CHAPTER - II

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Research is like a flow of river, which is always in motion. It invites investigations from time to time in order to keep them in line with the need of the dynamic society.

Review of related literature is a very significant aspect of the research process. It helps researcher by giving him some information about the status of knowledge in the area he/she intends to study. Someone has rightly said that Man is the only animal that does not have to begin a new in every generation but can take advantage of the knowledge, which has accumulated through centuries. The fact is of particular importance in research, which operates as continuous function of ever-closer approximation to the truth.

Review of related literature implies locating, studying and evaluating accumulated and recorded knowledge of the past and drawing maximum benefit from the designs and procedures of previous researches, matching the conclusions drawn earlier and hence adding to the existing store of knowledge.

In approaching the review of literature, an attempt has been made to provide a better understanding of sports skill test concept. Emphasis has been placed on the criteria to be followed and procedures to be used in selecting the test items in addition to test construction techniques. The presentation reveals test construction...
procedures used by the investigators who have previously
developed sports skill tests, identifies test items of sports skill used
in existing tests and establishes a basis for the procedures to be
followed in this study. It was found after reviewing the related
literature in dissertation abstracts international, journals, research
quarterly, completed research and unpublished research work that
a little work has been done to construct skill tests in the game of
handball. Another interesting fact that came to light was that most
of these studies had been done in advanced, developed countries,
and were, therefore, to a large extent limited by the conditions,
both physiological and environmental, that prevail in these
countries.

To have a better understanding of the concept of test
construction, the research scholar had to bank upon the literature
related to test construction of different games. Therefore a number
of sports skill tests of various games have been studied to know the
finer points of true test of sports skills. The investigator referred to
only a few work by Indian sports scientists. This was natural
because there is a lack of extensive work on the subject in India.
Moreover, the few Indian authors have again dealt with physical
fitness generally or referred to a few scientific components in
relation to some sports discipline, without developing
comprehensive skill test battery of handball.

The major sources of review of literature was the A.C. Joshi
Library of Panjab University, Chandigarh, Library of Department of
Physical Education, Panjab University, Chandigarh, library of NS
NIS, Patiala (Punjab) and internet websites.
The studies, which gave a better understanding of the problem under investigation, have been briefly explained in following paragraphs.

Scott and French (1959) suggested following steps in order to construct a standardized test.

1. Study the problem or need for the test.
2. Analyze the ability to be measured.
3. The test in its various forms should be tried out on small groups until one is quite sure that the dimensions, markings, and time allotments are satisfactory and the scoring system feasible.
4. The written test directions should be prepared.
5. Judges' ratings can be a satisfactory criterion if opportunities for observation are adequate and judges are well trained and competent.
6. The subjects used in the development of a new test or battery of tests should be a representative of the population for which the instrument is designed. There is no magical number, which can be given as the one, which will give satisfactory results in all studies.
7. The ideal method of ascertaining the reliability of the separate items (tests) is to administer each in identical form on two successive days and then to correlate the results.
8. The validity of the test is determined by correlating the scores of each subject with his criterion score.
9. The inter-correlation of the experimental tests prunes the test items important for the test battery.

10. The logic for combining tests should be clear. Each test to go into test battery should have a relatively high validity coefficient, but it should have a minimum relationship to the other tests in the battery.

Johnson and Nelson (1986) suggested following eight steps to devise a physical performance test that will adhere to the criteria of validity, reliability, and other basic principles.

1. The first step is to analyze the game or physical qualities in question to determine the skills or factors to be measured. The relative importance of each component must be determined.

2. The second step is to select test items with regard to their importance as well as their propensity to be measured accurately. The test items may be selected from other established tests, may be chosen by a jury of experts, or may be determined arbitrarily after analysis of performance in question. If the test pertains to a sport, the test item should conform as much as possible to the actual game situation and not be taken out of context.

3. The third step is to establish the exact procedures for the administration and scoring of the test.

4. The fourth step is to determine the reliability of each test item.

5. The fifth step is to compute the objectivity of each test item.
This step could be done at the same time that reliability is being assessed.

6. The sixth step is to establish validity, in some activities, such as team sports, the ratings of experts can be used as the criterion to which the performance on a test is correlated.

7. The seventh step is to revise the test in light of the findings of the first six steps and finalize the written instructions for administration and scoring the test.

8. The eighth and last step is to construct norms.

According to Kansal (1996) in a complete process of test construction, the researcher has to keep in mind following general steps:

1) The traits or characteristics to be measured are to be defined both in their philosophical as well as literal meaning.

2) Testing specifications of each trait or test item is to be enlisted with respect to the details of instructions required for its proper administering and scoring.

3) A pilot study on about two hundred subjects selected randomly is to be conducted.

4) Feasibility of administering the test is to be studied.

5) Checking of validity, reliability and objectivity.

6) Study of precision (Accuracy) of the measuring instrument including calibration of the instruments.

7) Construction of norms including the calculation of mean, standard deviation, standard score, and percentile ranks etc.
8) Testing of distribution for normalcy.

9) Decision regarding applicability: If all the steps are favourable i.e. the validity, reliability and objectivity is acceptable as per standards described earlier, the test is fit for use.

Baumgartner et al., (1984) suggested that the tests to be used in a sports skill should be 1. Accuracy tests, involve throwing, striking, or kicking an object toward a target for accuracy. Volleyball free throws, badminton short serves and volleyball serves are common accuracy tests. 2. Wall Volley Tests require the subject to repeatedly stroke, pass, throw or kick an object at a wall over a specified period of time or for a specified number of successful trials with time as the unit of measurement. 3. Tests of total body movement require the subject to run a standardized test course using movement characteristics of the sport. AAHPER (1966) dribble test is an example of this type of tests. 4. Throws, Kicks or Strokes for power and distance tests measure the students ability to throw, kick or strike an object forcefully. Obvious examples are football pass for distance and softball throw for distance.

