CALLAWAY, CAROLYN RANDALL. The Effect of Five Different Approaches in Teaching the Overhand Throw for Accuracy to Junior High Girls. (1968) Directed by: Dr. Marie Riley. 91 pp.

It was the purpose of this study to determine the effects of five different approaches in teaching the overhand throw for accuracy. The five approaches were through mechanical principles and kinesthetic cues, mechanical principles, kinesthetic cues, practice, and no practice.

A pilot study using 7th graders was conducted to test the procedures for the actual study. The actual study was then undertaken, and two physical education classes consisting of fifty 8th grade girls were selected as subjects for this study. The Overhand Throw for Accuracy Test from the American Association of Health, Physical Education, and Recreation was given as the pre-, midway, and post tests. The subjects were equated and divided into five groups by their Intelligence Quotient scores and pre-test scores.

The five groups were divided as follows: Group I, the mechanical principle and kinesthetic cue group; Group II, the kinesthetic cue group; Group III, the mechanical principle group; Group IV, the practice group; and Group V, the non-practice group.

The study lasted five weeks. Three class meetings were used for the three tests. Each group met two times a week for four weeks, except Group V, who met for the three tests only. Groups I and IV met every Monday and Wednesday. Group I was given mechanical principles and kinesthetic cues pertaining to the overhand throw for accuracy, then threw five practice throws. While practicing, Group IV was given coaching cues having no direct reference to mechanical principles or

kinesthetic cues. The cues given were cues such as throw harder or higher. Groups II and III met every Tuesday and Thursday. Group II was given the same kinesthetic cues as Group I, and then threw five practice throws. Group III was given the same mechanical principles as Group I, and then threw five practice throws.

This procedure continued until the end of two weeks after which a midway test was given to all five groups. The testing procedures were the same as for the pre-test. A list of mechanical principles was distributed to Groups I and III. The final two weeks were a duplicate of the first two weeks, culminating with the final throwing test.

The following results were obtained:

1. There was a significant difference within the mechanical principle and kinesthetic cue group between the pre-, midway, and post-test scores.

2. All other results were not statistically significant.

From the results, the following conclusions were drawn within the limits of the study:

1. The use of mechanical principles and kinesthetic cues seemed to be more effective for improvement within groups. However, when compared to the other groups, statistical evidence to support its superiority as a method was lacking.

2. Practice without mechanical principles or kinesthetic cues seemed to have no effect on the improvement of the scores.

THE EFFECT OF FIVE DIFFERENT APPROACHES IN TEACHING THE OVERHAND THROW FOR ACCURACY TO JUNIOR HIGH GIRLS

by

Carolyn Randall Callaway

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CHAPTER I

INTRODUCTION

The physical educator is continually concerned and confronted with new methods and procedures to be used in helping the unskilled student develop his overhand pattern.

The same overhand pattern can be applied to several skills: the tennis serve, the badminton high clear, the volleyball overhand serve, and the overhand throw. The overhand throw is usually the first skill of the overhand pattern with which a child comes in contact. Whether playing catch or throwing a snowball at a target, the individual who has developed an accurate overhand throw will find the greatest amount of success in that type of activity.

If this pattern is not developed in early childhood, it is the physical education teacher who must find the best way for the child to learn the pattern. Yet, "...little is known about how this skill is learned, nor has systematic study been made of ways to improve our instructional procedure." (70:2) Therefore, the child learns on his own by trial and error or through lengthy practice with the teacher giving him directional cues. Both are sometimes inefficient for the student and teacher.

Two ways through which the improvement of the overhand throw may be explored are kinesthesis and mechanical principles. Recognition of the importance of the kinesthetic sense in teaching physical education is not a recent development. (7,13,34,39,59,69) The kinesthetic sense that one uses in daily life, such as eating, turning on a light switch, walking up the stairs, lifting a carton of milk, is so covered by our visual experience that we are not aware that this sense exists. In the young child, kinesthetic control plays an important part in movement patterns although the child is unconscious of the fact. A teacher who understands the capabilities of the use of a conscious kinesthetic sense can help the student change fundamental body movements into skillful movements. (59)

Kinesthetic sense is equally as important as the other senses and physical educators should not let the importance of the other senses overrule the teaching of kinesthesis.

Every physical educator has been exposed at some time to anatomy, physiology, and kinesiology but the question arises as to how many teachers actually apply what they have learned. McCloy stated that the teaching of the techniques of throwing a ball and other activities have been thoroughly explained, but the mechanical principles upon which the techniques are based are seldom understood and used, and most of the teaching is done by trial and error. (8:55) Stevens added that it is necessary for the teacher to know and apply these fundamental principles in teaching in order to aid the learner to pitch a straighter ball. (69:3)

It has been stated that emphasis on kinesthesis and knowledge of mechanical principles can help an individual to produce movement efficiently. However, the question arises as to the emphasis that should be placed on each in the search for the complete picture of the performer.

In order to explore the effect that emphasis on kinesthesis and knowledge of mechanical principles would have on the overhand throw, this study was undertaken.

CHAPTER II

STATEMENT OF THE PROBLEM

The Problem

It was the purpose of this study to determine the effects of five different approaches in teaching 8th grade girls the overhand throw for accuracy. The five approaches were through: mechanical principles and kinesthetic cues; mechanical principles; kinesthetic cues; practice; and no practice.

Definitions

For the purpose of this study the following definitions were accepted:

Kinesthesis--"Kinesthesis is generally considered a sixth sense through which a person is aware of the position of the body and its parts and of the force and extent of movements." (67:1)

Mechanical Principles--Mechanical principles are laws of physics as applied to human motion.

Kinesthetic Cues--Kinesthetic cues are teaching devices used to help the subject become more aware of the correct feeling of the overhand throw.

Practice Group--The practice group received directional cues during their throwing practice. These were such as throw harder, higher, or more to the right.

CHAPTER III

REVIEW OF LITERATURE

It was the purpose of this study to determine the effects of five different approaches in teaching the overhand throw for accuracy. For this purpose the review of literature was divided into the following areas: kinesthesis, mechanical principles, and throwing.

KINESTHESIS

Importance of Kinesthesis

Many physical educators, psychologists, and other interested researchers have conducted studies, written articles, and books attempting to understand the effect of kinesthesis on our bodies. Kinesthesis, according to Scott (11:375) is an internal sense; therefore, it is one of the most difficult senses to study. Ragsdale (10:89) said that the awareness of kinesthetic sensations also provides a basis on which the person can become more independent and self-helpful in initiating learning of a skill or practicing on it.

Researchers have attempted to define kinesthesis. The following four, within the dates 1899 to 1954, seem to be the most complete definitions:

> The sense by which we are made conscious of the extent and force of muscle contraction and the position of our parts of our bodies. (1:304)

> To develop kinesthetic awareness means to develop an accurate and conscious control of the body in movement. (7:61)

> The ability to feel contraction and relaxation, to know what a muscle is doing, is called kinesthetic perception. (9:96)

> Kinesthesis is generally considered a sixth sense through which a person is aware of the position of the body and its parts and of the force and extent of movements. (67:1)

Kinesthesis is said to be our "sixth sense" and without this sense we would not be able to move with any coherent meaning. When walking up the stairs in the dark, every step would be trial and error. We would not be able to remember how far we lifted each preceding leg; what the angle in the hip and knee joints felt like. As Bowdlear (14: 100) stated, without kinesthetic perception, a person lacks information as to where a limb is to start. Thus he cannot know what movements to make, since this perception is very important in the control of both reflex and voluntary movement. The performer does not have any information as to how far the movement has progressed and cannot tell when to stop it. Steinhaus stated the individual would be dead without his muscle sense. He would not be able to find his mouth, breathe or blow his nose without muscle sense. Through muscle sense, he knows where his arm and ear are, and how to judge between two weights. Therefore, he could not acquire skill without muscle sense. (12:32-33)

The process of motor learning should be a very active, creative, and throughtful one. Learning through mimicry and blind trial and error is a waste of learning time, and it is next to impossible. (10:71-72) Hanley (28:366) commented on performance in golf by mimicry. She said that if you imitate what another is trying to do, this is weak. The important side of the game is ignored, that being kinesthetic sense. This perception is muscle feel. In Hanley's article, she stressed that golf should be taught along with the other fundamentals by having the pupil instill in his mind the idea of thinking the swing and recalling the correct pattern by a sense of muscle feel. Thus, the important thing is to instill this in his mind not by imitation, but by the kinesthetic sensations resulting from his movements.

Other writers have commented on the aspect of the "feel" of a movement. Hubbard (31:244) said that the performer may "feel" the difference between two movement patterns, but he cannot understand good movement, kinesthetically, until he can produce it. If he cannot determine which cues from kinesthesis, touch, and pressure to match with good performance, he cannot foretell the outcome of the performance from the "feel." Therefore, old errors could feel good to him.

According to Metheny, kinesthetic perception is very important to maintain balance and perform more efficiently. The individual must sense the feel of the correct or incorrect pattern of a movement or he will not have a basis for correcting it. Thus he will not be able to set up this correct pattern as a habitual pattern. (9:96) Elfeldt and Metheny (24:269) stated that without the kinescept (the feel of the movement) it would be impossible to move because movement must be felt to be identified.

In trying to find an awareness of movement, Ensign (59:91) stressed that the aim of the teacher should be to "...develop an awareness of the parts of the body as they are related to the whole and to the space around it, through the kinesthetic sense."

An individual becomes aware of what a movement feels like when his muscles contract and bring about a resulting movement. He learns the difference between tensionsthrough sensations in his muscles. (7:61)

The awareness of the body cannot be overly stressed. Todd (13:26) said, "This awareness of our own motion, weight, and position is obtained from within the body itself rather than from the outside world." Ensign (59:77) mentioned that body control can be developed at least one-fourth better in an individual by developing the muscle sense.

H'Doubler, Hubbard, and Ellfeldt and Metheny had various comments on the importance of kinesthesis as an error-sensing and correcting device. H'Doubler (6:90) said that errors are quickly detected, and the mind, once it senses something is wrong, becomes aware of it and makes corrections. Ellfeldt and Metheny (24), in trying to develop a general theory about the meaning of human movement, said that a movement pattern or experience is a kinestruct. The performer becomes aware of this movement through kinesthetic perception which is called a kinescept. The kinesymbol is the meaning, the mental abstraction, a person finds in this kinesthetic awareness of the movement. These kinesymbols can be recalled by the mind at any time this kinesthetic feedback is needed. Hubbard (31:244) disagreed with the generalizations of the above article. He said that the assumption that kinesthesis was an error-correcting mechanism, and that through kinesthesis, the performer senses errors in a performance in time to correct them is highly questionable. He stated that kinesthesis is an error-sensing and not an error-correction mechanism. Even if the error is realized as it is being performed, the error will still result unless the stroke is checked by an antagonistic muscle. This is because in fast and skilled movements, especially the ones using the large segments of the body, the segment will outrun the impressed force of the muscle that initiates the movement. Therefore, kinesthesis tells you what went wrong but usually not in time to change it.

