor Performance." Unpublished Master's thesis, University of California, 1951.(Micro Film).

40. Russell, Ruth Irene. "A Factor Analysis of the Components of Kinesthesis." Unpublished Ph.D. dissertation, State University of Iowa, Iowa City, 1954.(Micro Card).

41. Sheldon, Miriam Feely. "An Investigation of the Relative Effects of Mental Practice and Physical Practice in Improving the Efficiency of the Breast Stroke." University of Oregon, 1964.

42. Sisley, Becky L. "Kinesthesis in Relation to Skill Level in Basketball, Bowling, and Tennis." Unpublished Master's thesis, Woman's College of North Carolina, 1963.

43. Stevens, Mildred. "The Measurement of Kinesthesis in College Women." Umpublished Ph.D. dissertation, Indiana University, 1950.

44. Weiss, Raymond A. and Cureton, T.D. and Carolyn W. Bookwalter (compilers). Graduate Thesis Abstracts 1938-53. From New York and Indiana Universities. Urbana, Illinois: Sept. 1956. (n.p.).

45. Wiebe, Vernon R. "A Factor Analysis of Tests of Kinesthesis." Unpublished Ph.D. dissertation, Indiana University, 1956.(Micro Card).

46. Wilson, Sylvia. "A Study of the Literature Pertaining to Kinesthesia and Movement with Special Emphasis on the Application of these to the Teaching of Sports Skills." Unpublished Honors paper, Woman's College of the University of North Carolina, Greensboro, 1956.

47. Witte, Fae. "Relation of Kinesthetic Perception to a Selected Motor Skill for Elementary School Children." Research Quarterly, 33: 476-484, Oct., 1962.

APPENDIX A

DESCRIPTION OF ROLOFF TEST BATTERY

ROLOFF TEST BATTERY

Balance Stick

A stick which is one inch square and twelve inches long is securely taped to the floor with adhesive tape. The subject is given the following verbal directions:

> Stand with your foot lengthwise on the stick. When your foot is secure, close your eyes and lift the other foot off the floor and hold your balance as long as possible. You may do anything you like as long as you do not open your eyes or touch the floor with any part of your body. You will be timed from the moment you lift your foot from the floor until you open your eyes or touch the floor. You may have one practice with your right foot and then three test trials, and then one practice with your left foot and three test trials. Then, there will be three more trials on each foot. Your score will be the total time on 12 trials.

One demonstration is given while giving instructions. The subject is timed from the moment she lifts her foot until she opens her eyes or touches the floor. There are 12 trials which make up the total score: three right, three left, three right, three left. The total score is recorded in seconds.

Arm Raising

The subject is given the following verbal instructions: Raise your right arm out sideward to a horizontal position with the palm facing down. The instructor faces the subject and uses a goniometer to determine how far the subject has deviated in raising her arm to the horizontal. A line from the shoulder joint to the base of the thumb should be parallel with the floor. The deviation is recorded as degrees of deviation from the horizontal. The arm is lowered and the test is repeated. Then the test is given twice using the left arm. The total score is the sum of deviations on the four trials and is recorded in degrees. A score of zero is a perfect score.

Weight Shifting

The equipment for this test consists of a bathroom scale and a block of wood one foot long and half a foot wide. The thickness of the block is that which will make the block the same height as that of the scale platform. The block is placed next to the scale so that they are side by side, with the block on the left side. The subject places her left foot on the block and the right foot on the scale. One demonstration is made while the following verbal instructions are given:

Stand on the scale so her weight can be determined. Then put your left foot on this block of wood and

place just enough weight on your right foot to run the scale up to ____ pounds. You may have two practices to run the scale up to ____ pounds and then you will be asked to start with the scale at zero, look away and try to run the scale up to the same weight. As you see, it is hard to hold the scale steadily so you will have to say "Now" when you think you have the scale where you want it.

The subject is told to place one-half of her weight on the scale, but is not told that the required weight is one-half of her own weight. The test is repeated on the other side of the scale with the left foot on the scale. The scores on the test are the sums of the deviations of the right foot and the left foot from the required weight, one-half of the subject's weight. The score is given in pounds. A perfect score is zero.

Arm Circling

The instructor gives one demonstration of this test while giving the following verbal instructions:

Try to circle your arms in complete circles but in opposite directions so that one arm makes a complete circle going forward while the other arm makes a complete circle going backward. It will look like this. (demonstration)

The subject is not allowed to do the exercise with the instructor. The instructor rates the subject on her perform-

ance using the following 9-point scale in which each attempt to do the exercise is considered as a trial:

Rating Scale for Arm Circling Test:

9-Performed in good form on first attempt.

8-Performed in good form on second attempt.

7-Performed in fair form on second attempt.

6-Performed in fair form on third attempt.

A second demonstration is given if the subject has not performed the exercise after three attempts.

5-Performed in good form on fourth attempt.

4-Performed in fair form on fifth attempt.

3-Performed in poor form on sixth attempt.

2-Performed in poor form on seventh attempt.

1-Subject unable to perform exercise in seven attempts.