Scott and French (1959) suggested certain criteria for sports skill tests as follows:

1. Make a list of the important skills involved in the game and select tests, which use one or more of those skills.

2. The tests should be as near like game situation as possible.

3. The tests should encourage good form. In selecting test, care should be taken to avoid tests in which players using poor form can score higher than players using good form.
4. The test should involve only the person being tested. However, if one or more players assist the person being tested, the co-operation and competition for all players must be identical in the testing situations.

5. Tests should provide accurate scoring. Tests, which cannot be scored accurately, are usually low in reliability as well as objectivity cause dissatisfaction among the performers.

6. The number of trials should be sufficient to eliminate chance deviations.

7. Tests should be judged partly by statistical evidence i.e. reliability, validity, objectivity, economy and availability of norms.

8. Tests should provide a means for interpreting performance because a test score by itself is quite meaningless.

9. The scoring system should also be meaningful to the students. Students will remain interested in tests only if use is made of the test scores.

10. The difficulty level of the test should correspond to the ability of the group being tested.

Mishra (2005) advised that while selecting the tests, one should keep in mind the purposes of tests. Whereas the purposes are of major concerns, among other factors to be considered are the length of the tests, maturity of students, testing conditions, and type of scoring methods used. Each of these factors may, on occasion, limit the use of a particular test or suggest the need for a different kind of test. For instance, if a test designed to measure
one's understanding of a particular body of knowledge is too long, fatigue or boredom may occur, with their resultant effects upon the meaningfulness of test scores. Conversely, if a test is too short, it may sample too narrow a selection of student's understanding of the subject, and chance might turn out to be predominant factor in determining a student's score.

**Edgren** (1932) attempted to determine the ability and progress in playing basketball. However, no attempt to determine the reliability of the test was reported. Item were: (1) speed pass (2) Accuracy pass (3) Pivot and shoot (4) speed dribble (5) Dribble and shoot (6) Accuracy shooting (7) Opposition shooting (8) Ball handling. A validity coefficient of .77 was obtained between the test battery and a subjective rating of performance of players.

**Friermood** (1934) describes a battery of basketball skill tests useful for motivation. The items include (1) pass accurately (2) Pivot for efficiency and form (subjective) (3) speed control dribble, and (4) shoot accurately-free throw and dribble shot.

**Dyer and Apgar** (1939) developed a basketball test for college and secondary school girls which consisted of throwing at a swinging target, a ball handling test, the bounce and shoot and a free-jump and reach test. The validity of the test was .76 to .91 and reliability was .90.

**Shauffele** (1942), in his unpublished master's thesis devised the soccer test having 3 test items namely volleying, passing and receiving and judgment in passing for 9th 10th grade girls.
Subjective validity .34 and .65 with other tests was reported and reliability calculated by odd-even method was satisfactory at .69.

**Bontz** (1942) constructed a Soccer test what has proven to be an interesting test and practice technique for children in 5th and 6th grades, consisting of a series of skills administered in consecutive order. Validity is reported as .92 with subjective criterion, and reliability is .93 by odd-even technique. The ranges and medians for the study group are reported.

**Knox** (1947) developed a basketball battery composed of speed dribble, wall-bounce, dribble shot, and “penny cup” tests. Reliability coefficient for various test items ranged from .58 to .90; for the total battery the co-efficient was .86. The criterion for validating the test was success in making a ten-man high school varsity basketball squad competing in an Oregon District Tournament. Scoring of the test is accomplished by adding together directly the scores made on the four tests. The score in each instance is the number of seconds required to complete the test. The probable range of initial scores before extensive coaching and practice is from 34 to 38; low scores are the better scores.

**AAHPERD** (1948) developed a norm-referenced basketball skill test to measure the four essential skills in basketball in two class periods to an average size class. Six test items were administered in developing this battery. The four items chosen amongst these six were; (1) Speed shot shooting (2) Passing (3) Control dribble and (4) Defensive movement.
A committee of experts identified the essential skills of basketball and suggested performance tests. 5th to 8th grade students and college men were used as subjects for conducting the pilot studies. Large number of reliability coefficients, for the four test-items by test-retest method were computed on elementary, Jr. high School, Sr. high school and College range males and females. Reliability coefficient ranged between .84 to .98. AAPHERD developed basketball skill testing norms on 19000 pupils for testing of American school children and adult men and women. But no norms have been developed on Indian population.

The purpose of the study of Hartman, (1963) was to develop skill tests and to evaluate the skill level of seniors majoring in physical education at the Ohio State University in four selected activities. The four activities chosen for the study were soccer, volleyball, gymnastics, and tennis. To select the test to be used and to recommend the skills that should be tested in each area, a three-man jury of experts was selected for each activity. These men were selected on the basis of their coaching experience in that activity, their experience in teaching that activity in the major student program, or their proficiency in the sport.

In 1952, Leilick developed a Basketball skill test after factor analysis experimentation with the elements of Basketball playing ability for college women. He set up a battery of three tests: (1) bounce and shoot (2) half-minute shooting and (3) push-pass. The professional studies and research committee of Midwest Association of college teachers of Physical Education have constructed achievement scales on these tests for women.
Cunningham, (1965) constructed a battery of skill tests to measure the basketball playing ability of high school girls. To accomplish this, one test was chosen from those in the literature, another was revised, and five new ones were devised by the author. The tests were developed to measure the fundamental skills, which were identified in an analysis of the game, through the use of literature on girls' basketball, consultation with teachers and coaches, and tabulation of the frequency of use of the skills in six regulation games.