It is generally agreed that kinesthesis is important and a necessary part of performance in movement of any kind. McCloy (8:56) related the importance to the learning of skills. He said that in order for the learner to control the parts of his body to the point where they will obey him, he must have developed a substantial amount of kinesthetic sense.

Relationship to Vision and Hearing

Recent studies done in neuro-physiology proved that kinesthetic receptors are only second to the eye and ear in the intricateness and richness of sensory information they convey. (34:6) Steinhaus (12:32-33) seemed emphatic when he said that he did not believe that the eye was the most important sense organ. He said some people say that "...80% of one's knowledge comes through the eye." He also stated that the ear is a secondary sense organ, and to him the most important sense organ is the muscular system because 60% of the total nerve fibers are motor and this is what causes the muscle to contract. Compared to the eyes and ears, "...45% of our body weight is one large sense organ."

According to Steinhaus, newborn babies cannot depend on their eyes and must resort to the sense organs in their muscles. Steinhaus (47:38) added that we learn in relation to the "...near and far, heavy and light, and how to get things into the mouth," long before we are concerned with and are able to associate meaning with what comes through the eyes and ears. This is because of the sense organs in our muscles and joint structures. Ragsdale (10:89) also stated that kinesthetic perception is fundamental, but he said that our responses to objects and persons "... demand vision, hearing and tactual impressions; sensory components are important, but they must be ordered, interpreted, and acted upon."

It takes all of these responses to efficiently perform a motor activity or skill. However, we must still search for the best and most efficient combination of responses.

Measurement of Kinesthesis

To better understand the relationship of kinesthesis to motor performance, the nature of the kinesthetic sense, and the diversity of the factors of kinesthesis, it is important to understand how it can be measured.

Physical educators have been studying ways to accurately measure kinesthesis for years. The results are varied and not at all complete. Scott (44) said it is extremely hard to find information when there is such a lack of facts. In attempting to establish tests for kinesthesis she concluded that the validity of a single test was not high enough to be used alone as a measure of kinesthesis and that kinesthesis is composed of a series of specific functions.

A factor analysis technique was used by Witte (72), Russell (67), and Wiebe (71) in which they explored the nature of tests designed to measure kinesthesis. They found that kinesthesis could be divided into separate factors that are specific to the tasks involving kinesthesis.

Investigators of kinesthesis, therefore, believe that kinesthesis is a very complex thing, hard to pinpoint and measure, and cannot be thought of as a general trait.

Relationship Between Measures of Kinesthesis and Motor Performance

Through the years an understanding of kinesthesis has been and still is being developed. Researchers are using their different theories of kinesthesis and placing a different emphasis of kinesthetic perception on motor learning.

Because of this, several studies have been concerned with the relationship between kinesthesis and motor skills. (39, 40, 51, 46, 68) Sixty-three freshmen and sophomore male students were given ten tests of kinesthesis, five of which were correlated with two golf skills. A low but positive relationship existed between kinesthesis and successful performance in the early stages of learning two perceptuo-motor skills. Phillips concluded that there seemed to be no basis for the phrase "general kinesthetic sensitivity and control." Phillips also suggested that a battery of tests measuring several aspects of kinesthesis might predict possible success or failure in learning for individuals at the extremes of the distribution. (39)

Kinesthesis was shown again to be more important in early stages of motor skill learning than in later stages by Phillips and Summers. One hundred and fifteen women were tested on 12 positional measures of kinesthesis and the results were correlated with their success or failure in bowling. A positive relationship between motor learning and positional measures of kinesthesis was found. (40)

Witte in studying the relationship between selected measures of kinesthesis involving arm positioning and accuracy in ball rolling, found no significant relationship in first and second graders. (51) One of the more recent studies by Start (46) investigated the relationship between a measure of kinesthesis and performance of a gross bodily skill after a period of mental practice. Twenty-one male college students practiced a single leg upstart after mental practice. These scores were correlated with scores from the Wiebe Test of Kinesthesis. No significant relationship was found.

Sisley (68) compared the relationship between kinesthesis and the skill level of three groups of subjects selected on the basis of their ability in basketball, bowling, and tennis. She also compared the difference of the three groups on their measures of kinesthetic sensitivity. Sisley found that no group scored significantly higher on the kinesthesis battery, and there was no relationship between kinesthesis and skill level in basketball, bowling, or tennis.

Stevens (69), Young (52), and Roloff (42) all working with women studied the relationship between measures of kinesthesis and general motor ability. Stevens' investigation was one of the more recent attempts to control measures of kinesthesis scientifically. Her purpose was threefold: To determine if (1) there were good tests and measurements which differentiate among individuals in terms of their kinesthetic sensitivity; (2) individuals who were trained in motor movements showed a more highly developed kinesthesis than those who were untrained; and (3) highly skilled performers showed a higher development of kinesthesis than the less skilled when all had comparatively the same amount of motor training. Thirty-six tests were selected from a survey of all kinesthesis tests, and all subjects were blindfolded. The conclusions were that individuals who are trained in motor movements or who have had more motor experience show a more highly developed kinesthetic sense. Also when motor training is held constant, more highly skilled performers measured by the Scott Motor Ability Tests do not show a more highly developed kinesthetic sense. (69)

Thirty-seven college women were given 19 tests of kinesthesis to study the relationship of kinesthesis to selected movements used in gymnastics and sports activities, and to find the relationship of kinesthesis to general motor ability. Young found that only two tests correlated well enough with general motor ability as measured by the Scott Motor Ability Test. There was no relationship between arm positioning tests and accuracy of throwing. Young stated that she did not achieve the desired results, and more work was needed. (52)

Roloff continued to develop a battery of tests measuring kinesthesis and to investigate the relationship between kinesthesis and the learning rate of college women in certain motor skills. Eight tests of kinesthesis were given to 200 subjects enrolled in four skill clinic classes and four bowling classes. The results showed a positive relationship between the Scott Motor Ability Test and the kinesthetic tests given. (42)

Wiebe (49) studied twenty-one tests of kinesthesis which were administered to fifteen college varsity men, and fifteen college men who had never lettered in high school or college varsity sports. In investigating the relationship between the tests and athletic ability, Wiebe found varsity men superior to non-varsity men in kinesthetic sensitivity.

Clapper, in studying junior and senior high girls, measured selected kinesthetic responses and found that the measurement of kinesthesis was possible at this level with approximately the same degree of validity and consistency as at the college level. Other findings indicated that the relationship between intelligence and kinesthesis was inconclusive, and needs further study. After teachers had rated pupils on their ease and speed of motor learning, it was found that there was not a significant relationship between a battery of kinesthetic tests and the ease and speed of motor learning. (53)

Two female groups ranging from 12 to 14 years old were given a pre-test and a post-test for kinesthetic sense of the limbs. Cosgrove studied the effects of a free exercise course upon the kinesthetic sense of the limbs, and found that there was no significant relationship between kinesthetic sense of the limbs and free exercise ability. (57)

Studies Emphasizing Visual and Kinesthetic Cues in Motor Performance

Many researchers have admitted that the presence of kinesthetic sense is one of the factors contributing to the ability of an individual to learn a motor pattern. The following studies are concerned with the effects of vision (with and without blindfolds), manual guidance, and emphasizing the awareness of the feel of a good motor pattern on motor response.

Motor learning with and without vision was studied by Melcher. (33) She compared three groups of 15 children, 35 to 57 months. In each group, something different was stressed: visual guidance, manual and visual guidance, and manual guidance. She found that manual guidance without vision was the least effective, and that the stimuli initiated by the visual process alone can produce appropriate motor response in children as young as three years old.

Another study, where vision information was an important factor, was done by Morford. He hypothesized that by adding nonkinesthetic [sic] information to available kinesthetic information during practice, kinesthetic learning will improve. The apparatus built tested ninety male college subjects' ability to respond to continuously changing force that was applied through a spring and lever system to the flexed arm by way of the hand. The subjects were divided into three groups: one group practiced the task through trials guided by kinesthetic information only; the second group practiced using kinesthetic information, then used supplemental restricted visual information; the third received a greater amount of visual information. No appreciable learning occurred under the kinesthetic conditions. The author concluded by saying,

> Pure kinesthetic learning, however, must exclude all crucial nonkinesthetic information. There is certainly a difference between kinesthetic learning and learning with kinesthetic involvements. (37:394)

Methods of teaching awareness of kinesthesis have been emphasized by the use of blindfolds or just with the eyes closed. Ragsdale (10:88) said that a greater dependence on kinesthetic cues comes from practice where the subject is blindfolded, and that manual guidance often helps to develop his kinesthetic perception of the act.

Griffith (27) was one of the first to use blindfolds to determine the importance of kinesthetic sense in developing skill in driving a golf ball. He chose twelve subjects who had never before played golf, and divided them into two equal groups. In the beginning of the experiment both groups were given regular golf instruction, then the control group (group I) practiced while using normal form. The experimental group

(group II) practiced the first four weeks wearing blindfolds. Both groups hit ten shots a day, five days a week, for six weeks. He found that at the end of the six weeks, group II was scoring slightly higher than group I. Even though group II started out slower, they caught up and surpassed group I. The opposite results were found in a recent golf study done by Rollo. (66) The procedure was similar to Griffith's study of twenty years before. She compared two methods of teaching selected golf strokes. One group was blindfolded and each subject had a partner from a control group who lined up the shots and told her the results. She found the use of a blindfold emphasizing kinesthetic perception produced no great change or differences in learning.

An investigation of the methods of teaching basketball skills revealed that the accuracy of the free throw while using eyes was not increased by blindfold practice. The results were explained by saying that although children begin with a dominance of kinesthesis over the sensory organs, they slowly shift to visual dominance and substitute eye movements for kinesthesis at puberty. (64)

Cratty (18) studied and compared the performance and learning rates of a fine motor task and of a gross motor task while holding constant the sensory cues. Sixty male college students were given twelve blindfolded trials to learn two mazes; both mazes were identical except one was thirty times longer than the other. The performance was based on the traversal time. He found that the learning rates were similar, and there was no significant correlation between traversal times of the two tasks.

Coady (54) and Roloff (42) studied the effect of skills when the feel of the movement was emphasized. Coady used 38 freshman non-physical education major women. They were divided into two groups: a control and experimental. The teaching method of golf was similar for both except the experimental group was told to try to understand kinesthesis. They were to close their eyes, swing, and depend on the feel rather than visual aid. Throughout the experiment, the awareness of how the correct movement feels was emphasized, so they could repeat the pattern. However, she found that the golf skills were not significantly improved when the awareness of the technique was emphasized. Roloff also found no statistical evidence that the experimental method of teaching was better than the one used in the control group. The experimental groups had more frequent demonstrations, visual aids, and drills with the eyes closed. The feel of the movement was stressed while they were watching demonstration and films. She concluded that there needs to be further study on the refinement of specific methods of teaching.

