THE EFFECTS OF THREE TECHNIQUES OF INSTRUCTION ON THE MOTOR SKILL ACQUISITION OF JUNIOR SECONDARY SCHOOL BOYS.

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BY

AGBOOLA, ADEAGBO ADEBAYO.

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CERTIFICATION

This is to certify that the Thesis titled:

"The Effects of Three Techniques of Instruction on the Motor Skill Acquisition of Junior Secondary School Boys."

Submitted to the School of Postgraduate Studies, University of Lagos, for the award of the degree of Doctor of Philosophy in Physical Education is a record of original research carried out by Agboola Adeagbo Adebayo in the Department of Physical and Health Education.

Author

Dr. A. O. Ajiduah
Supervisor & Internal Examiner

18/12/87

Dr,(Mrs.) S. B. Ajasin
Internal Examiner

Dec. 18th 87

DR. A. F. A. FOLAWIYO
Ag. Head of the Department.

DR. J. Ade. Oyewusi
External Examiner.

DEDICATION

This Ph. D. Thesis is dedicated to:

My past, present and future students,

and

My wife, children, brothers, sisters and friends.

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ABSTRACT

The effects of the practice, inclusion and reciprocal techniques of instruction were determined on the acquisition and retention of dribbling and shooting skills in hockey.

Three groups with 30 boys in each were randomly selected from Form I of a Boys' Secondary School in the Somolu Local Government Area of Lagos State and randomly assigned to the treatment groups. Each treatment group received two 40 minutes instruction and training per week for four weeks. Using a hockey dribbling skill test developed by the investigator, data were collected from the boys prior to the training, immediately after four weeks of training and after four weeks of no practice.

The boys then received instruction and training on hockey shooting under the same treatment conditions for two 40-min. per week and for four weeks. The boys were measured prior to the training, immediately after the training and after four weeks of no practice with a hockey shooting test developed by the investigator.

Analysis of Variance (ANOVA) was used to determine whether there was any significant difference among the groups prior to, immediately after the training and after four weeks of no practice. Analysis of covariance (ANCOVA) was also used to determine whether the three techniques differ in effect on the post-test and final test scores. The t-test was employed to determine whether there was any significant improvement in each group after treatment and if there was any significant difference between the post-test and final test scores.

The result of the study seemed to show that (a) the three techniques of instruction were equally appropriate for learning dribbling and shooting in hockey, (b) the practice technique was superior to the reciprocal technique in the acquisition of shooting skill, but there was no significant difference between the reciprocal and the inclusion techniques, (c) the three techniques of instruction had no significant effect on the retention of dribbling skill in hockey, and (d) after a retention interval of four weeks, boys taught shooting with the reciprocal and inclusion techniques suffered loss of proficiency but those taught with the practice technique maintained the learned skill.

The study concluded that the three techniques of instruction were effective in facilitating learning of dribbling and shooting in hockey and that retention interval negatively affected motor skill acquisition.

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THE PROBLEM

Introduction

Acquisition of motor skills, one of the goals of physical education, is the connecting link between psychology and physical education. Psychology is a science that studies the individual, his behaviour, his ways of reacting to stimuli and how he learns. Since physical education is interested in teaching motor skills, the science of psychology is therefore, important in the teaching of physical education activities.

The developments of research on acquisition of motor skills in physical education have been closely associated with those in psychology (Irion 1966). The publication in 1926, of a book, The Psychology of Coaching, by C. R. Griffith, a Professor of educational psychology, was one of the early connections between psychology and physical education (Robb 1972).

By the 1940s, motor behaviour research had begun to grow rapidly. New theories of learning were propounded. A notable example was on motivation and reinforcement. In his book, Principles of Behaviour, Hull (1943) put forward a model in which motivation i.e. the driving force was provided by stimulation arising from internal need and in which reinforcement was equated with drive reduction. This model has exercised considerable influence over learning research since that time. During the late 1940s and early 1950s, a number of experimental psychologists tested some of the predictions from Hull's theory. Data provided by these psychologists tell the practitioners of motor skills a great deal about the way practice sessions should be structured.