The seven-item test battery was administered to 108 girls enrolled in University City and Maplewood-Richmond Heights High Schools, St. Louis, Missouri, during the second semester of the 1963-64 school years. The players were rated by four judges in regulation games at their respective schools. Reliabilities of the judges' ratings were obtained by computing correlation coefficients between the scores of pairs of judges. The relationships were high, ranging from .88 to .91. Reliabilities of the tests were computed by correlating trial one with trial two on the run and pass and 12-foot shooting tests and trial two with trial three on the other five measures. These reliabilities were then stepped up by use of the Spearmen-Brown Prophecy Formula for predicting the reliability for three trials of each test. Multiple correlations were obtained by use of the Bechtoldt program for Multiple Regression Analysis. The final battery yielded a validity coefficient of .69.

It was concluded that the final battery of run and pass, dribbling and modified Edgren provided a fairly valid measure of
basketball playing ability and these tests could be used as aids in classification, student motivation and grading.

In 1965, Edwards developed a test to measure Basketball playing ability for grading purposes at the university of Wisconsin. The test was tested on critical appraisal of the Young-Moser test. The items include (1) bounce and shoot (2) Zone toss i.e. to throw a ball over a rope and catch it outside a prescribed zone ten times and (3) wall speed. Norms are available, and satisfactory validity and reliability are reported.

During his research work for master's thesis, Johnson (1934) developed a battery of seven test items, which includes three items of basic skill, and four items of potential Basketball ability. Basic Basketball skill test items are: Field goal speed test, Basketball throw for accuracy, and Basketball dribble test. To establish validity of the test battery Johnson used biserial correlation and divided high school Basketball boys into two groups “good” and “poor”. The validity and reliability co-efficient of the test battery were .84 and .93 respectively. Individual test items on the test however had reliability co-efficient ranging from .73 to .80.

Lehsten (1948) reduced the high school battery to five tests as follows: dodging runs, 40-yard dash, baskets per minute, wall bounce and a vertical jump. Actually two of these tests involve handling a Basketball; the wall bounce and baskets shot per minute. This test is well related (approximately: .80) with subjective ratings of Basketball ability.
**Everett** (1952) attempted to develop a battery of test by which selection of individuals to play baseball could be more accurately made. Thirty university level players were selected as subjects. Analysis of data was made by product moment method for inter correlations. Multiple inter correlations were computed by the do little method in order to determine the relative contribution of the test to the criterion (rating). It was found after statistical analysis that sergeant jump is the best single predictor of baseball ability. While best economical combination found in this study to predict baseball ability is the sergeant jump, ‘S’ test and the blocks test.

**Stroup** (1955) studied the Basketball game scores of competitive teams in 31 ten-minutes games and compared them with the skill score averages of the team members. The battery included three test items: (1) Foul shooting for one minute from near the basket, no penalties, one trial. (2) Wall passing for one minute from a 6 feet restraining line from a flat wall, one trial (3) Dribbling for one minute; dribbles alternately to the left and right on a 90 feet court around bottles placed 15 feet apart and in line.

In the Stroup study approximately 84% of the games were won by the teams with the higher skill score average.

**Smith** (1947) devised a Kick-up to self test to measure the ability to convert a ground ball to an aerial ball. The test correlated .54 with a criterion of subjective rating and had a reliability coefficient of .90 for a group of college women. In the test the subject tosses the ball from behind 47’ restraining line and executes a kick-up to self when it rebounds. This pattern is
repeated for 30 seconds. Six trails are given and their combined score is taken for evaluation.

Morris (1966) constructed and standardized a comprehensive basketball motor ability test for college men through factor analysis.

Twenty-five test variables were chosen to comprise the trial test battery for this study. These test items included basketball-oriented measures and non-basketball oriented items, which were added to strengthen the design of the factor analysis and increase the inclusive nature of the trial battery. The trial battery was administered during the 1963-64 school year to fifty men.

All subjects performed each test and the resulting 1,250 raw scores were obtained and recorded by the investigator. The raw score data were treated statistically as follows:

Product-moment correlations were computed between all possible combinations of variables. The obtained inter-correlation matrix was factor analyzed by the principal-axis method. Guttman's criterion, relating to a minimum number of factors, was used to determine a sufficient number of factors. A varimax (orthogonal) rotation of the primary axes was applied to the principal-axis factor loadings. At this point, nine varimax factors were extracted, and two of these factors were considered to be unique.

After identifying these components, the test which best measured a component was retained, and the seven test variables together incorporated into the Morris Basketball Motor ability Test.
The ultimate usefulness of the test battery was further enhanced by the construction of percentile and T-score norms by for two groups of college men.

It was concluded that this measure of basketball motor ability could be a helpful and essential tool for college physical educator in improving the teaching of basketball skills. This can be reliably as a representative method of measuring basketball motor ability in college men.

Yeagly (1972) constructed a soccer skill test battery to measure basic soccer skills of beginning players. It consists of four test items 1) Dribble, 2) Wall volley 3) Juggling, and 4) Heading. The validity of each of the four test-items was examined with two different criteria: (1) the ratings of four judges on the soccer juggling skill and (2) the composite standard score of the four tests. When the test was administered on male physical education majors, who were beginning soccer players, the following internal–consistency coefficients were reported: dribble, .92, wall volley, .90, juggling, .95; and heading, .64. The test was designed to be administered in a standard gym with the basketball floor markings used to outline the various test stations. Two assistants are needed to assist.

Friedel (1956) proposed a test of fielding, control and drive while moving for high School Girls. The subject runs from the starting end of a 10 by 25 yard rectangle and fields a ball rolled from a corner on the starting end towards a target 1 by 2 yards, centered 15 yards away. After fielding, the ball is dribbled to the end line and driven back across the starting line. Ten trials are
given with the ball rolled from the right corner and ten from the left. The elapsed time is totaled separately for each side. A validity coefficient of .87 was reported. The reliability of the test was .90 and .77 on left and right sides.