An earlier study involved finding out if kinesthetic perception of bodily movement could be developed and improved by practice. High school boys practiced the upstart on the parallel bars with no corrections. The average number of misses the first day was 100, and at the end of fifteen days, only 60 misses. Therefore, it was concluded that kinesthetic sense could be developed and improved. (14)

Every person has a kinesthetic sense. However, the awareness of this sense depends on the individual. The activity taught, the method of instruction, the age of learner, and the learner's past experience are all variables in the total picture of the development of kinesthesis.

Although researchers have not had significant success in proving that the awareness of kinesthesis can be developed to insure more efficient movement, each new piece of research brings us closer in understanding the intricate makeup of kinesthesis.

MECHANICAL PRINCIPLES

Importance of Mechanical Principles

Mechanical principles are laws of physics as applied to human motion. Cureton (19:23) said that the teaching of physical education is dependent for the most part on the natural physical laws. An understanding of these mechanics creates a deep appreciation of the body movements, its efficiency, and its details.

Many researchers are in agreement that the physical education teacher and coach should know and apply mechanical principles (4,8,9,11, 13,64) to produce more efficient movement. However, few have commented on the importance of the performer knowing the mechanical principles. McCloy commented that students make slow progress in the learning of the correct techniques of motor skills, and the reason usually being the students do not understand what they are supposed to learn. They often are learning the skill incorrectly because they think it is the correct way. A good way to make sure students have the correct objectives is to teach so the mechanics of each type of skill are clear not only to the teacher but also to the student. (8:55) Dyson stated that the performer is best left unaware of these specific facts and that he need only sufficient detail to correct his faults, satisfy his curiosity, and inspire confidence. (5:9) He adds, however, that with physical educators and coaches, a knowledge of mechanics can provide "...an essential tool with which to distinguish between important and unimportant, correct and incorrect, cause and effect, possible and impossible." With this knowledge, the teachers and coaches can observe and conclude much more than otherwise from athletic performance and help toward a better understanding of other subjects. (23:30)

Helping to build this knowledge in physical educators, studies have been conducted involving the analysis and application of mechanical principles. Heidloff, in 1938, selected and explained the fundamental elements of physics which operate in the successful performance of acrobatic stunts. He also used fundamentals of physics and made direct application to the four stunts selected: forward handspring, back handspring, forward tuck somersault, and back tuck somersault, in an effort to learn why these stunts could be successfully performed. (62) Gustafson, in 1955, analyzed 36 competitive gymnastics that are performed on the horizontal bar, 23 on the parallel bars, 12 on the side horse, 9 on the still rings, and 12 on the swinging rings, according to principles of mechanics. He used motion pictures in his analysis. (61) Doss, in attempting to give an over-all picture of mechanical principles, constructed a manual of illustrations, pointing out application of given principles in physics to certain aspects of physical education. (58)

Effect of Knowledge of Mechanical Principles on Motor Performance

Graves (60) and Dusenberry (22) investigated the effect of knowledge of mechanical principles on the overhand throw of elementary school children. Graves used 624 boys: one-third sixth graders, one-third fourth graders, and one-third second graders. The subjects at each grade level were divided into four groups for different treatments: control group one received only the final test on the ball throw for distance; control group two received an initial and final test on the ball throw for distance; experimental group one received only instruction concerning three mechanical principles and the final test; and experimental group two received the initial test followed by the instruction and then the final throwing test. The mechanical principles used were projection, acceleration, and footforce. He concluded that the second and sixth graders performance improved significantly following instruction and demonstrations concerning the projectile principle, and all other findings were not significant.

Dusenberry investigated the learning in ball throwing for distance due to training on how to throw. She used principles in weight shift, body rotation, ball release, throwing pattern, and the leading foot. Body parts were placed in the position for the younger subjects, and corrections were made about the poor throws. She found that the older children profited more by the training in throwing than the younger children. (22)

Mechanical principles were also used while teaching swimming, badminton, tennis, archery, and gymnastic stunts, to discover what difference, if any, they would produce. Mohr and Barrett (36) exposed students to mechanical principles in the front crawl, back crawl, side and elementary back strokes. Thirty-four college women in two intermediate swimming classes were used. For the experimental group, stress was placed on the application of mechanical principles during class explanations and demonstrations. Mimeographed material referring to their list of mechanical principles was also given to this group. Due to the differences between the pre- and post-tests of form ratings and objective tests, Mohr and Barrett concluded that the group exposed to the understanding and application of mechanical principles greatly improved over the group with no exposure to these principles.

Mikesell placed emphasis on the understanding of mechanical principles and their application to each phase of instruction. The principles were written on the blackboard and given orally during skill analysis, demonstration, and skill correction. It was concluded that the mechanical principle approach in badminton did not affect the learning achievement. She recommended a larger sample, different skilled individuals, different ages, and application to other sports. (65)

Cobane, using 64 freshmen and sophomore college women enrolled in four beginning tennis classes, introduced the understanding of selected principles of human movement. She wanted to find the difference between two groups in respect to their motor skill, knowledge, and understanding of these principles. One group was taught by the traditional method, and the other the same with the added factor of mechanical principles as applied to force and accuracy in a tennis stroke. There was no significant difference shown in the acquisition of motor skill between the two groups. However, the group exposed to the mechanical principles was superior in the acquisition of knowledge and understanding, as measured by a written examination. (55)

In learning archery skills, Davies used two groups: an experimental group that received instruction preceding the first shooting, and a control group that received no instruction. She concluded that the experimental group started at a higher level and also improved more rapidly than the control group. (21)

Testing the hypothesis that there is a faster rate in learning achievement when a group is taught the effect of the laws of motion on gymnastic stunts, Zuber (73) used eight stunts. The eight stunts were chosen out of the 60 taught because these stunts depended on the control of body forces in motion and precise timing rather than strength. The experimental group learned six of the eight stunts faster than the control group and it appeared that the learning rate of students who were taught by laws of motion increased as the student gained more background in the mechanics.

The following studies were done using mechanical principles as applied to dart throwing, jig saw puzzles, and mechanical puzzles. In the first situation, Judd used two groups. They practiced throwing darts at a target 12" underwater. One group was given mechanical principles on the laws of refraction. There was no difference between the learning of the two groups until the target was moved 4" underwater. Then the group with the knowledge of principles of refraction showed a significant improvement.(32) Hildreth (30) found that young children solved jig saw puzzles more efficiently following a study of the picture and discussion about it. Ruger (43) found that subjects having an understanding of principles involved in solving mechanical puzzles had greater success in solving different puzzles later than those without such understanding.

A variety of results was found in determining the effect of mechanical principles on a combination of skills. Colville (17) investigated certain questions related to the teaching of physical education activities in which specific principles of mechanics are involved. She selected three principles of mechanics which were pertinent to motor skill, and three motor skills which utilized one of the principles. One group was taught without reference to the principle involved and the other spent time practicing the skill and learning the principle. Colville found that instruction in mechanical principles did not facilitate the learning of the skill to a greater extent than no instruction. A significant amount of learning took place under both methods of instruction.

Broer, prior to instruction in volleyball, basketball, and softball, emphasized problem solving and understanding mechanics. The experimental group and control group were equated by the Scott Motor Ability Test, the modified Humiston Motor Ability Test, and intelligence scores. The experimental group was given one-third as much instruction in volleyball, two-thirds as much in basketball, and the same amount in softball. The experimental group surpassed the control group in all skill tests given at the end of each unit; therefore, Broer concluded that the understanding of mechanical principles can lead to more efficient learning of specific activities. (15)

In showing the effects of applying mechanical principles to the skill performance and strength development, Daugherty used 497 junior high boys. The skills tested were football, fifty yard dash, eight pound shot put, standing broad jump, and the under-basket shot. One group followed a mechanical principle program, and the other group followed the regular experience in curriculum procedure. After three months, the group that followed the mechanical principle program showed significant improvement in skill performances and strength over the other group. (20)

Research indicates that the results obtained through the learner's knowledge of mechanical principles depends upon the activity or task to be performed, and the age and sex of the learner. Although the results are conflicting, the majority of researchers agree that learning with the knowledge of mechanical principles is as effective as learning without this knowledge.

THROWING

When teaching any skill, both speed and accuracy must be considered. The problem that is faced is how much emphasis should be placed on accuracy or speed, or the combination of accuracy and speed.

Speed Versus Accuracy

When teaching a motor skill such as the overhand throw, teachers are faced with the problem of the initial speed-accuracy emphasis that should be placed on the throw. It is the belief of some instructors that speed should be emphasized early, while others contend that throwing speed is incidental without proper direction. The latter, therefore, favor an early accuracy set. There are still other instructors who place equal emphasis on speed and accuracy. (70)

An early law of practice concerning speed and accuracy was started by Poppelreuter (41) and followed by many. (29,38,48) This law stated that to achieve the best results in motor learning, speed should be held back until a reasonable level of accuracy has been met, after which speed is increased.

Later studies by Fulton (25,26) stated that an early emphasis should be placed on speed. The reason for this was that when speed was attained under the emphasis placed on it, speed transferred to a learning period where both speed and accuracy were considered important. Accuracy, on the other hand, did not develop under the same conditions to any sizeable degree.

Ragsdale (10:86) summarized that the recommendation that accuracy or form should be set first and then let speed increase gradually with practice is questionable. He added that fast motion is unlike slow motion in neurophysiological pattern and in form. Therefore, the learner who practices slowly cannot use the same form when he becomes an advanced fast performer.

Solley (45) questioned the past attempts to determine the effect of emphasizing speed, accuracy, or speed and accuracy equally upon the learning of a motor skill. His conclusions pointed out that the group in which accuracy was emphasized gained in accuracy and lost in speed, and the group which received emphasis on speed gained speed and lost in accuracy. However, the group that received equal emphasis on speed and accuracy maintained their accuracy and gained in speed.

Straub (70) studied 108 males, fourteen to nineteen years old, to determine the effect of warm-up drills on the accuracy of the overarm throw and to determine the effect of 6 weeks overload training on the accuracy of the overarm throw. The subjects were selected randomly and placed into two groups: a short-range phase, and a long-range phase. Sixty subjects participated in the short-range phase consisting of 12 days, and were examined to see the immediate effect of the systematic overload. The long-range phase took 36 days and included 48 subjects who were trained on the effect of varied speed-accuracy emphasis. Systematic overloading procedures were used as stimulus variables. The subjects in each phase were ranked on the basis of their throwing speed (fastest to slowest), and each throw was scored for accuracy. He concluded that: there was no differential effect of the overload warm-up upon speed and accuracy of the high or low velocity throwers; and the subjects who trained under progressive overload with equal emphasis on speed and accuracy were able to achieve higher mean accuracy scores than subjects under different emphases.