APPENDIX B

PROGRESSION AND ADMINISTRATION OF TRAINING PROGRAM

THE TRAINING PROGRAM

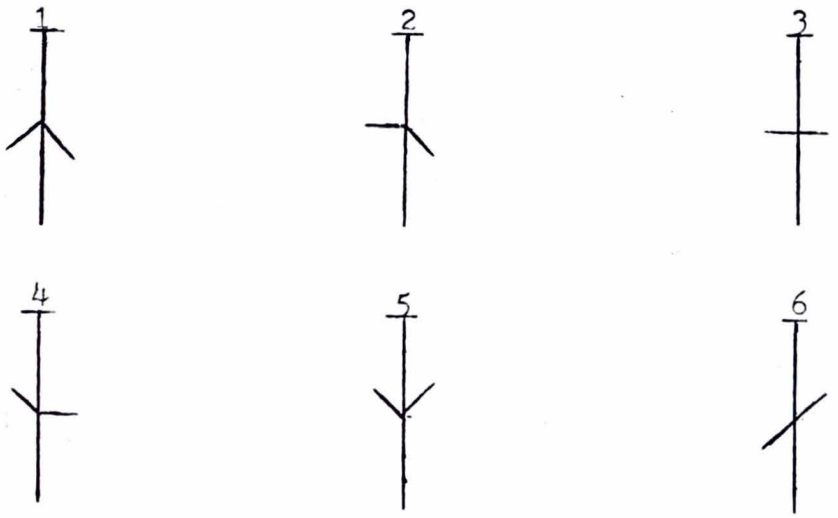
First Week

Walking Board Training

1. Walk forward on beam, arms held sideward.
2. Walk backward on beam, arms held sideward.
3. Walk forward with left foot always in front of right.
4. Walk backward with hands on hip.
5. Walk forward to center, kneel on one knee, rise and continue to end of beam.

Imitation of Movements

Movements should be made promptly and with definiteness. Instructor should observe hesitations. Look especially for abortive movements. Movements are performed with the use of a mirror for correction purposes.



Second Week

Angels-in-the-snow

Bilateral Movements

The student lies flat on her back on the floor with her feet together. She is then asked to move her arms apart as far as she can keeping her elbows stiff. Encourage the student to press against the floor with her arms as she moves them. Ask her to move her legs as far apart as she can. Move fast-Move slow. When the student brings her feet together, encourage her to "click her heels." When she brings her arms down to her sides, encourage her to slap her sides. By this means, awareness of body parts can be increased through the addition of tactual stimulation. Also, awareness of the differences between a body-body contact and a body-outside object contact can be heightened. Now combine arm and leg movements. In this phase she is asked to move her legs apart and at the same time move her arms over her head. She then moves her legs together and at the same time brings her arms down to her sides. She is asked to coordinate these two movement patterns so that her legs are apart at the same time that her hands come together above her head. As her heels touch, at the same time her hands touch her sides. The arm movements must take as long as, and no longer than, the leg movements.

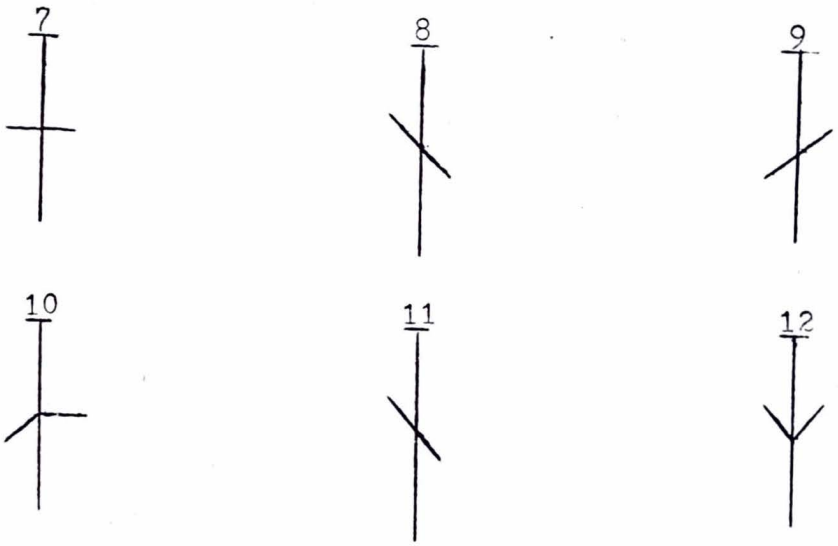
Walking Board Training

1. Hop on right foot, the full length of beam.
2. Hop on left foot the full length of beam, turn around and hop back.
3. Hold a wand three feet high. Walk forward, hands on hips, and pass under the bar.
4. Walk beam forward, eyes closed.

Third Week

Imitation of Movements

See description of movements on page 75.



Angels-in-the-snow

Unilateral and Cross-lateral movements

Student moves her right leg only to the extended position. Then ask her to return it. Always stop at the end of any movement. Then ask her to do the same with her left leg only, then her right arm only, then her left arm only. Some students will have difficulty moving one leg or one arm without moving the other.