**Vanderhoof** (1956) soccer test was an early and inclusive test of soccer skill for girls. It included important elements of soccer. Items included: dribble; trapping; place kick for accuracy; dropped ball kick for distance; volley for distance with forehead, hip or knee; throw-down; tackling corner kicks; and goalkeeper’s test. The test descriptions include a suggested scoring graph to facilitate analyzing the individual’s ability and to afford a basis for assigning team positions.

**McDonald** (1951) selected control kicking as a most fundamental skill element of soccer. The aim of this test is to measure accurate kicking, ball control and judgment of a moving ball in soccer. The test was constructed for college men. Validity coefficients were obtained by correlating the scores of three skill level groups with the best criterion (coach’s rating). The coefficients were .94, .63, .76 and .85 for varsity, junior varsity, freshman varsity, and combined groups (55) respectively. The author conducted kicking test with the restraining line distance of 9’, 15’, 21’ and 30’ from the kickboard. However, the test with a 9’ rest distance provided the highest validity coefficient and is in common use for soccer skill testing.

**Lockhart and McPherson** (1949) developed a badminton skill test to measure badminton playing ability and validated it on the basis of subjective rating of the competence of 68 girls. The test
consists of volleying the shuttlecock off the wall for a period of 30 seconds. Three trials are given and 15 second practice trial before first trial is allowed. Appropriate rest intervals should be allowed between all trials. The correlation coefficient obtained was .71. The result of a round robin tournament of 27 girls produced a correlation coefficient of .60 with the test. The reliability coefficient, based on a test-retest of 50 girls within a period of three days, was .90.

Warner (1950) attempted to construct a test to measure fundamental skills of soccer, to arouse interest in learning fundamental skills, to measure improvement during the sports season and to help select a university team. The test items were evaluated by soccer coaches who rated them according to their importance and the degree of difficulty to learn. A 7-item battery was suggested: 1) kicking for distance, right foot 2) kicking for distance, left foot 3) corner kicking for accuracy 4) Heading for accuracy 5) Throws-ins for distance 6) penalty picking for accuracy and 7) Dribbling for time.

Dereha (1987) constructed an objective skill test in hockey for senior secondary boys. The general hockey playing ability of the subjects was assessed by a panel of three experts who were technically qualified in hockey. The evaluation was done by the experts through observing the performance of the subjects in the real game situations. On the basis of available literature and discussions with hockey experts three combinations A) Angular hitting and stopping for one minute test B) Pass receiving, dribbling
and hitting test C) Dribbling and goal shooting test were selected keeping in view the progression the game. A pilot study was conducted on subjects who were from 9th to 12th class in the age group of 15-18 years. The zero order correlation matrix, second order partial correlation coefficient and coefficient of multiple correlation were calculated which indicated that reliability coefficients obtained from the different tests ranged between 0.91 to 0.94. The objectivity coefficient from 0.91 to 0.96 was reported. The validity of the test as a whole was obtained by correlating the composite scores obtained by the subjects in all three tests with the playing ability of the subjects rated by the judges. The coefficient of correlation obtained for validity was 0.91. It was concluded that all three test items meet the criteria of scientific authenticity.

Sharma (1987) constructed and standardized specific physical fitness test for badminton players. The data collected for 100 inter-college and district level badminton players of north India was treated by factor analysis technique. As many as seven factors of specific physical fitness were obtained, out of which five were considered meaningful to select test items from each factor, which had the highest loading and were included in the test battery. The derived test items were applied on 500 badminton players to develop norms.

Hensley, et al. (1979) investigated the factor structure of beginning-level racquetball skills in the domain of human motor performance to identify the robust factors in that domain. A battery of 10 experimental variables was administered to 230 male and
female university beginning-level racquetball players. These variables were selected on the basis of their representation of a theoretical domain possessing the hypothesized dimensions of serve, kill shot, and passing/defense shots.

The Inter-correlations among the criterion scores of the 10 tests were calculated and the matrix was subjected to the factor analytic models of principal components analysis, alpha factor analysis, and maximum-likelihood factor analysis. The initial factor solutions were transformed by orthogonal and oblique solutions. Those factors identified by several factor analytic models were interpreted as defining beginning-level racquetball playing ability.

Meyers (1962) proposed to construct a battery of motor ability measures appropriate for boys and girls ages six through twelve. A pilot study was conducted during the summer of 1966 by administering the forty-five variables to thirty-two boys and that the proposed battery, after minor administrative and procedure changes, would meet the criteria of item selection and was therefore adopted as the trial test battery.

The final test battery was administered to forty-nine girls and fifty-one boys selected at random from the fourth grades of all six integrated elementary schools in Newton County Georgia. This battery has several distinct advantages. Each test item demonstrates an acceptable level of reliability. Only items yielding continuous point scores were considered and the administrative feasibility of the item is such as to meet most practical and administrative demands. Finally, a representative method of
assessing general motor ability of the elementary school boy and girl ages six through twelve was scientifically constructed.

Stewart (1965) developed discriminating measure of the field hockey skill of college women. The test consisted of five items: Ball Control Test; Fielding and drive Test; Goal Shooting Test; Backboard Test; and Hit for Distance and Accuracy Test. The first three items in the battery were developed by Schmithals and French. The last two items were developed by the investigator.

The subjects were 228 college women from Earlham College, Ohio Wesleyan University, and Wittenberg University. These subjects were students in field hockey classes or members of the intercollegiate field hockey teams.

The plans for the statistical treatment of the data were composed of two parts. The first part involved the technique of correlation, and the findings were to be used to indicate the single item or the items in the test battery necessary for best measuring the field hockey skill of women students.