Another individual who effectively related the study of human performance to the concern of physical educators was John D. Lawther. In 1951 he published his book, Psychology of Coaching. This book amalgamated principles of several academic disciplines with data empirically derived from coaching and other high level learning situations.

Several theories of learning have been presented during the course of educational history. Three of such theories that have affected physical education are:

1. trial-and-error theory;
2. association theory and
3. cognitive theory.

The trial-and-error theory postulates that skills are mastered only after a period of practice, during which time a path is made on the nervous system. This results in proper muscle stimulation and action. When a beginner learns a skill he has uncoordinated awkward movements. Later if he practices consistently, he performs the skill with a much higher degree of smoothness and with a little expenditure of energy. This means that through practice a person gradually cuts down on the errors, and this results in a better performance.

The association theory maintains that people behave in response to the force to which they are exposed. That is, learning is the formation and strengthening of bonds between a given stimulus and its response. According to the theory, each set of stimuli has its own set of response and the job of the educator is to provide opportunities for the association of the stimuli and responses. The teacher makes sure that the student learns the 'correct form'

at the initial stage of learning the skill though this may not be accompanied by understanding.

The cognitive theory otherwise known as the field theory stresses that one learns best by grasping the whole concepts. It holds that learning takes place through insight, that is, suddenly 'seeing' how to do something. The individual performs the whole act and does it until he gains an insight into the situation. It is the role of the teacher to help the student structure problem in order to gain insight or perceive the solution. From the three theories it can be seen that a person must practise before he can learn a skill. If this is so the question which the physical educator may ask is "what is the best teaching strategy which will make the student acquire motor skill?" In recent years, attempts to answer the question have led to studies which began to focus on the relationship between the teacher and the learner for example, Flanders (1961), Shavelson and Dempsey (1976) and Doyle (1978). These attempts also led to researches with concrete models for the art of teaching.

One of such models, 'The Spectrum of Teaching Styles', has been proposed by Mosston (1981). The Spectrum is a theoretical construct and an operational design of alternative teaching styles. Each style has a specific structure which delineates the roles of the teacher and the learner and identifies the objectives that can be achieved when that style is operated.

A style of teaching is defined as the decisions that are made by the teacher and those made by the learner in a given episode. The kind of decisions made by the teacher and the learner determines the process. Therefore, the Spectrum offers the teachers an array

of options in teaching behaviour which enables them to reach more learners and meet more objectives.

The Spectrum identifies the implication of each style to growth and the development of the learner in the physical, emotional, social and cognitive domains. The important point here is that what the teacher says and does has an intrinsic and direct relationship to learning behaviour. All the styles are derived from the same decision-making schema. The schema is organised in three sets that represent the sequence of decision in any teaching/learning transactions.

These are:

1. Pre-Impact or Planning Decision. This includes the decision that must be made prior to the face-to-face contact between the teacher and the learner.
2. Impact or Execution Decision. This includes the decisions that must be made during the performance of the task.
3. Post-Impact or Assessment Decision. This includes the decision that must be made concerning the evaluation of the performance and feedback to the learner.

The Mosston's Spectrum of Teaching Style consists of eight styles. These are:

1. The Command Style- This is characterised by the teacher making all the decisions in the planning set, the execution set and the assessment set. The learner only obeys and performs the task to the command of the teacher. All the decisions about location, posture, starting time, pace and rhythm, stopping time, duration of the task and interval are made by the teacher.

2. The Practice Style- In this style, the teacher designs

specific tasks, which provide many practice trials in the skill to be learnt. The learners make nine decisions, viz: posture, location, order of task, starting time, pace and rhythm, stopping time, interval, attire and appearance and initiating question for clarification, which affect the conditions under which they perform the task. These decisions help to individualise the learning conditions without affecting the quality or quantity of the performance itself. During the time the learners are practising, the teacher's role is to make post-impact decision about the learner's performance and offer feedback to the learner.

3. The Reciprocal Style- This is structurally similar to the Practice Style, but the post-impact is offered after every practice trial by a peer. After the teacher's explanation of the task, the learners form pairs and as one partner performs the task, the other offers feedback based on the criteria supplied by the teacher. The observer carefully watches the performance of the partner, compares the performance to very specific criteria provided by the teacher, draws conclusion about the quality of what was observed and communicates this information, in helpful ways, to the partner doing the task. The learners then switch roles. The doer becomes the observer and the observer becomes the doer and performs the assigned task. The role of the teacher is to:

(a) make the pre-impact decisions,

(b) deliver the task and the criteria to the learner,

(c) observe the performance of both the doer and the observer, and

(d) be available to the observer.