Introduce cross-lateral movements. Ask her to move her left leg and right arm together. Then ask her to move her right leg and left arm. Alter the time. Ask the student to move fast, then slow. Ask the student to turn over facedown on the floor and repeat all the exercises in this new position. Then place a pillow under the abdomen so that by raising her shoulders and legs she can be free of the floor except for the pivot provided by the support. The entire series of exercises should be repeated in this position. Now she has added anti-gravity factor which requires a greater muscle tonus throughout all the muscle systems involved. The exercises are designed to help the child learn laterality to increase her awareness of her body image. It can assist herin discovering her extremities and becoming aware of their position in space relative to her body.

Fourth Week

Walking Board Training

1. Walk the beam backward with an eraser balanced on the back of each hand.
2. Walk beam sideward, eyes closed.
3. Walk beam backward, eyes closed.
4. Walk backward with arms folded on chest.

Kinesthetic Training

The subjects were shown the locations of various degrees on a large cardboard protractor. They were then blindfolded and ask to trace the location of the appointed positions with their hand.(5)

Fifth Week

Angels-in-the-snow

A combination of the bilateral, unilateral, and cross-lateral movements were used as described before.

Kinesthetic Training

Same training as described before.

Sixth Week

Walking Board Training

1. Stand on right foot, eyes closed, and record number of seconds balance is maintained.
2. Walk beam sideward left, eyes closed.
3. "Cat Walk" on beam, walk on "all fours" with hands and feet on beam.
4. Stand on beam, one foot in advance of the other, eyes closed and record number of seconds balance is maintained.

Imitation of Movements

Students were asked to assume designated movements, 1-6, page 75, lieing on the floor on their back. Emphasis was placed on their awareness of movements at the shoulder level.

APPENDIX C

PROGRESSION OF THE SWIMMING PROGRAM

PROGRESSION OF THE SWIMMING PROGRAM

First Week

Rating for equality of groups by water safety instructors.

Beginning swimming skills of floating, rhymthic breathing, opening eyes under water, bubble blowing, beginner armstroke.

Second Week

Coordination of the American crawl. Rhymthic breathing.

Second rating by water safety instructors as the elementary back stroke was introduced.

Third Week

Practice of whip kick, armstroke for elementary back stroke, and coordination of stroke.

Third rating by water safety instructors as the breast stroke was introduced.

Fourth Week

Practice of whip kick, armstroke for breast stroke, and coordination of stroke. Review of elementary back stroke.

Review of breast stroke and elementary back stroke. Practice of American crawl.

Fifth Week

Practice in performance of American crawl, elementary back stroke and breast stroke.

Sixth Week

Final rating by instructors on elementary back stroke and breast stroke.

APPENDIX D

RECORD OF THE PRE-TEST OF THE ROLOFF TEST BATTERY

Pre-Test Scores of Balance Stick Test
of Control Group

Subjects	Trials												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
1. S.B.	4.7	2.8	2.8	4.6	2.2	4.2	1.7	3.7	4.5	4.0	4.8	3.0	43.0
2. D.B.	15.6	26.0	4.1	3.2	4.7	1.8	7.5	6.5	24.4	2.6	20.5	9.0	125.9
3. L.D.	5.1	2.3	3.4	.5	.6	.7	3.0	3.2	5.6	1.5	.7	1.2	27.8
4. D.E.	1.1	3.2	1.8	2.4	1.8	3.9	3.5	2.7	4.2	5.2	2.7	2.0	34.5
5. R.H.	4.5	2.2	1.5	2.2	3.0	2.1	2.9	3.4	1.4	3.2	2.3	4.0	32.7
6. D.J.	4.2	10.8	4.0	1.9	10.5	4.3	4.6	29.6	54.6	10.0	42.1	106.1	282.7
7. B.K.	1.9	2.5	1.7	3.4	8.6	2.4	1.7	2.9	1.5	8.6	2.1	5.5	42.8
8. E.L.	2.9	5.0	4.2	3.8	6.6	8.7	1.3	9.5	14.6	9.4	10.5	6.1	82.6
9. D.O.	3.3	3.2	5.4	1.6	2.6	2.1	2.0	7.8	2.4	3.3	2.9	2.2	38.8
10. M.R.	2.1	2.5	3.2	2.9	3.9	4.0	3.4	2.7	2.7	2.0	3.5	15.4	48.3
11. V.S.	2.3	6.8	10.6	6.6	12.7	10.9	10.1	12.4	4.7	3.2	20.4	15.3	116.0
12. G.S.	2.6	2.2	1.9	3.5	2.9	14.1	4.9	12.7	5.8	2.3	20.1	2.2	75.2
13. S.T.	1.9	3.5	7.2	2.3	3.2	3.4	2.0	1.4	2.9	7.9	.9	1.9	38.5
14. J.T.	25.3	16.3	8.5	2.3	9.3	4.7	11.7	4.5	5.5	5.9	6.6	3.1	103.7