A study investigating the effect of various degrees of speed and accuracy feedback upon the throwing performance of 55 high school males was conducted by Malina. (63) He came to four conclusions: 1) providing both speed and accuracy feedback information concurrently resulted in improvement in both speed and accuracy; 2) providing accuracy information with speed information held back resulted in improvement in accuracy and a decrement in throwing speed; 3) emphasizing speed and not accuracy increased speed and not throwing accuracy; 4) withholding both speed and accuracy information feedback resulted in a reduction of throwing accuracy with no improvement in the throwing speed.

It seems necessary to conclude that equal emphasis should be placed on speed and accuracy in those tasks in which both are desirable.

Studies on the Overhand Throw

Browne (16) and Collins (56) took motion pictures of the overhand throw. Browne used 42 high school girls and concluded that there seems to be some extension of the arm at the elbow joint in the better throwers. However, members of the low velocity group held their forearm more nearly at right angles to the upper arm at moment of release. Collins described and compared certain aspects of body mechanics in the overhand and side arm throw. One male and one female graduate student, who were highly skilled in throwing, were photographed from the front and back during a throw. She concluded that the velocity of the overarm throw is greater than the side arm, and that the velocity of the ball is attributed to the action of the arms, hip, spine, shoulders, and wrist. (56)

The motion picture method was used also by Wild. (50) She studied the overhand throwing pattern of 32 right-handed boys and girls. A boy and a girl were picked at each six-months age level from 2-7 years and a boy and a girl at each year level from 7-12 years of age. The analysis of the motion picture method was used in three ways: 1) it showed the distances of the throw; 2) it facilitated the translation of the visual representation of the throw into verbal description; and 3) it traced the positions of the body, arm, and hand at various stages of the throw. She concluded that a common feature of the hard overhand throw is the release which starts the ball on a nearly horizontal path. This happened at all age levels, but is more established in the older children and stands out more in the older boys. Wild also concluded that maturity is a factor in the development of a throwing pattern and learning after 6 years old influences the skill pattern.

Miller (35) investigated to see if the performance of first grade children could be improved by instruction in the motor skill of throwing beyond the effects produced by maturation and general practice. The subjects were divided into an experimental and a control group. The experimental group was divided into two groups: 21 boys and 18 girls who received instruction in the overhand throw for accuracy for a total of twenty-six 20-minute periods. Two groups consisting of 15 boys and 23 girls made up the control group. They received twenty-six 20-minute periods of play that consisted of throwing a ball without instruction in throwing skills. She concluded that instruction of the overhand throw for accuracy did not improve the skill of the child over and above what was expected to occur by practice without instruction. However, the group that received instruction improved over the group that did not.

Few researchers have explored a scientific approach to throwing. Although evidence is lacking in quantity and quality, various methods have been used to obtain the existing results. The motion picture, overload training and warm up exercises, and instruction versus no instruction constituted the majority of approaches. Researchers seemed to have only worked with two age brackets: elementary school children, and high school children. No studies in throwing were found dealing with the junior high school child.

CHAPTER IV

PROCEDURES

PILOT STUDY

The pilot study was conducted before the actual study to test several factors: to see if the directions of the test were clear; to see how long it would take to administer the test; to see if the instructions of the mechanical principles and kinesthetic cues given were clear; and to see how long it would take to teach mechanical principles, kinesthetic cues, and to have the subjects practice five throws at the target.

Selection of the Throwing Test

The Overhand Throw for Accuracy test used in this study was selected from the Sports Skills Test of the American Association of Health, Physical Education, and Recreation. (2:20) This test was selected because it was a validated and accepted test which could be given to junior high students. A description of the test can be found in Appendix C.

Selection of Subjects

Thirty-three girls from one seventh grade physical education class from Mendenhall Junior High School, Greensboro, North Carolina, were subjects for the pilot study. A seventh grade class was selected because it was felt that if a seventh grade class could understand and apply mechanical principles and kinesthetic cues, then probably an eighth grade class could do the same.

Testing Procedure

The Overhand Throw for Accuracy test was given to all thirty-three subjects in their physical education class during the first week of the spring semester, 1968. The directions of the throwing test were explained, and the girls were divided into two groups, one group for each of the two targets. After two practice throws, each subject had 10 trials. The 10 throws were recorded by the writer at one target, and by the subjects' teacher at the other target. A member of the class stood to the side of each target and called the number of the area hit with each ball thrown. The score was the sum of the ten hits.

Method of Instruction

The total scores ranged from 0 to 16. Ten subjects who had either low, average, or high scores were chosen. The next day these subjects were taken into the hall adjacent to the gymnasium and were given two mechanical principles pertaining to the overhand throw:

1. The wider the base of support, the more stable the body.
2. The base should be enlarged in the direction of the moving force.

The two principles were written on a piece of paper and attached to the wall in front of the subjects. After explaining and demonstrating the principles, the subjects were taken onto the stage where they threw five softballs at the target. They were encouraged to apply what they had just learned. The third day the same subjects were taken into the hall where they reviewed the first and second principles given the previous day. They were then given a third mechanical principle:

3. The distance that a projectile (ball) travels depends upon its initial speed and the angle at which it is projected (thrown).

In addition to the new mechanical principle, they were given one kinesthetic cue.

1. Each subjects' elbow was placed at a position away from her body, so that the humerus was parallel to the floor, and the hand was near her ear. She put her arm down, closed her eyes, and tried to repeat this position twice. The feeling and awareness of this position was stressed. The subjects then threw five softballs at the target, again trying to apply what they had previously learned.

The pilot study continued two more days, following the same outline as above, and the following mechanical principles and kinesthetic cues were added to the ones previously mentioned.

Mechanical Principles:

4. If one body part moves away from the line of gravity in one direction, the center of gravity shifts in that direction.
5. The speed of the rotation of the body and arm is transferred to the motion of the ball.

Kinesthetic Cues:

2. Each subject held onto a tennis ball attached to a 6' rope with another tennis ball on the other end of the rope. The balls were attached by puncturing a small hole in each ball and then pushing the knotted end of the rope through the hole. The rope was stretched out behind the person, and she threw it after being told to throw as if she had a soft-

ball in her hand. She was told to hold onto one ball when throwing. If the overhand throw was correct, the rope and the ball on the end flew forward over the subject's head. If thrown incorrectly (elbow close to the body and the ball is pushed), the rope folded up behind her or went under her throwing arm. After the subject seemed to have the correct throwing pattern, she closed her eyes and threw the rope three times. This was done to aid in developing a correct kinesthetic feeling of the throw. See Appendix C for a diagram of the rope and tennis balls.

3. After being assured the subject's arm was relaxed by feeling for tension in the arm, the writer stood behind her and moved the subject's arm through the movement pattern with the elbow out from the body. This was repeated twice and the writer stressed that each subject should remember what this felt like when she threw a ball at the target. The subject then threw three times with her eyes closed, without the ball, trying to repeat the correct feeling and pattern.

Only five of the seven mechanical principles and three of the four kinesthetic cues were used in the pilot study because of the time factor.

At the end of the pilot study, the following conclusions were drawn:

1. The seventh graders seemed to understand the directions of the test and the mechanical principles.

2. The kinesthetic feeling of the correct pattern or position needed to be stressed more, and more time should be spent on this kinesthetic awareness. It was felt that this was due to the newness and strangeness of the kinesthetic approach.

3. The time spent for instruction and practice did not exceed the time allotted.

CONDUCT OF EXPERIMENT

It was the purpose of this study to determine the effects of five different approaches in teaching the overhand throw for accuracy. The five approaches were taught through: mechanical principles and kinesthetic cues; mechanical principles; kinesthetic cues; practice; and no practice.

Selection of Test

The Overhand Throw for Accuracy test used for the actual study was the same test used in the pilot study. This test was given as a pre-test, midway test, and a post-test.

Selection of Subjects

Two physical education classes consisting of fifty-two eighth grade girls from Mendenhall Junior High School in Greensboro, North Carolina, were selected for this study. Two subjects could not be used in the study because of health reasons. The two classes of fifty subjects met every day from 9:35 to 10:25. The amount of time for activity was approximately thirty-five minutes due to the time needed for changing clothes.

Administration of Pre-Test

Three targets were set up for the pre-test, one on the stage wall and two on the walls of the gymnasium. At the beginning of class the subjects were told that they had been chosen to participate in a study and that the pre-test was to test the accuracy of their overhand throw.

All directions were given by the writer and the subjects were asked to do the best they could. The two women physical education instructors and the writer were each in charge of one target. The above persons positioned themselves at the throwing line and recorded the score of each throw as it was given by a class member designated for this purpose. The subjects were divided into three groups, one group at each target. Standing with both feet behind the 40' throwing line, the subjects threw two overhand practice throws, then 10 throws that were scored. The score for each subject was the total sum of the ten throws. A sample of a score card is in Appendix C. Each group had a basket of softballs, and two girls to retrieve the balls. Two girls who were absent the day of the pre-test were tested the next day.

<u>Grouping of Subjects</u>

The fifty subjects were divided into five groups of ten each. The groups were equated as nearly as possible on the pre-test scores and Intelligence Quotient scores. By randomly putting subjects who had low, average, and high total scores on the throwing test in each group, the scores were similar. See Table I. The Intelligence Quotient scores were obtained for each individual to help equate the groups because of the importance of understanding the mechanical principles. The total Intelligence Quotient scores were very close among the five groups. See Table I.

The five groups were then arbitrarily assigned a number: Group I was called the mechanical principles and kinesthetic cues group; Group II the kinesthetic cue group; Group III the mechanical principles group; Group IV the practice group; and Group V the non-practice group.

TABLE I

TOTAL PRE-TEST AND INTELLIGENCE QUOTIENT SCORES
FOR THE FIVE GROUPS

	GROUPS				
	I	II	III	IV	V
Total Pre-Test Scores	78	78	81	81	78
Total Intelligence Quotient Scores	1163	1165	1164	1160	1167

Experimental Conditions

The study lasted five weeks. Four weeks were used for instruction and one week for the three tests.

The following mechanical principles were taught to Groups I and III. (3,4,11)

1. The wider the base of support, the more stable the body.
2. The base should be enlarged in the direction of the moving force.
3. If one body part moves away from the line of gravity in one direction, the center of gravity shifts in that direction.
4. The distance that a projectile (ball) travels depends upon its initial speed and the angle at which it is projected (thrown).
5. The speed of the rotation of the body and arm is transferred into the motion of the ball.
6. Force is the effect which one body exerts on another.
7. Sequential extension of the joints of the arm when throwing adds force.

The following kinesthetic cues were given to Groups I and II. (3)

1. The subject's elbow was placed at a position away from her body so that her humerus was parallel to the floor, and her hand was near her ear. She put her arm down, closed her eyes, and tried to repeat this position twice. The feeling and awareness of this correct position was stressed.