For the second part of the statistical treatment, the subjects were placed into a low, average, or high ability group. Analyses of variance of the Ball Control Test scores of these selected subjects in each ability group were computed to determine whether or not the test items did discriminate between the ability or skill levels.

Based upon the findings and within the limitations of this study, it was concluded that the use of the fielding and Drive test, Ball Control Test, goal shooting test and hit for distance and
accuracy test were unsatisfactory as measures of field hockey skill of college women. Only the Backboard Test was an objective and reliable test. It did discriminate among the three skill levels.

Morris (1966) employed factor analysis to construct and standardize a comprehensive basketball motor ability test for college men.

Twenty-five test variables were chosen to comprise the trial test battery for this study. These test items included basketball-oriented measures and non-basketball oriented items which were added to strengthen the design of the factor analysis and increase the inclusive nature of the trial battery. The trial battery was administered during the 1963-64 school year to fifty men.

All subjects performed each test and the resulting 1,250 raw scores were obtained and recorded by the investigator. The raw score data were treated statistically as follows:

Product-moment correlations were computed between all possible combinations of variables. The obtained inter-correlation matrix was factor analyzed by the principal-axis method. Guttman's criterion, relating to a minimum number of factors, was used to determine a sufficient number of factors. A varimax (orthogonal) rotation of the primary axes was applied to the principal-axis factor loadings. At this point, nine varimax factors were extracted, and two of these factors were considered to be unique.
After identifying these components, the test which best measured a component was retained, and the seven test variables together incorporated into the Morris Basketball Motor ability test.

The ultimate usefulness of the test battery was further enhanced by the construction of percentile and T-score norms by for two groups of college men.

It was concluded that this measure of basketball motor ability could be a helpful and essential tool for college physical educator in improving the teaching of basketball skills. This can be reliably as a representative method of measuring basketball motor ability in college men.

Safrit (1967) examined basic skills in a variety of sports activities through factor analytic techniques. The skills examined comprise one aspect of the domain of physical proficiency.

Three alternate sets of factors were hypothesized on the basis of a logical and prior analysis.

For factor models were selected for the analysis of the data. These models included the incomplete principal components solution, Alpha factor analysis, Joreskog’s approximation to the maximum likelihood solution, and Model D, which is similar to incomplete image analysis. The matrix developed from the data gathered in this study was analyzed by each of these models yielding four initial orthogonal solutions. For each of these four initial orthogonal solutions, a derived orthogonal solution was developed by the normal varimax procedure.
The four models provided essentially the same measures of fit. Examination of the results indicated that the original hypothesized sets of factors were an inadequate representation of the skills measured.

**Holland** (1963) determined the value of speed, agility, upper-arm strength, power, ball-handling ability, reaction, shooting ability, passing ability, height, weight, age, and previous experience in predicting ability to play high school basketball: to determine which tests are most practical and useful to coaches in small high schools for measuring these characteristics; and to develop a method for predicting a successful high school basketball player.

The sixty-yard dash, an adaptation of the Edgren Side-Step Test, pull-ups, the Vertical Jump, a speed dribble test, the Penny Cup Test, a shooting coordination test, a wall bounce test, age, height, weight, and previous experience were used to collect data during the first two weeks of basketball practice. During the first part of February, the basketball coaches completed rating scales for their boys. From these data, means, standard deviations, product moment correlation coefficients, and standard scores were calculated. Multiple regressions were computed with the coaches' ratings used as the criterion. Based on the four significant beta coefficients, multiple correlations were computed.

It was concluded that experience, ball handling, passing, and shooting ability have the greatest influence on a player's success in basketball.
Pennington (1967) conducted a study to develop a wall handball skills test that would discriminate between good and poor performances.

In the original study, 17 strength, motor ability, and handball skill items were used as experimental variables. No specific practice to warm-up was prescribed before administration of the test items. Subjects were involved in regular handball participation before and after testing. The statistic treatment of data suggested three variables for final test namely, (1) service placement; (2) wall volley; and (3) Back wall placement.

The validity coefficient of .80 was obtained by correlating the three test items with the test criterion. No norms were published with the study, possibly because of the small number of cases used (N = 37).

Harrison (1969) studied other basketball tests and basketball books to determine that shooting, passing, dribbling and jumping were evident as the four general skill areas of basketball. The test-retest method was used to determine reliability. The reliability coefficients for each test were computed by correlating the better raw score of the first administration with the better raw score of the second administration given 7 days later. To obtain reliability the raw scores were converted to T-scores and T-scores for 4 tests were totaled to get a total battery score. Three criterion namely, (1) The Johnson Basketball test of 3 items; (2) Peer ratings by 3 members of the Basketball team, and (3) jury ratings by 3 physical educators.
and coaches observing scrimmages were used to establish validity of the test.

**Henry** (1970) studied 1-item tests by Friedel, Strait, and Stewart, and decided that the Friedel test was most suited to modification. Henry’s test was proven on 31 college and high school hockey players ranging in experience from 2 weeks to 6 years. Two judges rated the players on general abilities such as footwork and body control while they are performing 20 trials of the modified test and 6 trials of Strait’s test. The agreement between judges was reported with a coefficient of .97. Henry set several criteria for the modified test to meet: it should be a 1-item test, have a minimum of equipment, have a game-like situation and be economic of time in terms of test administration. It should also encourage good form. Enough of these criteria were met to consider this test item worthy of use.

**Franklin** (1970) conducted a study to develop measuring technique by which an individual player’s performance under game condition could be measured. One hundred twenty-two high school and thirty-one college players participated in the study. A step-wise regression programme for multiple correlation analysis was used to identify the items, which (1) were the most highly correlated to the success criterion and (2) to identify the items, which were the best predictors of teams winning tendencies. The multiple correlation shown by the eight items for college sample was .69 and for the high school sample the multiple co-relation was .95 which explained .91 of variance.
Shick (1970) constructed a battery of defensive softball skill test, which consists of a repeated throw test, a fielding test and a target test. An administration of these tests to college women yielded battery reliability co-efficient of .88 and battery validity co-efficient of .78 when test scores were compared to the rating of defensive softball playing ability.