Pre-Test Scores of Weight Shifting
Test of Control Group

Subjects	Weight	Right Trial	Left Trial	Deviation Right	Deviation Left	Total
1. S.B.	119	50.0	73.0	-9.5	13.5	23.0
2. D.B.	126	63.0	68.0	0.0	5.0	5.0
3. L.D.	122	58.0	58.0	-3.0	-3.0	6.0
4. D.E.	122	54.0	58.0	-7.0	-3.0	10.0
5. R.H.	124	47.0	44.0	-15.0	-18.0	33.0
6. D.J.	143	74.0	55.5	3.5	-16.0	19.5
7. B.K.	123	58.0	100.0	-3.5	38.5	42.0
8. E.L.	107	44.5	52.0	-9.0	-1.5	10.5
9. D.O.	146	65.5	68.0	-7.5	-5.0	12.5
10. M.R.	112	56.0	38.0	0.0	-18.0	18.0
11. V.S.	147	69.0	93.5	-4.5	20.0	24.5
12. G.S.	104	55.5	56.0	3.5	4.0	7.5
13. S.T.	117	45.0	45.5	-13.5	-13.0	26.5
14. J.T.	130	70.5	83.0	5.5	18.0	23.5

Pre-Test Score of Arm Raising
Test of Control Group

Subjects	Right Trial	Right Trial	Left Trial	Left Trial	Total
1. S.B.	-1	-2	-4	4	11
2. D.B.	-1	-2	-5	-6	14
3. L.D.	3	4	3	5	15
4. D.E.	3	2	3	2	10
5. R.H.	3	3	-3	-10	19
6. D.J.	11	11	17	9	48
7. B.K.	-1	-1	1	1	4
8. E.L.	10	5	4	6	25
9. D.O.	-3	-1	-5	-5	14
10. M.R.	-4	-4	4	-3	15
11. V.S.	-3	-4	-2	-7	16
12. G.S.	-2	-5	-7	-1	15
13. S.T.	1	0	5	3	9
14. J.T.	-5	-5	-6	-6	22

Pre-Test Scores of Arm Circling
Test of Control Group

Subjects	Rating Score According To 9 Point Scale
1. S.B.	8
2. D.B.	9
3. L.D.	3
4. D.E.	8
5. R.H.	7
6. D.J.	9
7. B.K.	4
8. E.L.	4
9. D.O.	8
10. M.R.	7
11. V.S.	8
12. G.S	7
13. S.T.	8
14. J.T.	6

Pre-Test Scores of Balance Stick Test
of the Experimental Group

Subjects	Trials												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
1. R.A.	3.6	10.3	1.5	11.9	2.3	3.1	3.0	4.4	15.6	3.4	4.0	10.7	73.8
2. K.B.	1.6	2.6	5.3	2.7	3.2	2.6	4.5	3.2	10.1	1.3	2.3	1.2	40.4
3. G.D.	5.5	7.6	6.3	4.1	10.1	3.6	1.0	27.3	60.3	11.0	5.9	44.5	138.4
4. W.H.	2.9	2.6	2.8	1.6	2.0	3.3	2.4	1.8	3.3	3.4	3.5	4.3	33.9
5. G.H.	4.4	60.0	11.9	12.2	5.4	18.5	3.4	13.0	5.4	1.9	13.3	15.3	104.7
6. R.J.	2.4	3.1	7.4	3.9	2.5	4.3	3.4	1.3	4.1	2.1	2.4	2.4	39.3
7. R.J.	1.0	3.4	1.3	5.5	1.5	2.1	11.0	7.0	3.4	4.0	5.5	3.3	49.0
8. D.K.	7.0	1.4	7.9	5.4	2.9	2.4	7.3	8.9	13.5	3.4	2.0	1.5	63.6
9. B.L.	3.7	3.2	2.6	9.1	2.4	6.6	9.5	3.5	17.6	9.5	8.2	9.5	85.4
10. B.M.	17.1	20.4	1.4	12.1	2.4	23.1	44.6	24.3	18.5	2.8	44.7	10.8	223.2
11. L.M.	2.0	3.2	3.0	6.1	1.0	2.5	3.2	3.5	3.6	13.5	16.0	3.5	61.1
12. V.T.	7.1	2.3	2.6	5.1	2.4	2.4	3.4	8.0	3.4	5.8	7.6	6.7	57.8
13. J.T.	8.5	5.2	2.5	1.2	4.3	16.0	4.2	3.5	8.0	1.6	18.5	8.0	81.5
14. P.W.	2.1	5.9	6.1	9.0	5.8	18.4	2.0	3.3	6.8	8.0	3.2	9.1	79.7
15. M.A.	1.9	4.5	7.7	5.9	2.0	10.0	11.0	9.9	5.5	4.2	5.3	6.4	74.2

Pre-Test Scores of Weight Shifting
Test of Experimental Group

Subjects	Weight	Right Trial	Left Trial	Deviation Right	Deviation Left	Total
1. R.A.	115	53.5	53.5	-4.0	-4.0	8.0
2. K.B.	112	45.0	35.0	-11.0	-21.0	32.0
3. G.D.	118	30.0	49.5	-29.0	-10.5	39.5
4. W.H.	93	45.0	31.5	1.5	-15.0	16.5
5. G.H.	131	55.0	47.0	-10.5	-18.5	29.0
6. R.J.	115	45.0	68.0	-10.0	12.0	22.0
7. R.J.	110	45.0	54.0	-10.0	-1.0	11.0
8. D.K.	141	78.0	76.0	7.5	5.5	13.0
9. B.L.	185	66.0	95.0	26.5	2.5	29.0
10. B.M.	158	68.0	60.0	-11.0	-19.0	30.0
11. L.M.	174	88.5	72.0	1.5	-15.0	16.5
12. V.T.	136	70.0	66.0	2.0	-2.0	4.0
13. J.T.	159	55.0	72.0	23.0	6.0	29.0
14. P.W.	130	68.0	67.0	3.0	2.0	5.0
15. M.A.	110	74.0	81.0	3.0	10.0	13.0