2. Each subject held onto a tennis ball attached to a 6' rope with another tennis ball on the other end of the rope. The balls were attached by puncturing a small hole in each ball and then pushing the knotted end of the rope through the hole. The rope was stretched out behind the person, and she threw it after being told to throw as if she had a softball in her hand. She was told to hold onto one ball when throwing. If the overhand throw was correct, the rope and the ball on the end flew forward over the subject's head. If thrown incorrectly (elbow close to the body and the ball is pushed), the rope folded up behind her or went under her throwing arm. After the subject seemed to have the correct throwing pattern, she closed her eyes and threw the rope three times. This was done to try to develop a correct kinesthetic feeling of the throw. See the appendix for a picture of the rope and tennis balls.
3. After being assured the subject's arm was relaxed, the writer stood behind her and moved the subject's arm through the movement pattern with the elbow out from the body. This was repeated twice and the writer stressed that each subject should remember what this felt like when she threw a ball at the target. The subject then threw three times with her eyes closed, without the ball, trying to repeat the correct feeling and pattern.

4. After watching each subject throw two balls, the subject's arm was placed at the correct angle of release according to her force behind the ball. This was decided by the writer. The subject held her arm at that position, put it down and repeated it two times with her eyes closed, trying to feel that position.

Group IV was called the practice group. They were given coaching cues having no direct reference to mechanical principles or kinesthesis. Cues such as throw higher, harder, more to the right were given.

Group V had no instruction or practice during the four weeks.

Method of Instruction

Groups I and IV met every Monday and Wednesday; Groups II and III met every Tuesday and Thursday; and Group V met only for the three tests. Each day two groups met on the stage with the curtains closed to control the majority of the noise in the gymnasium. After roll was taken, one group sat on the edge of the stage facing the gymnasium with the curtains closed behind them, while the other group received instruction and threw five practice throws. This was done to prevent one group from gaining any additional information that was being given another group. The two groups alternated days as to which group started first. Each group had approximately 15 minutes per day.

The mechanical principles and kinesthetic cues were progressively taught. One or two new mechanical principles were added each time following a brief review of the previously taught mechanical principles. One new kinesthetic cue was added each time following a brief review of the previously taught kinesthetic cues.

On the first day of instruction, Group I was given two mechanical principles pertaining to the overhand throw. The writer read those from a paper attached to the wall, explained and demonstrated these principles. The subjects were then given one kinesthetic cue, emphasizing the feeling of the correct position of a body part during the overhand throw. Immediately following instruction, they threw five practice balls at the target. Group I left the stage and Group IV threw five practice balls with verbal cues having no relationship to mechanical principles or kinesthesis. Tuesday, Group II was given the same kinesthetic cue as Group I, and Group III was given the same mechanical principles as Group I the previous day. Wednesday, Group IV went first, and the same procedure took place as on Monday. For Group I, the same kinesthetic cue and mechanical principles were reviewed that were given the previous day, then one mechanical principle and one kinesthetic cue were added. Thursday, Group III preceded Group II and were given the same mechanical principles and kinesthetic cues as Group I was given the previous day.

This procedure continued until the end of two weeks, after which a midway test was given to all five groups. The testing procedures were the same as the pre-test. A list of the mechanical principles was distributed to Groups I and III. The final two weeks was an exact duplicate of the first two weeks, culminating with the final throwing test. The lesson plans are in Appendix B.

STATISTICAL TREATMENT

Score sheets showing the ten subjects' scores of each group on each of the three tests were made. The scores of the five groups were statistically treated by the analysis of variance technique to determine the differences among the groups on the pre-test, the midway test, and the post-test, and on their Intelligence Quotient scores. The analysis of variance technique was also used to determine the changes within each group between the pre-, midway, and post-tests.*

Fisher's "t" test of significance for small correlated groups was used when an analysis of variance technique revealed a difference.

*The terms pre-, midway, and post-tests are used interchangeably with tests one, two, and three.

CHAPTER V

ANALYSIS AND INTERPRETATION OF DATA

It was the purpose of this study to determine the effects of five different approaches in teaching the overhand throw for accuracy. The five approaches were through: mechanical principles and kinesthetic cues; mechanical principles; kinesthetic cues; practice; and no practice.

Fifty eighth grade girls from Mendenhall Junior High School, Greensboro, North Carolina, were given the Overhand Throw for Accuracy test (2) for the pre-test. On the basis of the subjects' pre-test scores and Intelligence Quotient scores, the subjects were split into five groups equated as nearly as possible. Group I threw five practice throws following instruction in mechanical principles and kinesthetic cues pertaining to the overhand throw; Group II threw five practice throws following instruction in kinesthetic cues; Group III threw five practice throws following instruction in mechanical principles; Group IV threw five practice throws following cues having no direct relationship to mechanical principles or kinesthesis; and Group V did not practice. Groups I - IV were given instruction and practice twice a week for four weeks, and Group V only met for the tests. The Overhand Throw for Accuracy test was also given for a midway and post-test. The raw scores for all subjects on the three throwing tests are presented in Appendix A.

A series of null hypotheses were formulated and a significance of difference at the five per cent level of confidence was considered an acceptable standard at which to reject the null hypotheses. The null hypotheses are presented here in terms of:

1. differences among the five groups on the pre-test scores
2. differences among the five groups on their Intelligence Quotient scores
3. differences among the five groups on the midway test scores
4. differences among the five groups on the post-test scores
5. differences within each group between the pre-, midway, and post-test scores
6. differences among the groups on changes from test one to test two, and from test one to test three.

<u>Difference Among Groups on Pre-Test Scores</u>

The first null hypothesis was: there is no difference among the total scores of the five groups on the initial throwing test.

An analysis of variance technique was used to determine the statistical difference among the five groups on the pre-test scores. No significant difference was found between the total scores of the five groups. Therefore, the null hypothesis was accepted. The results appear in Table II.

Discussion.--The analysis of variance technique showed that the five groups were statistically equal at the beginning of the experiment in terms of their throwing accuracy. The fact that there was no significant difference among the five groups might have been anticipated since the subjects were divided into as similar groups as possible on the basis of their pre-test scores.

TABLE II

ANALYSIS OF VARIANCE OF THE DIFFERENCE AMONG THE GROUPS ON THE PRE-TEST SCORES

Source	Ss	df	MS	F
Between Groups	1.08	4	.27	.0057
Within Groups	2134.60	45	47.44	
Total	2135.68	49		

An F value of 5.63 was needed for the .05 per cent level of confidence.

Difference Among Groups on Their Intelligence Quotient Scores

The second null hypothesis was: there is no difference among the total Intelligence Quotient scores of the five groups.

An analysis of variance technique was used to determine the statistical difference among the five groups on their Intelligence Quotient scores. No significant difference was found among the total Intelligence Quotient scores of the five groups. Therefore, the null hypothesis was accepted. The results appear in Table III.

Discussion.--Since no significant difference was found, the groups were considered equal in terms of the total Intelligence Quotient scores as was shown by the analysis of variance technique at the beginning of the experiment. It was felt that the total Intelligence Quotient scores of the five groups should be as similar as possible due to the need to apply and understand the mechanical principles presented in class and distributed to the students. Since the groups were equated as nearly as possible on the basis of Intelligence Quotient scores, the fact that the groups were statistically equal in terms of their scores might have been anticipated.

Difference Among Groups on the Midway Test Scores

The third null hypothesis was: there is no difference among the total scores of the five groups on the midway test.

An analysis of variance technique was used to determine the statistical difference among the five groups on the midway test scores. No significant difference was found among the total scores of the five groups. Therefore, the null hypothesis was accepted. The results appear in Table IV, page 46.

TABLE III

ANALYSIS OF VARIANCE OF THE DIFFERENCE AMONG THE INTELLIGENCE QUOTIENT SCORES OF THE GROUPS

Source	Ss	df	MS	F
Between Groups	2.68	4	.67	.0054
Within Groups	5606.10	45	124.50	
Total	5608.78	49		

An F value of 5.63 was needed for the .05 per cent level of confidence.

TABLE IV

ANALYSIS OF VARIANCE OF THE DIFFERENCE AMONG THE GROUPS ON THE MIDWAY TEST SCORES

Source	Ss	df	MS	F
Between Groups	95.2	4	23.80	.59
Within Groups	1822.8	45	40.51	
Total	1918.0	49		

An F value of 5.63 was needed for the .05 per cent level of confidence.

Discussion.--The analysis of variance technique showed that one group did not score significantly higher on the midway test than another. Although the range of total groups throwing scores was from 66 to 106, this difference was not enough to be significant. One reason for this result might be the small number of subjects in each group.

Difference Among Groups on the Post-Test Scores

The fourth null hypothesis was: there is no difference among the total scores of the five groups on the final throwing test.

An analysis of variance technique was used to determine the statistical difference among the five groups on the post-test scores. No significant difference was found among the total scores of the five groups. Therefore, the null hypothesis was accepted. The results appear in Table V.

Discussion.--The analysis of variance again showed that one group did not score significantly above the other on the final throwing test, although the range of scores was from 57 to 115. This indicated that one method of teaching did not prove to be superior to another method in the teaching of throwing overhand, as measured by the final throwing test.

Differences Within Each Group Between the Pre-, Midway, and Post-Test Scores

Group I.--The fifth null hypothesis was: there is no significant difference within Group I between the pre-, midway, and post-test scores.

An analysis of variance of repeated measures technique was used to determine if this group significantly improved their accuracy between the tests. The F value was found to be significant at the one per cent level

TABLE V

ANALYSIS OF VARIANCE OF THE DIFFERENCE AMONG THE GROUPS ON THE POST-TEST SCORES

Source	Ss	df	MS	F
Between Groups	238.52	4	59.63	2.15
Within Groups	1245.90	45	27.69	
Total	1484.42	49		

An F value of 2.58 was needed for the .05 per cent level of confidence.

of confidence. Therefore, the null hypothesis was found untenable. The results appear in Table VI.

Fisher's "t" test of significance between correlated groups was used between tests one and two, one and three, and two and three, to determine where the difference existed.

The "t" between tests one and two was found significant at the five per cent level of confidence, and the "t's" between tests two and three and one and three were found significant at the one per cent level of confidence. This was due to the fact that there was greater improvement between the second and third trials of the test. As was anticipated, the "t" value between tests one and three was greater than between tests one and two or two and three due to the fact that both "t's" were statistically significant.

The results appear in Table VII, page 51.

Group II.--The sixth null hypothesis was: there is no significant difference within Group II between the pre-, midway, and post-test scores.

An analysis of variance of repeated measures technique was used to determine if this group significantly improved their accuracy between the tests. No significant difference was found between the trials. Therefore, the null hypothesis was accepted. The results appear in Table VIII, page 52.

Group III.--The seventh null hypothesis was: there is no significant difference within Group III between the pre-, midway, and post-test scores.

An analysis of variance of repeated measures technique was used to

TABLE VI

ANALYSIS OF VARIANCE OF REPEATED MEASURES WITHIN GROUP I BETWEEN THE PRE-, MIDWAY, AND POST-TEST SCORES

Source	Ss	df	MS	F
Between trials	69.27	2	34.64	10.72*
Between Subjects	1368.02	9	152.00	47.06*
Interaction	58.08	18	3.23	
Total	1495.37	29		

*Significant at the one per cent level of confidence.