Hicks (1971) constructed an achievement test battery in beginning lacrosse for college women. Forty-five college women from Ithaca College participated as subjects in the study. College women from Ithaca College, Cornell University and the University of Iowa participated as subjects for the collection of the norms.

The skills to be measured were determined by tabulating the incidence of various skills in two games in beginning classes recorded via videotape. After reviewing the results of the incidence chart and the related literature, five tests were constructed: the Lacrosse Multi-Skill Test, the lacrosse Throw for Distance Test, the Wall Rally Test, the Wall Toss Test and the Goal Shooting Test. Inter judge correlations were computed on the judges rating by utilizing the Pearson Product Moment method of correlation.

The reliability coefficients for the achievement test were compared by the Spearman-Brown odd-even method of correlation. Reliability coefficients were also computed on the achievement tests by correlating the sum of the trials of the test against the sum of the re-test. The Spearman-Brown Prophecy formula was utilized to step up the reliability coefficients of the tests. The validity coefficients for the achievement tests were computed by utilizing
the Pearson Product-Moment method of correlation. The criterion, sums of judges' scores, was correlated with the sum of the trials of the tests.

Multiple correlations indicated that the following battery could be useful in measuring the playing ability of beginning players in lacrosse: the Lacrosse Multi-Skill Test plus the Lacrosse Throw for Distance Test. Multiple regression correlations were used to determine how these tests were to be combined into a battery. Norms were provided in the form of T-Scales for the Lacrosse Throw for Distance Test and the Lacrosse Ability Battery.

Green (1972) developed a practical skills test or battery of tests that may be used as a basis in measuring effectively the playing ability of a college male golfer after completion of a one-semester course in beginning golf.

For the purpose of this study it was necessary to utilize two groups of subjects. The first group that took part in the study was college male students who had completed a one-semester course in beginning golf at the University of Arkansas. A second group of subjects participated in validating the battery of six tests (which were determined in the first phase of this study) with a criterion measure of thirty-six holes of golf. The step-wise multiple regression program was the statistical technique used in validating the test battery.

Sherman, (1972) during his work of Ph.D. constructed a battery of tennis skill tests with a purpose to evaluate the achievements of beginning tennis students. The secondary purpose
of this study was to construct a rating scale with which to measure tennis serving ability at the beginning level.

The subject for the study were 113 women undergraduate students who were enrolled in six beginning tennis classes in the Women’s Physical Education Department at the University of Iowa during the seven week spring session of 1971. Seven tests were constructed for the pilot study, three of these were chosen for the main study, and two of the three tests were included in the final tennis battery.

The three tests chosen for the main study were the Untimed Consecutive Rally Test, the Untimed Consecutive Volley Test, and the Service Test. Of these three tests, the rally test, with a validity coefficient of .60 was the best single estimate of tennis playing ability. The two tests combined for the final battery were the Untimed Consecutive Rally Test and Service Test. The validity for this battery was .62 and the reliability was .92.

A subjective Service Rating Scale was also constructed for the purpose of measuring beginning tennis serving ability. A zero to seven point scale was utilized. Three raters were employed. The inter-rater reliability of the Subjective Service Rating was extremely high, .98. The validity, however, was low. The reliability of each test was computed by using the split-halves (odd-even) method of correlation. Spearman-Brown prophecy formula was utilized to step up the reliability coefficient for the full length of the test.
The purpose of Kovacs (1973) “Bounce drill’ soccer test was to measure general soccer ability. Kovacs used both the McDonald Kicking skill test and judges’ ratings as criteria with the assistance of 38 soccer players comprised of members of a freshman soccer team, university team, and professional players. The reliability, figured on the split halves method, was .97 for the total group, .94 for university group and .95 for the freshman group. The test is more valid for the freshman level players than the university players. Reliability however, is high for both groups.

Rowlands (1974) revised a series of validated test items, which were assumed to measure a person’s ability to play the game of golf and compare the obtained test battery scores with the USGA handicaps of the subjects. Ninety-two experienced male golfers with USGA handicaps from the Glenview, Illinois Men’s Golf Club served as subjects. This represented the first attempt to validate a golf test using handicaps as a criterion measure.

The test battery consisted of (1) The five iron test, (2) the nine iron test, (3) The pitch shot test, (4) The putt test. Simple correlations were computed to determine validity and reliability coefficients and the interrelationship between each pair of individual test item scores. The results of the statistical analysis indicated that various test battery combinations accurately measured the golfers’ skills. A multiple correlation of .82 was obtained for the four test battery. It was concluded that golf skills testing program could be used to evaluate students with some degree of confidence.
The purpose of the study of Hopkins (1976) was to investigate the factor structure of the sports skill domain of basketball and to identify test items to measure in this skill domain. A theoretical model of the hypothesized dimensions of basketball playing ability was developed based on a review of literature concerning basketball skill testing from 1906 to the present day. These dimensions were: (a) shooting, (b) passing, (c) jumping, (d) movement without the ball and (e) movement with the ball. Twenty-one items, including the nine items in the AAHPER basketball skill test for boys, were selected to sample these hypothesized dimensions. The tests were administered to 70 male junior high and high school students enrolled in the University of Minnesota, Duluth basketball camp during the summer of 1975. The hypothesized dimensions were analyzed by use of the following: (a) alpha factor analysis; (b) canonical factor analysis; (c) image analysis, and (d) principal components analysis. Both oblique and orthogonal rotations were performed with each of the four analyses. The hypothesized model was partially substantiated in that the results confirmed three of the factors: (a) shooting, (b) passing and (c) jumping with the only difference being that the factors of movement with the ball and movement without the ball combined into one. Since the test items, (a) jump and reach, (b) dribble, (c) speed pass; and (d) front shot, best represented the dimensions; it appeared that a battery comprised of these items would provide a quick and objective measure of basketball skill.