Pre-Test Scores of Arm Raising
Test of Experimental Group

Subjects	Right Trial	Right Trial	Left Trial	Left Trial	Total
1. R.A.	-3	-5	0	8	16
2. K.B.	-2	-2	-3	-11	18
3. G.D.	-3	-3	-5	-6	17
4. W.H.	-4	-8	-3	-4	19
5. G.H.	-3	-4	-4	-2	13
6. R.J.	-2	-3	-7	-9	21
7. R.J.	0	0	-2	-4	6
8. D.K.	-1	0	-4	-3	8
9. B.L.	-7	-6	-2	-5	20
10. B.M.	1	1	8	4	14
11. L.M.	-3	2	1	1	7
12. V.T.	-5	-8	-4	-5	22
13. J.T.	-6	-7	10	3	26
14. P.W.	2	2	-1	-5	10
15. M.A.	5	2	1	3	11

Pre-Test Scores of Arm Circling
Test of Experimental Group

Subjects	Rating Score According To 9 Point Scale
1. R.A.	9
2. K.B.	7
3. G.D.	8
4. W.H.	4
5. G.H.	8
6. R.J.	6
7. R.J.	1
8. D.K.	2
9. B.L.	6
10. B.M.	4
11. L.M.	9
12. V.T.	8
13. J.T.	9
14. P.W.	9
15. M.A.	9

APPENDIX E

RECORD OF THE POST-TEST OF THE ROLOFF TEST BATTERY

Post-Test Scores of Balance Stick Test
of the Control Group

Subject	Trials 1	2	3	4	5	6	7	8	9	10	11	12	Total
1. S.B.	15.0	16.0	9.0	6.3	10.1	5.0	9.0	8.1	9.5	7.5	4.0	8.0	107.5
2. D.B.	3.5	23.5	13.6	1.5	4.0	9.2	2.5	4.0	2.3	53.5	32.5	40.0	190.1
3. L.D.	2.2	3.7	5.0	2.2	1.5	1.5	2.7	3.5	1.5	2.2	1.5	3.5	31.0
4. D.E.	2.5	4.0	2.2	2.0	3.0	8.7	1.0	3.7	6.3	7.7	5.2	4.0	50.3
5. R.H.	1.5	2.0	2.5	1.7	3.3	4.0	1.5	4.0	2.1	2.0	3.5	3.5	31.6
6. D.J.	40.0	14.5	20.5	24.7	7.2	20.1	37.1	24.0	48.2	90.0	75.0	20.5	429.8
7. B.K.	3.3	2.5	4.0	6.6	4.2	4.4	1.2	2.5	7.5	13.0	1.5	3.5	54.2
8. E.L.	1.2	3.0	10.2	2.5	2.0	1.0	1.0	1.2	6.0	3.5	1.0	8.5	41.1
9. D.O.	1.9	3.7	3.5	2.5	2.2	1.5	4.0	5.0	4.0	3.0	4.2	3.0	38.5
10. M.R.	3.2	5.5	.7	2.5	14.0	2.7	1.6	19.2	10.0	15.0	14.0	2.5	90.9
11. V.S.	17.0	1.5	81.5	14.0	31.1	4.0	5.5	11.9	16.4	31.1	2.6	10.2	53.8
12. G.S.	2.3	12.0	16.5	25.0	12.0	12.0	25.0	52.0	6.0	30.0	4.0	27.0	263.8
13. S.T.	3.0	15.0	31.0	2.0	2.0	1.5	5.0	21.0	5.5	5.1	9.2	2.0	104.3
14. J.T.	5.0	8.0	2.5	5.3	1.6	2.5	5.4	7.5	1.5	7.0	2.5	2.5	90.9

Post-Test Scores of Weight Shifting
Test of Control Group

Subject	Weight	Right Trial	Left Trial	Deviation Right	Deviation Left	Total
1. S.B.	121	70	50	9.5	11.5	21
2. D.B.	126	65	58	2.0	-5.0	7
3. L.D.	122	48	63	-13.0	2.0	15
4. D.E.	124	61	62	-1.0	0.0	1
5. R.H.	125	50	50	-12.5	-12.5	25
6. D.J.	145	90	71	17.5	-1.5	19
7. B.K.	124	60	50	-2.0	-12.0	14
8. E.L.	108	50	46	-4.0	-8.0	12
9. D.O.	148	60	50	-14.0	-24.0	38
10. M.R.	113	68	56	11.5	-.5	12
11. V.S.	150	73	75	-2.0	0.0	2
12. G.S.	108	40	35	-14.0	-19.0	33
13. S.T.	118	62	58	3.0	-1.0	4
14. J.T.	137	70	68	1.5	-.5	2