TABLE VII

"t" TEST OF SIGNIFICANCE OF DIFFERENCE BETWEEN THE PRE-, MIDWAY, AND POST-TEST SCORES WITHIN GROUP I

Tests	N	D	"t"
1 and 2	10	2.2	2.29**
2 and 3	10	1.5	3.26*
1 and 3	10	3.7	4.21*

*Significant at the one per cent level of confidence.
**Significant at the five per cent level of confidence.

TABLE VIII

ANALYSIS OF VARIANCE OF REPEATED MEASURES WITHIN GROUP II BETWEEN THE PRE-, MIDWAY, AND POST-TEST SCORES

Source	Ss	df	MS	F
Between trials	36.47	2	18.24	1.94
Between Subjects	916.81	9	101.87	10.86*
Interaction	168.89	18	9.38	
Total	1122.17	29		

*Significant at the one per cent level of confidence.

An F value of 3.55 was needed for the .05 per cent level of confidence.

determine if this group significantly improved their accuracy between the tests. Since no significant difference was found between the trials, the null hypothesis was accepted. The results appear in Table IX.

Group IV.--The eighth null hypothesis was: that there is no significant difference within Group IV between the pre-, midway, and post-test scores.

An analysis of variance of repeated measures technique was used to determine if this group significantly improved their accuracy between the tests. No significant difference was found between the trials. Therefore, the null hypothesis was accepted. The results appear in Table X, page 55.

Group V.--The ninth null hypothesis was: There is no significant difference within Group V between the pre-, midway, and post-test scores.

An analysis of variance of repeated measures technique was used to determine if this group significantly improved their accuracy between the tests. No significant difference was found between the trials. Therefore, the hypothesis was accepted. The results appear in Table XI, page 56.

Discussion.--Group I improved at the one per cent level of confidence between tests two and three and tests one and three, and at the five per cent level of confidence between tests one and two. The other four groups did not improve. This evidence might suggest that the combination of mechanical principles and kinesthetic cues taught were more effective than mechanical principles or kinesthetic cues alone, and more effective than practice alone and no practice.

TABLE IX

ANALYSIS OF VARIANCE OF REPEATED MEASURES WITHIN GROUP III BETWEEN THE PRE-, MIDWAY, AND POST-TEST SCORES

Source	Ss	df	MS	F
Between trials	59.27	2	29.64	2.00
Between Subjects	716.27	9	79.58	5.52*
Interaction	259.43	18	14.41	
Total	1034.97	29		

*Significant at the one per cent level of confidence.

An F value of 3.55 was needed for the .05 per cent level of confidence.

TABLE X

ANALYSIS OF VARIANCE OF REPEATED MEASURES WITHIN GROUP IV BETWEEN THE PRE-, MIDWAY, AND POST-TEST SCORES

Source	Ss	df	MS	F
Between trials	1.67	2	.84	.08
Between Subjects	790.02	9	87.78	8.42*
Interaction	187.68	18	10.43	
Total	979.37	29		

*Significant at the one per cent level of confidence.

An F value of 19.41 was needed for the .05 per cent level of confidence.

TABLE XI

ANALYSIS OF VARIANCE OF REPEATED MEASURES WITHIN GROUP V BETWEEN THE PRE-, MIDWAY, AND POST-TEST SCORES

Source	Ss	df	MS	F
Between trials	22.20	2	11.1	1.0
Between Subjects	542.28	9	60.25	5.5*
Interaction	195.82	18	10.87	
Total	760.30	29		

*Significant at the one per cent level of confidence.

An F value of 3.55 was needed for the .05 per cent level of confidence.

Differences Among the Groups on Changes from Test One to Test Two and from Test One to Test Three

The tenth null hypothesis was: there is no difference among the groups on changes from test one to test two and from test one to test three.

The analysis of variance technique was used to determine the statistical difference among the groups on changes from test one to test two and again from test one to test three. No significant difference was found among the changes. Therefore, the null hypothesis was accepted. The results appear in Tables XII and XIII.

Summary of Interpretations

Through analysis of variance, it was found that the five groups were equated at the beginning of the experiment in terms of throwing accuracy and Intelligence Quotient. Therefore, each group started the experiment with equal opportunity to improve the accuracy of the overhand throw.

Group I who received mechanical principles and kinesthetic cues and Group III who received mechanical principles seemed to have similar improvement between their pre-, midway, and post-test scores when looking at each groups' total score. However, in looking at the throwing scores of the individuals within the two groups, the majority of subjects in Group I improved between each test, whereas in Group III a few subjects improved greatly and a few subjects' scores decreased between each throwing test. This steady increase by the majority of the subjects within Group I probably was the reason why the improvement was statistically significant in Group I and not in Group III.

TABLE XII

ANALYSIS OF VARIANCE OF THE DIFFERENCE AMONG THE GROUPS ON CHANGES FROM TEST ONE TO TEST TWO

Source	Ss	df	MS	F
Between Groups	89.08	4	22.27	.94
Within Groups	1068.60	45	23.75	
Total	1157.68	49		

An F value of 5.63 was needed for the .05 per cent level of confidence.

TABLE XIII

ANALYSIS OF VARIANCE OF THE DIFFERENCE AMONG THE GROUPS ON CHANGES FROM TEST ONE TO TEST THREE

Source	Ss	df	MS	F
Between Groups	234.08	4	58.52	2.54
Within Groups	1038.70	45	23.08	
Total	1272.78	49		

An F value of 5.63 was needed for the .05 per cent level of confidence.

Group II was given kinesthetic cues pertaining to the overhand throw. This group did not improve between the three tests. The kinesthetic approach was entirely new to this group of children. They had never had to feel where a body part is in relation to the rest of their body and then to try and remember and repeat this feeling while executing a skill. Therefore, it was felt that the strangeness of this approach might have inhibited their concentration and/or understanding. They also could not relate this method of teaching to anything else at the time since only kinesthetic cues were given, whereas Group I, who received mechanical principles in addition to the kinesthetic cues, could relate one of these to another.

Group IV was the practice group, and was given cues of the overhand throw having no relationship to mechanical principles or kinesthetic cues. These cues, such as throw higher or harder, in the writer's opinion are similar to the cues the majority of physical education teachers give their junior high school students. The subjects' scores between the three tests remained almost the same and appeared to be on a plateau. It was felt that the subjects did not improve because they were not given any new ideas or concepts to apply to their throwing. Also, after eight lessons of hearing the same ideas each time, their motivation could have decreased.

Group V did not increase between either test. In fact, the subjects' scores as a total decreased between each test, although the change was not statistically significant. This decrease could have been due to several things; however, the following two seem more probable.

The group was not allowed to practice at all between tests, thus their skill level was not expected to increase. Motivation was most likely the important factor. The girls could not do what the rest of the class was doing, and they probably felt left out. This group only met three times for the tests so they probably did not care if they improved or not.

In Tables VI, VIII, IX, X, and XI, the analysis of variance shows that the difference between the subjects was significant at the one per cent level of confidence. Since the number in each group was small, and the variability between the subjects in each group was great, this decreased the possibility of a statistically significant F value between the trials of the test.

It must be interpreted that for this age group, who met twice a week for four weeks, practice of the overhand throw following instruction with application of mechanical principles and kinesthetic cues seemed to be the most effective method for improving throwing accuracy. However, when compared to the other groups, statistical evidence to support its superiority as a method was lacking.

CHAPTER VI

SUMMARY AND CONCLUSIONS

A pilot study was conducted to test the procedures for the actual study. Thirty-three 7th grade girls were given the Overhand Throw for Accuracy Test (2) using softballs. Ten of these girls were given mechanical principles and kinesthetic cues to apply to their throw. On the basis of the results obtained, the actual study was undertaken.

It was the purpose of this study to determine the effects of five different approaches in teaching the overhand throw for accuracy. The five approaches were through: mechanical principles and kinesthetic cues; mechanical principles; kinesthetic cues; practice; and no practice.

Two physical education classes consisting of fifty 8th grade girls from Mendenhall Junior High School in Greensboro, North Carolina, were selected as subjects for this study. They were given the same throwing test as was used in the pilot study. This test was used for the pre-, midway, and post-tests. The Intelligence Quotient scores of all fifty subjects were obtained and, using these scores and the pre-test scores, the subjects were divided into five groups that were as nearly equal as possible.

The five groups were divided as follows: Group I, the mechanical principle and kinesthetic cue group; Group II, the kinesthetic cue group; Group III, the mechanical principle group; Group IV, the practice group; and Group V, the non-practice group.

The study lasted five weeks: four weeks for instruction, one week for the three tests. Each group met two times a week for four weeks, except Group V, who met for the three tests only. Groups I and IV met every Monday and Wednesday. Group I was given mechanical principles and kinesthetic cues pertaining to the overhand throw for accuracy, then threw five practice throws. While practicing, Group IV was given coaching cues having no direct reference to mechanical principles or kinesthetic cues. The cues given were cues such as throw harder or higher. Groups II and III met every Tuesday and Thursday. Group II was given the same kinesthetic cues as Group I, and then threw five practice throws. Group III was given the same mechanical principles as Group I, and then threw five practice throws.

This procedure continued until the end of two weeks after which a midway test was given to all five groups. The testing procedures were the same as the pre-test. A list of mechanical principles was distributed to Groups I and III. The final two weeks was an exact duplicate of the first two weeks, culminating with the final throwing test.

The scores of the five groups were statistically treated by the analysis of variance technique to determine the differences among the groups on the pre-test, the midway test, the post-test, and on their Intelligence Quotient scores. The analysis of variance technique was also used to determine the changes within each group between the pre-, midway, and post-tests. The following results were obtained:

1. There was no significant difference among the groups on the pre-test scores.

2. There was no significant difference among the groups on their Intelligence Quotient scores.

3. There was no significant difference among the groups on the midway test scores.

4. There was no significant difference among the groups on the post-test scores.

5. There was a significant difference within the mechanical principle and kinesthetic cue group between the pre-, midway, and post-test scores.

6. There was no significant difference within the kinesthetic cue group between the pre-, midway, and post-test scores.

7. There was no significant difference within the mechanical principle group between the pre-, midway, and post-test scores.

8. There was no significant difference within the practice group between the pre-, midway, and post-test scores.

9. There was no significant difference within the non-practice group between the pre-, midway, and post-test scores.

10. There was no significant difference among the groups on changes from test one to test two and from test one to test three.

From these results the following conclusions have been drawn within the limits of this study:

1. The use of mechanical principles and kinesthetic cues seemed to be more effective for improvement within groups. However, when compared to the other groups, statistical evidence to support its superiority as a method was lacking.

2. The five groups were considered equivalent at the beginning of the experiment in terms of throwing accuracy and Intelligence Quotient scores.

3. Practice without mechanical principles or kinesthetic cues seems to have no effect on the improvement of the scores.

4. The difference between the test scores decreased with no practice. This was not statistically significant; therefore, the difference was due to chance.