Avery (1979) constructed a test in tennis to maximize the practical relationship between skills tests and playing situation in
tennis. The test incorporates the game-like criteria of two balls per trials, service attempts to both right and left service courts, and comparable credits for flat, slices, and spin serves. In addition, norms were established for both college males and females at beginning and intermediate skill levels in tennis. Construct validity was established for the service test. To determine reliability, 93 males and 59 females were given the test on two separate occasions. Cronbach’s alpha coefficients were calculated with resulting reliability estimates, which ranged from .64 to .80 for the group studied.

Hensley et al. (1979) constructed a racquetball skills test for the evaluation of skill achievement in racquetball for college men and women. Subjects were 113 men and 99 women students enrolled in beginning level co-ed racquetball classes at the university of Georgia during the 1978 academic years. The first phase in test development involved a task analysis of racquetball skills.

The second phase of test development involved a consideration of possible measurement techniques. As a result a “Short Wall Volley Test” to measure speed component and a “Long Wall Volley” test to measure power component were selected as the test items. Students were tested in regulation size racquetball class periods. The order of administration of tests was reversed during the retest to eliminate any systematic bias resulting from the order of testing.

Hopkins (1979) investigated the relationship of 21 selected
basketball skill tests to successful basketball performance. The 21 skill test items were administered to 70 boys ranging in age from 12 to 17 attending the 1977 University of Minnesota-Duluth basketball camp for boys. Based on the ratings of three high school and three college coaches, camp participants were designated as successful (n=32) and unsuccessful (n=38) performers. The stepwise discriminant analysis procedure was used. Six skill tests were identified as significantly contributing to discriminating between group memberships. These tests, in order of the magnitude of their standardized discriminant function coefficients, were (1) speed pass, (2) zigzag run, (3) free jump, (4) side step, (5) front shot, and (6) zigzag dribble. It was concluded that a basketball skill test battery comprised of these six test items would objectively measure basketball playing ability and discriminate between successful and unsuccessful performers.

The purpose of Joseph Digennaro’s (1968) study was to develop a battery of tennis skills tests in a manner that would serve as a model for construction. A series of 12 procedures was outlined and followed in the construction of forehead drive, backhand drive, and service tests of accuracy in placement for novice tennis players, to as the TTA (Tennis Tests of Achievement). The planning and formulation of TTA were based on (a) knowledge of tennis authorities including recommended drive and service teaching progressions and methods of practice; (b) strengths and deficiencies in existing tennis skill tests; and (c) results of pilot procedures relating to the nature of the tests. Sixty-four male college novice tennis players participated in an appraisal of the tests. Reliability
was ascertained by means of the test-retest method. In determining the predictive validity of the drive tests, the selected criterion measure was accuracy in placement in driving a tennis ball tossed from the net by a ball-tossing machine. The reliability coefficients produced were .80 for the service test, .67 for the forehand drive test, and .66 for the backhand drive test.

Avery (1979) constructed a test in tennis to maximize the practical relationship between skills tests and playing situation in tennis. The test incorporates the game-like criteria of two balls per trials, service attempts to both right and left service courts, and comparable credits for flat, slices, and spin serves. In addition, norms were established for both college males and females at beginning and intermediate skill levels in tennis. Construct validity was established for the service test. To determine reliability, 93 males and 59 females were given the test on two separate occasions. Cronbach’s alpha coefficients were calculated with resulting reliability estimates, which ranged from .64 to .80 for the group studied.

Phipps (1981) compared selected general ability tests, specific skill rests and personality traits as predictors of volleyball performances in high school girls.

Three general ability tests, three specific volleyball skill tests and a personality test were administered to 120 high school girls trying out for university teams in six schools.

The data from three of the schools were used to develop prediction equations using a general linear model procedure. The data from the remaining schools were used to validate the
equations. The specific test model had the highest correlation with overall performance. The variables of general ability and personality were not related to volleyball performance. It was concluded that the specific test model and combinations of the general ability and personality with the specific are better predictors of volleyball performance than the coaches beginning of season judgment.

**Chapman** (1982) designed a skill test in field hockey to assess the subject’s ability to combine quickness in wrist and hand movements needed to manipulate the stick with ability to control to the force element when contacting the ball. The test was administered in a pilot study to 23 women at Illinois state university. The test-retest scores were got on two separate days. The players rated each other by each player rank ordering the top three players of both the teams. Assigned rank orders (1-2-3) of team members were converted to raw scores by assigning the numerical values of 3, 2 and 1 for rank orders, 1, 2, and 3 respectively. The total of rank order values for the 11 university players and the 12 junior university players and their ball control test scores were treated by Pearson product-moment technique. The coefficient of correlation was reported to be .40.

**Shick et al.** (1983) constructed indoor golf skill test for junior high school boys. The subjects were 63 junior high school boys who had just completed a unit in golf. The numbers of subjects in grades 7, 8, and 9 were 37, 15, and 11, respectively. Informed consent was obtained from both the students and their parents or guardians. Although 63 students took the test on Day 1, only 58
were present for the test on Day 2. The second day of testing took place four days after the initial administration.

Means and standard deviations for both the test and the criterion measure were computed. Reliability was determined by intra-class correlation methods described by Safrit (1976). In order to estimate the validity of the test, test scores for tests of varying length were correlated with the scores on the par-3 hole golf course. It was concluded that this test provides a valid and reliable measure of golf for junior high school boys.