Post-Test Scores of Arm Raising
Test of Control Group

Subjects	Right Trial	Right Trial	Left Trial	Left Trial	Total
1. S.B.	0	5	-3	-6	14
2. D.B.	-8	-4	-4	-8	24
3. L.D.	7	-5	3	-5	20
4. D.E.	-5	-2	-3	-5	15
5. R.H.	-2	3	1	1	7
6. D.J.	6	5	5	5	21
7. B.K.	2	1	4	3	15
8. E.L.	9	8	4	3	24
9. D.O.	-2	-1	-4	-3	10
10. M.R.	-2	-3	-4	-3	12
11. V.S.	5	-1	3	-1	10
12. G.S.	1	-5	8	-4	18
13. S.T.	4	5	1	-1	11
14. J.T.	3	1	4	-2	10

Post-Test Scores of Arm Circling
Test of Control Group

Subjects	Rating Scale According To 9 Point Scale
1. S.B.	4
2. D.B.	9
3. L.D.	6
4. D.E.	5
5. R.H.	9
6. D.J.	8
7. B.K.	5
8. E.L.	6
9. D.O.	8
10. M.R.	9
11. V.S.	8
12. G.S.	8
13. S.T.	6
14. J.T.	3

Post-Test Scores of Balance Stick Test
of the Experimental Group

Subjects	Trials												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
1. R.A.	4.2	19.0	17.5	35.5	15.0	29.6	15.2	27.0	13.5	20.0	15.2	14.2	226.7
2. K.B.	1.5	3.5	2.5	7.5	2.0	6.5	3.5	3.5	9.5	4.5	1.5	3.8	49.8
3. G.D.	12.0	58.0	4.5	13.5	25.5	27.5	113.2	97.0	45.0	10.0	41.0	17.5	464.7
4. W.H.	3.5	3.4	2.9	8.8	14.5	10.5	3.0	7.5	11.7	2.5	66.5	22.5	137.3
5. G.H.	3.5	6.5	41.2	7.0	20.5	6.8	32.0	27.5	16.5	3.5	41.2	9.5	215.7
6. R.J.	4.0	3.1	4.0	3.0	4.6	2.6	1.2	18.2	3.5	1.5	4.5	4.5	54.6
7. R.J.	3.5	6.8	5.5	3.5	2.0	12.2	17.0	4.5	7.5	9.5	24.1	2.5	98.6
8. D.K.	13.0	11.5	4.5	24.4	23.0	6.5	3.5	52.5	63.5	43.5	21.3	38.5	305.3
9. B.L.	23.0	8.5	10.5	2.8	31.2	22.5	61.2	18.2	19.5	23.5	10.5	19.5	249.9
10. B.M.	8.4	8.5	6.0	27.8	14.5	3.5	3.5	43.5	79.5	5.0	12.5	142.5	355.2
11. L.M.	3.0	34.0	36.0	67.5	51.5	35.5	57.0	13.5	45.0	95.5	44.0	38.5	161.0
12. V.T.	7.0	11.5	10.0	4.0	3.5	2.7	2.5	8.2	6.5	3.2	2.5	6.5	68.1
13. J.T.	33.5	128.3	36.1	139.5	39.2	52.5	36.2	35.2	46.5	118.5	38.5	98.5	782.6
14. P.W.	4.2	3.2	3.5	6.2	22.1	44.5	5.0	4.7	3.3	31.2	39.5	18.5	185.9
15. M.A.	81.5	11.5	9.3	5.5	6.5	4.5	10.0	5.0	11.0	4.0	12.2	5.5	93.5

Post-Test Scores of Weight Shifting
Test of Experimental Group

Subject	Weight	Right Trial	Left Trial	Deviation Right	Deviation Left	Total
1. R.A.	121	59	64	-1.5	3.5	5
2. K.B.	114	53	55	-4.0	-2.0	6
3. G.D.	120	58	60	-2.0	0.0	2
4. W.H.	94	44	40	-3.0	-7.0	10
5. G.H.	135	59	62	-8.5	-5.5	14
6. R.J.	112	60	58	4.0	2.0	6
7. R.J.	112	50	50	-6.0	-6.0	12
8. D.K.	134	50	67	-17.0	0.0	17
9. B.L.	192	95	96	-1.0	0.0	1
10. B.M.	164	70	75	-12.0	-7.0	19
11. L.M.	170	83	80	-2.0	-5.0	7
12. V.T.	135	70	55	2.5	-12.5	15
13. J.T.	160	75	70	-5.0	-10.0	15
14. P.W.	136	60	66	-8.0	-2.0	10
15. M.A.	139	61	69	-.5	-.5	9

Post-Test Scores of Arm Raising
Test of Experimental Group

Subjects	Right Trial	Right Trial	Left Trial	Left Trial	Total
1. R.A.	0	0	-1	-3	4
2. K.B.	-7	-6	-8	-5	26
3. G.D.	-5	0	-4	-3	12
4. W.H.	-3	-5	-11	-6	25
5. G.H.	-3	-2	-2	-5	12
6. R.J.	-5	0	-3	1	9
7. R.J.	2	1	0	5	8
8. D.K.	-3	-5	0	-3	11
9. B.L.	-4	-4	-4	-6	18
10. B.M.	0	1	2	-2	5
11. L.M.	-3	-4	-3	-2	12
12. V.T.	1	-1	-1	-1	4
13. J.T.	-9	-3	-9	-1	22
14. P.W.	-4	-4	-6	-6	20
15. M.A.	2	1	0	-3	6