Critique of Study

The greatest limiting factor of this study was the number of subjects within each group. It would have been impossible, however, to include more subjects because of the availability of the subjects and the length of the class period.

Certain decisions had to be made in respect to the methods of teaching used. The results of the study reflect the methods chosen and this might have been a limiting factor. A written test was not given at the end of the experiment. Therefore, it had to be assumed that an understanding of the mechanical principles and kinesthetic cues was attained by the students.

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APPENDIX

APPENDIX A

RAW SCORES FOR PRE-TEST AND INTELLIGENCE QUOTIENT SCORES

GROUP I

	Throws											
Subjects	1	2	3	4	5	6	7	8	9	10	Total	IQ
1	0	0	0	1	0	0	2	1	0	0	4	106
2	0	0	0	0	0	0	0	0	0	0	0	118
3	1	2	0	0	0	0	1	0	0	0	4	120
4	1	1	1	0	2	0	2	2	3	0	12	123
5	3	2	3	2	2	1	1	1	2	1	18	126
6	0	2	1	1	3	2	2	0	0	1	12	115
7	0	0	0	0	0	0	0	0	0	0	0	105
8	1	0	0	0	0	0	0	0	0	0	1	120
9	2	0	0	0	0	2	1	1	0	0	6	110
10	2	2	3	3	3	3	2	0	1	2	21	120
											78	1163

GROUP II

Subjects	Throws 1	2	3	4	5	6	7	8	9	10	Total	IQ
1	0	2	2	1	1	2	3	3	2	2	18	110
2	0	0	0	0	0	0	0	0	0	0	0	130
3	0	2	1	2	1	0	2	0	2	3	13	109
4	0	0	0	0	0	0	0	2	2	0	4	103
5	1	0	2	0	0	0	0	2	1	1	7	117
6	3	2	1	1	3	1	2	1	3	2	19	131
7	1	0	0	1	0	1	0	0	1	1	5	106
8	0	0	1	0	0	0	0	0	0	0	1	131
9	0	0	2	2	0	0	2	2	2	0	10	124
10	0	1	0	0	0	0	0	0	0	0	1	104
											78	1165

GROUP III

Subjects	Throws 1	2	3	4	5	6	7	8	9	10	Total	IQ
1	1	0	1	0	3	2	3	1	0	0	11	118
2	0	0	0	1	0	0	0	0	0	0	1	130
3	0	0	1	0	0	1	1	2	1	1	7	112
4	1	3	3	0	2	2	1	3	0	2	17	123
5	0	0	0	1	0	0	3	0	0	0	4	116
6	1	1	0	1	2	3	2	2	0	0	12	105
7	0	0	0	0	0	0	0	0	0	0	0	112
8	0	0	0	0	0	0	0	0	2	0	2	111
9	2	3	3	2	1	2	2	2	2	3	22	119
10	1	1	0	0	2	0	0	0	0	1	5	118
											81	1164

GROUP IV

Subjects	Throws 1	2	3	4	5	6	7	8	9	10	Total	IQ
1	2	0	1	0	0	2	2	0	2	3	12	117
2	0	2	0	0	0	0	0	0	0	0	2	120
3	0	1	1	2	2	3	0	2	1	3	15	93
4	3	2	0	0	1	2	0	0	0	1	9	112
5	0	1	2	3	1	2	0	3	0	2	14	120
6	0	0	0	0	0	0	0	1	0	0	1	126
7	1	2	2	0	2	2	3	2	2	3	19	102
8	0	0	0	0	0	0	0	0	0	0	0	158
9	0	1	0	1	0	2	0	0	0	0	4	107
10	1	2	2	0	0	0	0	0	0	0	5	102
											81	1160

GROUP V

Subjects	Throws 1	2	3	4	5	6	7	8	9	10	Total	IQ
1	0	0	0	0	0	0	0	1	0	0	1	115
2	1	2	0	0	1	2	1	1	0	3	11	136
3	0	0	0	0	0	0	0	0	0	0	0	133
4	0	0	1	0	0	0	0	1	3	0	5	125
5	3	1	0	2	2	2	2	0	2	2	16	96
6	0	3	2	2	1	0	3	1	3	2	17	112
7	1	0	2	0	0	0	3	2	0	2	10	108
8	0	0	2	1	0	3	2	0	1	0	9	117
9	2	0	0	1	0	1	0	0	1	1	6	115
10	1	0	1	0	1	0	0	0	0	0	3	110
											78	1167

RAW SCORES FOR MIDWAY TEST

GROUP I

Subjects	Throws 1	2	3	4	5	6	7	8	9	10	Total
1	2	0	1	1	2	0	1	0	2	1	10
2	0	0	0	0	0	0	0	0	0	0	0
3	0	1	0	1	2	2	1	1	0	0	8
4	2	1	1	1	3	0	2	1	2	0	13
5	3	3	2	1	1	3	3	3	0	1	20
6	0	1	0	1	2	2	2	1	2	1	12
7	0	0	0	0	0	0	0	0	0	0	0
8	1	0	1	1	0	0	0	1	0	0	4
9	3	2	1	1	2	0	2	0	2	1	14
10	3	3	2	2	1	2	2	1	0	3	19
											100

GROUP II

Subjects	Throws 1	2	3	4	5	6	7	8	9	10	Total
1	2	1	2	3	2	1	3	3	3	2	22
2	0	0	0	0	1	1	0	0	0	0	2
3	0	1	0	3	3	1	0	1	1	2	12
4	3	0	0	2	3	0	0	3	2	1	14
5	0	2	0	0	0	0	0	1	1	0	4
6	1	0	1	1	3	1	2	2	0	1	12
7	1	2	1	0	2	2	2	1	2	0	13
8	2	0	0	0	2	1	0	0	0	1	6
9	0	2	0	1	2	0	2	0	0	0	7
10	0	0	0	0	0	0	0	0	0	0	0
											92

GROUP III

Subjects	Throws 1	2	3	4	5	6	7	8	9	10	Total
1	0	2	1	3	2	0	1	0	0	1	10
2	0	0	0	1	0	0	0	0	1	0	2
3	2	2	2	0	1	2	0	1	0	0	10
4	1	1	1	0	0	3	2	2	1	2	13
5	2	2	0	0	0	2	2	0	2	1	11
6	1	3	3	1	1	0	2	0	1	2	14
7	0	0	0	0	0	0	2	3	1	0	6
8	3	2	0	2	2	2	0	3	2	2	18
9	2	0	2	1	3	2	2	3	2	3	20
10	1	0	0	0	0	0	0	0	1	0	2
											106

GROUP IV

Subjects	Throws 1	2	3	4	5	6	7	8	9	10	Total
1	1	3	1	0	0	0	1	0	0	0	6
2	1	0	0	1	0	0	1	0	0	0	3
3	0	2	0	0	2	2	1	2	0	0	9
4	1	0	2	0	1	0	0	3	1	3	11
5	2	2	3	2	2	2	3	2	1	2	21
6	0	0	1	0	0	0	0	0	0	0	1
7	0	2	1	1	3	0	2	1	2	0	12
8	0	0	1	2	0	0	0	0	0	0	3
9	0	2	1	0	0	0	0	2	0	0	5
10	3	1	2	2	0	2	0	1	1	3	15
											86

GROUP V

Subjects	Throws 1	2	3	4	5	6	7	8	9	10	Total
1	0	0	0	0	0	0	0	0	0	0	0
2	2	0	0	1	1	2	0	3	0	0	9
3	0	0	0	0	0	0	0	0	0	0	0
4	2	0	0	1	0	0	0	1	2	0	6
5	1	1	0	3	0	0	1	2	3	2	13
6	3	3	0	0	1	2	2	2	1	0	14
7	0	0	0	0	0	1	0	1	0	0	2
8	0	2	2	2	2	0	0	2	0	0	10
9	3	2	2	0	2	1	1	0	0	1	12
10	0	0	0	0	0	0	0	0	0	0	0
											66

RAW SCORES FOR POST-TEST

GROUP I

Subjects	Throws 1	2	3	4	5	6	7	8	9	10	Total
1	2	1	1	0	1	0	1	1	1	3	11
2	0	0	0	0	0	0	0	0	0	0	0
3	2	1	2	0	0	0	0	2	1	2	10
4	1	0	2	3	1	1	2	3	3	1	17
5	2	2	3	2	1	3	1	2	2	3	21
6	3	2	2	0	2	1	1	0	2	2	15
7	0	0	0	0	0	0	0	0	0	0	0
8	1	0	0	1	1	0	0	0	2	1	6
9	0	3	0	0	0	2	2	1	2	3	13
10	2	3	2	1	1	3	0	3	3	2	20
											115

GROUP II

Subjects	Throws 1	2	3	4	5	6	7	8	9	10	Total
1	1	3	0	3	2	2	1	3	1	3	19
2	0	0	0	0	0	0	0	0	0	2	2
3	1	0	2	2	0	0	0	1	3	2	11
4	0	0	2	2	2	0	1	2	2	0	11
5	1	0	0	1	1	0	0	2	1	1	7
6	2	2	2	1	2	0	1	2	3	1	16
7	1	0	1	2	2	1	2	0	1	1	11
8	1	0	1	0	2	0	2	2	0	1	9
9	2	3	1	1	0	2	0	3	2	1	15
10	0	0	0	1	1	2	0	0	0	0	4
											105

GROUP III

Subjects	Throws 1	2	3	4	5	6	7	8	9	10	Total
1	3	3	1	0	0	1	1	2	0	2	13
2	0	0	2	0	0	1	1	1	3	1	9
3	2	1	0	1	1	0	1	2	0	1	9
4	1	2	0	0	3	1	2	0	0	1	10
5	2	1	2	0	0	2	1	3	0	0	11
6	1	3	0	1	1	1	2	1	1	2	13
7	0	0	0	2	0	0	0	2	3	2	9
8	1	2	1	0	1	1	3	2	3	3	17
9	3	1	1	0	2	3	3	3	0	3	19
10	0	1	0	0	0	1	1	0	0	1	4
											114

GROUP IV

Subjects	Throws 1	2	3	4	5	6	7	8	9	10	Total
1	1	0	0	0	0	0	0	3	1	1	6
2	0	0	0	2	1	0	0	2	0	0	5
3	1	0	0	0	2	0	2	2	0	2	9
4	2	1	2	2	0	1	0	2	0	1	11
5	2	2	2	2	3	2	1	2	1	2	19
6	2	2	0	0	1	1	1	0	0	0	7
7	1	0	2	1	1	1	2	2	1	2	13
8	0	0	0	0	0	0	0	1	0	0	1
9	3	0	0	0	1	0	0	1	0	0	5
10	1	2	0	2	1	1	2	0	1	0	10
											86