**Sangral** (1987) constructed and standardized a skill test for field hockey. The subjects of study were 63 male hockey players of inter-college, inter-varsity, state and national level. High reliability co-efficient, validity coefficients and objectivity were reported.

**Dowd** (1990) investigated the factor structure of beginning-level racquetball skills in the domain of human motor performance to identify the robust factors in that domain. A battery of 10 experimental variables was administered to 230 male and female university beginning-level racquetball players.

The inter-correlations among the criterion scores of the 10 tests were calculated and the matrix was subjected to the factor analytic models of principal components analysis, alpha factor analysis and maximum likelihood factor analysis. The initial factor solutions were transformed by orthogonal and oblique solutions. Those factors identified by several factor analytic models were interpreted as defining beginning-level racquetball playing ability.
Results of the study showed that there was a difference in the factor structure for males and females.

In 1992, S.A.I. (Sports Authority of India) devised a basketball test for spotting and nurturing of basketball talent in young boys and girls. The battery consists of three test items namely wall pass test, Dribble test and jumping and turning in the air test. This battery is meant for 10-14 year boys and girls. There is no mention of validity, reliability and norms and testing procedure in the S.A.I Publications. The scores are converted to evaluation points with the help of S.A.I. standards.

Bergeman, (1995) made a sincere attempt to construct a team handball test battery that would be reflective of the skills, abilities, physical fitness components and anthropometric factors that contribute to high levels of performance, and to establish a database of performances by the National team handball players.

The 20 players who were the members of United States National handball team served as the subjects for the study. The coaches and Bergman discussed the test items and agreed that they were relevant to the sport. These test items include:

1. Anthropometric measurements: height, weight, handbreadth, arm length, and arm span.
2. Hand grip strength
3. Running speed: 20m dash
4. Vertical jump
5. Accuracy throw
6. 50m dribble test.
7. Jump and throw test
8. Endurance test.

The players were ranked by the coaches. These rankings were then compared to the rankings of the anthropometric date, the vertical jump data; the skills test data and the total composite data. The correlation coefficients for the anthropometric, vertical jump and the skills tests with the Experts Rankings were very low. The correlation between the Total Composite T-scores and the Experts Rankings were the highest with r= .364. This is not significant but was very close to the r= .3783 needed for significance.

In this particular battery of tests, many different concepts relevant to team handball were assessed; however they do not encompass all of the factors that contribute to high level performance.

Lam (2001) developed a racquetball skill test battery for young adult beginners. Based on a review of literature and test of content validity by a panel of experienced racquetball instructors, five racquetball skill elements with eight items were formulated: Service Placement (Left and Right), Power Drive (Forehand and Backhand), Power Shot Placement (Forehand and Backhand), Ceiling Shot, and Wall Rally. Participants (N=131) were 87 male and 44 female college students. The test was conducted on two official size racquetball courts. Each test item had 20 trials and
was administered twice within a post. Data on subjective rating and tournament standing were used as criterion variables for examining test validity. Multiple regression analyses revealed that the six items out of eight were positively predictive of the criterion variables. Utilizing factorial repeated measures analysis of variance; intra-class reliability and generalizability were conducted. It was concluded that this battery has a great application potential in instructional programs to improve skill levels of young adult beginners.

Wan-Ka and Hong (2001) conducted a study to develop a test battery for assessing basic skill proficiency of squash for all playing levels. One hundred and ninety-nine male squash players, representing five different groups, participated in the test. A pilot test was conducted to confirm that the sample of the elementary and leisure groups could handle the test.

The testers were requested to stand behind the Short Line and hit rallies within a 30 second period. Both forehand and backhand were required and a test-retest was adopted, allowing a 1-min. rest time between two tests. Alpha reliability coefficients ranged from .44 to .81, and the reliability for a single trial among the test items was calculated and ranged from .28 to .78.

The results suggested that the test battery was reliable and valid. The data findings can be used for the purpose of selection or standard classification.
Lichtman (2004) attempted to develop a Soccer Ball-Juggling Test to evaluate general ball handling skills and eliminate the need for facility setting-up, and individual administration, due to judgment calls as seen in most existing passing and dribbling tests. The Ball-Juggling Test required participants to repeatedly tap, or contact a soccer ball using any body part except the hands and arms, as many times as possible within a 30-s period. No penalty was assessed if the ball bounced on the ground during the trial. Each time the hands or arms were used to control the ball, a one-point penalty was deducted.

Data were collected over a 2-year interval in seven classes during the last 1½ weeks of instruction. The data analysis was based upon the scores from the last two trials. Significant test-retest reliability coefficients of $r = .85$, $r = .79$ and $r = .84$ were obtained for men, women, and all participants, respectively.

Sunderland et. al. (2006) tested and retested thirty-nine (20 male and 19 female) well-trained university field hockey players who had volunteered to participate in the study. The reliability of the in house designed test was determined by repeating the test (3-14 days later) following full familiarisation. The validity was assessed by comparing coaches’ ranks of players with ranked performance on the skill test. The mean difference and confidence limits in overall skill test performance was $0.0 \pm 1.0 \%$ and the standard error (confidence limits) was $2.1 \%$ (1.7 to 2.8 %). The mean difference and confidence limits for the “decision making” time was $0.0 \pm 1.0 \%$ and the standard error (confidence limits) was
4.5 % (3.6 to 6.2 %). The validity correlation was established by applying Pearson’s correlation method. This was $r = .83$ and $r = .73$ for female players and $r = .61$ and $r = .70$ for male players for overall time and "decision making" time respectively.

The analysis of results concluded that the field hockey skill test was a reliable measure of skill performance and that it was valid as a predictor of coach-assessed hockey performance.