Post-Test Scores of Arm Circling
Test of Experimental Group

Subject	Rating Score According To 9 Point Scale
1. R.A.	9
2. K.B.	6
3. G.D.	8
4. W.H.	5
5. G.H.	7
6. R.J.	7
7. R.J.	5
8. D.K.	8
9. B.L.	8
10. B.M.	9
11. L.M.	8
12. V.T.	9
13. J.T.	9
14. P.W.	9
15. M.A.	9

APPENDIX F

RECORD OF THE PRE-TEST SCORES OF BEGINNING SWIMMING SKILLS

Pre-Test Scores of Beginning Swimming Skills of Control Group

Subject	First W.S.I. Rating	Second W.S.I. Rating	Third W.S.I. Rating	Total Score
1. S.B.	9.5	8.0	10.0	27.5
2. D.B.	16.5	18.0	16.5	51.0
3. L.D.	7.5	7.0	6.0	20.5
4. D.E.	16.0	14.0	14.0	44.0
5. R.H.	15.5	15.0	13.5	44.0
6. D.J.	12.5	12.0	11.0	35.5
7. B.K.	10.5	9.0	10.0	29.5
8. E.L.	13.5	10.0	12.0	35.5
9. D.O.	17.5	18.0	14.5	50.0
10. M.R.	15.0	17.0	16.5	48.5
11. V.S.	17.5	18.0	15.5	51.0
12. G.S.	16.5	16.0	13.5	46.0
13. S.T.	12.5	10.0	11.0	33.5
14. J.T.	17.0	17.0	15.5	49.5

Pre-Test Scores of Beginning Swimming Skills of Experimental Group

Subject	First W.S.I. Rating	Second W.S.I. Rating	Third W.S.I. Rating	Total Score
1. R.A.	15.0	14.0	13.0	42.0
2. K.B.	16.5	16.0	16.5	49.0
3. G.D.	9.0	8.0	11.0	28.0
4. W.H.	5.0	7.0	7.0	19.0
5. G.H.	16.5	17.0	18.0	51.5
6. R.J.	10.0	10.0	12.5	32.5
7. R.J.	8.0	7.0	9.0	24.0
8. D.K.	16.5	17.0	18.0	51.5
9. B.L.	18.0	18.0	18.0	54.0
10. B.M.	15.0	14.0	15.0	44.0
11. L.M.	15.0	11.0	14.0	40.0
12. V.T.	16.5	16.0	17.0	49.5
13. J.T.	17.5	18.0	18.0	53.5
14. P.W.	16.5	16.0	18.0	50.5
15. M.A.	18.0	18.0	17.5	53.5

APPENDIX G

RECORD OF THE TEST SCORES FOR ARM PLACEMENT OF THE ELEMENTARY BACK STROKE AND BREAST STROKE

Test Scores For the Elementary Back Stroke for the Control Group

Subjects	First W.S.I. Rating	Second W.S.I. Rating	Third W.S.I. Rating	Total Score
1. S.B.	0.0	1	1.0	2
2. D.B.	4.0	5	3.0	12
3. L.D.	Observed			
4. P.E.	Observed			
5. R.H.	Observed			
6. D.J.	0.0	1	1.0	2
7. B.K.	1.0	3	2.0	6
8. E.L.	2.0	5	3.0	10
9. D.C.	4.0	4	3.0	11
10. M.R.	2.5	4	4.0	11
11. V.S.	4.0	4	3.0	11
12. G.S.	4.0	5	3.5	13
13. S.T.	2.0	3	1.0	6
14. J.T.	2.0	3	1.0	6

Test Scores for the Elementary Back Stroke for the Experimental Group

Subjects	First W.S.I. Rating	Second W.S.I. Rating	Third W.S.I. Rating	Total Score
1. R.A.	4.0	3	3.5	11
2. K.B.	2.5	4	3.0	10
3. G.D.	.5	1	2.0	4
4. W.H.	Observed			
5. G.H.	4.0	5	3.0	12
6. R.J.	0.0	0	0.0	0
7. R.J.	0.0	0	0.0	0
8. D.K.	6.0	5	4.0	15
9. B.L.	5.0	4	3.0	12
10. B.M.	5.0	4	4.0	13
11. L.M.	4.0	3	2.0	9
12. V.T.	5.0	4	4.0	13
13. J.T.	5.0	4	5.0	14
14. P.W.	Observed			
15. M.A.	4.5	5	4.0	14

Test Scores For the Breast Stroke
For the Control Group

Subject	First W.S.I. Rating	Second W.S.I. Rating	Third W.S.I. Rating	Total Score
1. S.B.	3.0	4	2.5	9.5
2. D.B.	10.0	8	7.0	25.0
3. L.D.	2.0	3	2.0	7.0
4. P.E.	Observed			
5. R.H.	2.5	6	4.5	13.0
6. D.J.	4.5	4	3.0	11.5
7. B.K.	6.0	6	7.0	19.0
8. E.L.	7.5	7	5.5	20.0
9. D.O.	6.5	8	6.5	21.0
10. M.R.	5.5	6	5.5	17.0
11. V.S.	9.0	11	7.5	27.5
12. S.T.	4.0	5	4.0	13.0
13. J.T.	5.0	4	3.5	12.5
14. G.S.	6.0	8	7.5	21.5