GROUP V

Subjects	Throws 1	2	3	4	5	6	7	8	9	10	Total
1	0	0	0	0	0	0	2	0	0	2	4
2	1	1	0	3	2	2	0	0	2	2	13
3	0	0	0	0	0	0	0	0	0	1	1
4	0	0	1	1	1	0	1	0	0	0	4
5	0	2	3	0	1	2	1	0	0	1	10
6	0	1	0	0	0	0	1	0	0	1	3
7	0	0	0	2	0	0	0	0	0	0	2
8	2	0	0	2	0	0	0	2	2	0	8
9	0	2	0	1	0	3	0	1	0	1	8
10	0	0	2	0	0	0	0	1	1	0	4
											57

TOTAL SCORES OF PRE-, MIDWAY, AND POST-TESTS

Subjects	GROUP I			GROUP II			GROUP III			GROUP IV			GROUP V		
	Pre	Midway	Post	Pre	Midway	Post	Pre	Midway	Post	Pre	Midway	Post	Pre	Midway	Post
1	4	10	11	18	22	19	11	10	13	12	6	6	1	0	4
2	0	0	2	0	2	2	1	2	9	2	3	5	11	9	13
3	4	8	10	13	12	11	7	10	9	15	9	9	0	0	1
4	12	13	17	4	14	11	17	13	10	9	11	11	5	6	4
5	18	20	21	7	4	7	4	11	11	14	21	19	16	13	10
6	12	12	15	19	12	16	12	14	13	1	1	7	17	14	3
7	0	0	0	5	13	11	0	6	9	19	12	13	10	2	2
8	1	4	6	1	6	9	2	18	17	0	3	1	9	10	8
9	6	14	13	10	7	15	22	20	19	4	5	5	6	12	8
10	21	19	20	1	0	4	5	2	4	5	15	10	3	0	4
	78	100	115	78	92	105	81	106	114	81	86	86	78	66	57

APPENDIX B

LESSON PLANS

Mechanical Principles were taken from (3) (4) (11)

Kinesthetic Cues were taken from (3)

PRE-TEST - February 19, 1968

Administer to class

LESSON I - Monday, February 26, 1968

Group I: Mechanical principle and kinesthetic cue group

Mechanical principle #1. The larger the base of support, the more stable the body.

Explain and demonstrate by having subjects stand with feet together and then apart (side to side then forward and backward) and have partner push them in various directions. Have them decide which stance is best.

Mechanical principle #2. The base should be enlarged in the direction of the moving or opposing force.

Explain and demonstrate by having subjects stand with feet apart in a side to side stance, and then in a forward and backward stance. Have them go through the motions of throwing a ball in both positions. Have them decide which feels better in terms of balance.

Kinesthetic cue #1. Place each subject's elbow at the correct position away from their body, so that their humerus is parallel to the floor, and their hand is near their ear. Have subjects put their arm down, close their eyes, and repeat the position two times.

Stress the feeling and awareness of this correct position in relation to the rest of the body.

Have each subject throw five practice throws at the target.

Group IV: Practice group

Have each subject throw five softballs at the target. While she is throwing, give certain cues, such as throw harder, higher, more to the right, etc. Be sure not to give any reference to mechanical principles or kinesthetic cues.

LESSON II - Tuesday, February 27, 1968

Group II: Kinesthetic cue group

Same kinesthetic cue as given in Lesson I. Have each subject throw five practice throws at the target.

Group III: Mechanical principle group

Same mechanical principle as given in Lesson I. Have each subject throw five practice throws at the target.

LESSON III - Wednesday, February 28, 1968

Group IV: Practice group

Same procedure as before.

Group I: Mechanical principle and kinesthetic cue group

Review mechanical principles 1 and 2, and kinesthetic cue 1.

Mechanical principle #3. If one body part moves away from the line of gravity in one direction, the center of gravity shifts in that direction.

Explain that if this shift is beyond the base, another body part must move in the opposite direction to bring the center of gravity back over the base or balance will be lost. Apply this fact on the backswing by raising the opposite arm. Explain that we want this loss of balance to occur in the forward motion of the throw. Therefore, the subject will have to step toward the target to regain her balance.

Kinesthetic cue #2. Have each subject hold onto a tennis ball attached to a 6' rope with another tennis ball on the end of the rope. Be sure the rope is stretched out behind the subject; then have her throw it like she has a softball in her hand, but not to let go of the ball. If the throw is correct, the rope and the ball will go forward over her head. If incorrect, (elbow close to body and pushes ball) the rope will fold up behind her or go under her throwing arm. After the subject seems to have the correct throwing pattern, have her close her eyes and throw the rope three times. This is done to develop a correct kinesthetic feeling of the throw.

Have each subject throw five practice throws at the target.

LESSON IV - Thursday, February 29, 1968

<u>Group III</u>: Mechanical principle group

Review mechanical principles 1 and 2, and give #3. Have each subject throw five practice throws at the target.

LESSON V - Monday, March 4, 1968

<u>Group I</u>: Mechanical principle and kinesthetic cue group

Review mechanical principles 1, 2, and 3.

Mechanical principle #4. The distance that a projectile (ball) travels depends upon its initial speed and the angle at which it is projected (thrown).

Explain that the speed of the ball is important, but that the direction of the throw is just as important to them. Have them throw three balls, varying the speed and angle of release, and see which is best.

Correct the individual's angle of release during the five practice throws.

Mechanical principle #5. The speed and the rotation of the body and arm is transferred into the motion of the ball.

Explain and demonstrate how much faster a ball will go when the body and arm rotates when throwing. Therefore, have the subject turn toward the target as she throws.

Kinesthetic cue #3. After assured the subject's arm is relaxed and her eyes are closed, stand behind her and throw her arm in the correct sequence with the elbow out from the body. Repeat two times, and then have the subject go through the motion by herself two times. Stress the feeling of the correct pattern.

Have each subject throw five practice throws at the target.

Group IV: Practice group

Same procedure as before.

LESSON VI - Tuesday, March 5, 1968

Group II: Kinesthetic cue group

Review kinesthetic cues 1 and 2, and give #3.

Have each subject throw five practice throws at the target.

Group III: Mechanical principle group

Review mechanical principles 1, 2, and 3, and give #4 and 5.

Have each subject throw five practice throws at the target.

LESSON VII - Wednesday, March 6, 1968

Group IV: Practice group

Same procedure as before.

Group I: Mechanical principle and kinesthetic cue group

Review mechanical principles 1, 2, 3, 4, and 5.

Mechanical principle #6. Force is the effect which one body exerts on another.

Explain and demonstrate by exerting a little force and a lot of force into a subject. Using a part of my body and then lots of parts. Remind the subjects that in applying this force, one must consider the amount of force to be applied, and the direction of application.

Mechanical principle #7. Sequential extension of the joints of the arm when throwing adds force.

Explain and demonstrate by throwing the ball with the hand coming through first, and then throwing with the elbow leading and hand last.

Kinesthetic cue #4. Place the arm at the correct angle of release for the distance thrown for each individual. This is to be done during her practice throw. Have her close her eyes and repeat the angle twice.

Have each subject throw five practice throws at the target.

LESSON VIII - Thursday, March 7, 1968

Group III: Mechanical principle group

Review mechanical principles 1, 2, 3, 4, 5, and give #6 and 7.

Have each subject throw five practice throws at the target.

<u>Group II</u>: Kinesthetic cue group

Review kinesthetic cues 1, 2, 3, and give #4.

Have each subject throw five practice throws at the target.

MIDWAY TEST - Friday, March 9; Monday, March 11; and Tuesday, March 12

Hand out Mechanical Principles to Groups I and III.

REPEAT LESSONS I THROUGH VIII

POST-TEST - Tuesday, March 26; Wednesday, March 27; and Thursday, March 28.

APPENDIX C

OVERHAND THROW FOR ACCURACY TEST

Equipment

The equipment consists of wall space, oil cloth, paint, and softballs.

Description

The target consists of three concentric circles marked by lines one inch wide painted on oil cloth 8 feet square hung on a wall. The center circle is 2 feet in diameter, the next circle 4 feet in diameter, and the outer circle 6 feet in diameter. The bottom of the outer circle is exactly 3 feet above the floor. The throw is made from behind a line parallel to and 40 feet from the face of the target. After one or two practice throws, the player takes ten throws.

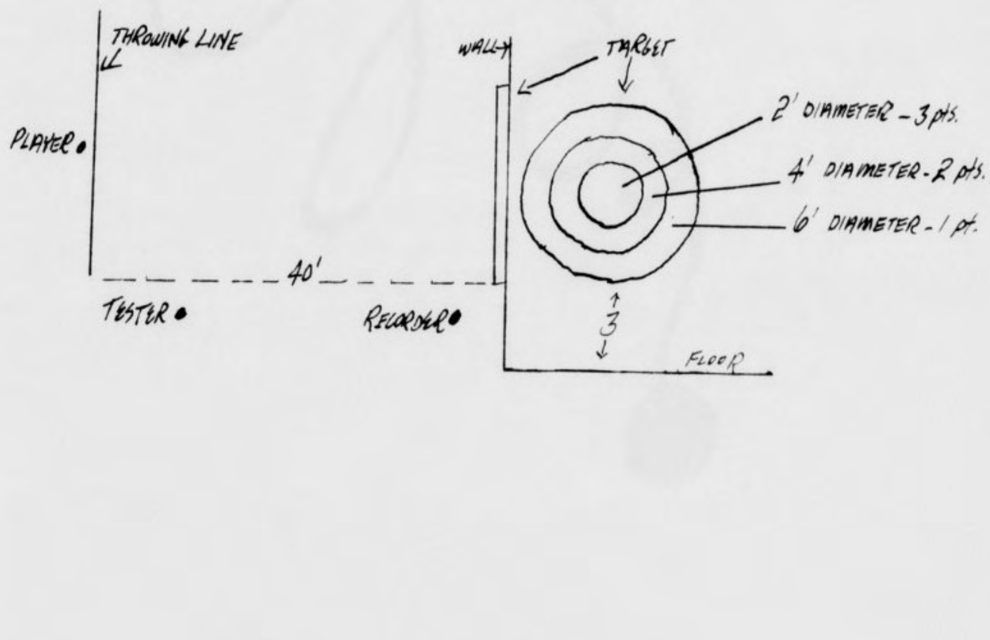
Rules

1. Throws must be made with both feet behind the throwing line.
2. One or two steps can be taken in making the throw.
3. Ten throws are taken.

Scoring

Balls hitting in the center circle count 3 points, balls hitting in the next area count 2 points, and balls hitting in the outer area count 1 point. Balls hitting on a line count as the higher number of points. The score is the sum of points made on ten throws. Record points on each throw as made, and the maximum score is 30 points.

A diagram of the target is on the following page.


THROWING LINE
PLAYER
WALL
TARGET
2' DIAMETER - 3 pts.
4' DIAMETER - 2 pts.
6' DIAMETER - 1 pt.
40'
TESTER
RECORDER
3
FLOOR

KINESTHETIC CUE #2
ROPE AND BALLS

Figure 1.

SAMPLE SCORE CARD

Subject's Name	Throws 1	2	3	4	5	6	7	8	9	10	Total