Test Strokes for the Breast Stroke
for the Experimental Group

Subjects	Frist W.S.I. Rating	Second W.S.I. Rating	Third W.S.I. Rating	Total Score
1. R.A.	Observed			
2. K.B.	9.0	7.0	8.0	24.0
3. G.D.	7.0	6.0	7.0	20.0
4. W.H.	5.5	5.0	5.5	16.5
5. G.H.	9.5	8.0	9.0	27.5
6. R.J.	4.5	3.0	4.5	12.0
7. R.J.	4.5	2.0	3.5	10.0
8. D.K.	4.5	3.0	3.5	11.0
9. B.L.	10.0	10.0	8.0	18.0
10. B.M.	8.0	8.0	9.5	25.5
11. L.M.	7.0	5.0	8.0	20.0
12. V.T.	5.5	4.0	6.0	15.5
13. J.T.	10.0	8.0	9.5	27.5
14. P.W.	Observed			
15. M.A.	9.0	9.5	10.0	28.5

APPENDIX H

RECORD OF THE FINAL TEST SCORES FOR ARM PLACEMENT OF THE ELEMENTARY BACK STROKE AND BREAST STROKE

FINAL TEST SCORES FOR THE ELEMENTARY BACK STROKE FOR THE CONTROL GROUP

Subjects	First W.S.I. Rating	Second W.S.I. Rating	Third W.S.I. Rating	Total Score
1. S.B.	4.5	6	6	17
2. D.B.	10.0	9	10.5	30
3. L.D.	2.0	4	4	10
4. P.E.	6.5	8	8	23
5. R.H.	11.0	9	11.0	31
6. D.J.	5.5	4	5.0	15
7. B.K.	5.5	4	6	16
8. E.L.	9.0	6	9.5	25
9. D.O.	11.5	7	10.5	29
10. M.R.	11.0	9	10.5	31
11. V.S.	12.0	10	10.0	32
12. G.S.	11.5	10	10.5	32
13. S.T.	Observed			
14. J.T.	Observed			

FINAL TEST SCORES FOR THE ELEMENTARY BACK STROKE FOR THE EXPERIMENTAL GROUP

Subjects	First W.S.I. Rating	Second W.S.I. Rating	Third W.S.I. Rating	Total Scores
1. R.A.	5.0	6	5.5	17
2. K.B.	6.0	5	5.5	17
3. G.D.	2.0	4	1.5	17
4. W.H.	2.0	2	5.5	10
5. G.H.	5.5	4	5.5	15
6. R.J.	5.0	2	2.0	9
7. R.J.	3.0	5	3.5	11
8. D.K.	6.0	5	3.0	14
9. B.L.	2.0	4	5.5	11
10. B.M.	Observed			
11. L.M.	6.0	2	5.5	14
12. V.T.	6.0	4	6.0	16
13. J.T.	4.5	4	5.0	14
14. P.W.	5.0	6	6.0	17
15. M.A.	5.5	4	5.5	15

FINAL TEST SCORES FOR THE BREAST STROKE
FOR THE CONTROL GROUP

Subjects	First W.S.I. Rating	Second W.S.I. Rating	Third W.S.I. Rating	Total Scores
1. S.B.	1	1.0	2.5	5
2. D.B.	4	4.5	5.0	13
3. L.D.	2	1.5	2.0	4
4. P.E.	3	4.0	4.0	11
5. R.H.	5	5.0	5.0	15
6. D.J.	2	3.5	3.0	9
7. B.K.	2	3.5	4.0	9
8. E.L.	4	5.0	5.0	14
9. D.O.	5	6.0	5.0	16
10. M.R.	5	5.5	5.5	16
11. V.S.	6	6.0	5.0	17
12. G.S.	5	6.0	6.0	16
13. S.T.	Observed			
14. J.T.	Observed			

FINAL TEST STROKES FOR THE BREAST STROKE
FOR THE EXPERIMENTAL GROUP

Subjects	First W.S.I. Rating	Second W.S.I. Rating	Third W.S.I. Rating	Total Scores
1. R.A.	4.5	2	4.5	11
2. K.B.	4.5	3	6.0	14
3. G.D.	5.0	5	6.0	16
4. W.H.	5.0	6	2.5	14
5. G.H.	4.0	3	6.0	14
6. R.J.	3.0	2	6.0	11
7. R.J.	4.5	4	2.5	11
8. D.K.	2.0	2	5.0	9
9. B.L.	2.0	3	2.5	8
10. B.M.	6.0	4	4.0	14
11. L.M.	4.5	6	5.5	17
12. V.T.	4.0	4	4.5	12
13. J.T.	5.5	4	4.5	14
14. P.W.	5.0	4	4.5	14
15. M.A.	Observed			

Vita was removed during scanning