4. The Self-Check Style- In this style, each learner

performs the task as in the Practice Style and then makes the post-impact decisions for himself or herself.

5. The Inclusion Style. This style makes the teacher provide as many alternative levels of the same task in order to allow each learner work at the level most suitable to him or her. The learner, in the impact set, makes the decisions which include the decision about the 'entry point' into the subject matter by selecting the level of task performance. In the post-impact set, the learner makes assessment decisions about his/her performance a and the decision about further placement in the available level. The role of the teacher is to offer the learner feedback about how he/she is doing in self-assessment.

6. The Guided Discovery Style. In this style, the teacher makes the decisions in the pre-impact set. In the impact set, some subject matter decisions are shifted to the learner. The learner is engaged in a series of discoveries, the learner actually makes decisions about the part of the subject matter within the topic about which the teacher made the decision in the pre-impact. The teacher is also involved in the impact set by asking sequence of questions. In the post impact set, the teacher verifies the response to each question. At times the learner can verify the response for himself or herself.

7. The divergent Style- In the pre-impact set, for this style, the teacher decides on the subject matter. That is, he designs the problems. In the impact set, the learner makes decisions about the responses, about the solutions that are applicable to the problem. He discovers the alternative answers that solve the problems. In the post-impact set, the learner engages in making 'evaluation'

decisions about the discovered solutions, the learner can verify the solution himself. In some cases, however, the teacher can verify the solution.

8. Going Beyond- In this style, the learner, in the pre-impact, discovers and designs the problem. In the impact, the role of the teacher is supportive. That is, he listens, watches and asks questions for clarification and alerts the learner about the decisions that are omitted. In the post-impact, the learner evaluates the activities done in the impact set. The role of the teacher, again, is supportive. He listens to the learner and watches his solutions. If there are discrepancies in the solution, it is his role to ask questions for clarification. These questions enable the learner identify the discrepancies.

In this investigation, the Practice Style, the Reciprocal Style and the Inclusion Style were chosen for the following reasons:

1. they are, particularly the Practice Style, the most popular instructional technique in use in Nigeria by most practitioners in the field,

and 2. they form a sub-set of the Spectrum. Comparing their effectiveness should, therefore, provide a useful information as to their specific applications.

Statement of the Problem

Physical educators, as teachers, are confronted daily with the problem of utilising efficient technique in teaching sports skills. In recent years, studies have been conducted to find answers to the question, "Which is the best technique for teaching motor skills?" Such studies in the United States of America and Britain began to:

1. focus on the relationship between the teacher and the

learner, e.g. Flanders (1961),

and 2. offer models for teaching with more concrete procedures for the art of teaching, e.g. Hyman (1974), Gentile (1972), Whitting (1972) and Mosston (1966 and 1981).

In an attempt to answer the question given above it was the purpose of this study to compare the relative effectiveness of three of the Mosston's Spectrum of Teaching Styles, viz: Practice Style, Reciprocal Style and Inclusion Style on the acquisition of the skills of dribbling and shooting in the game of hockey.

Specifically, the study aimed at determining:

1. whether, after receiving instruction in dribbling and shooting in the game of hockey through any of the three techniques, there would be improvement in the performances of the hockey skills by the boys,
2. which of the three techniques was most superior for teaching either dribbling or shooting in hockey,

and 3. which of the three techniques would allow for best retention of the acquired skills after a period of no practice.

Hypotheses

This study sets out to investigate the probable effect of the Practice, the Reciprocal and the Inclusion techniques of instruction on the acquisition and retention of dribbling and shooting in hockey by Junior Secondary School boys.

In order to do this the following hypotheses were postulated for testing:

General Hypotheses

1. There will be no statistical significant difference among the effects of the three techniques of instruction on

acquisition of hockey skills.

2. There will be no statistical significant difference among the effects of the three techniques of instruction on retention of hockey skills.

Specific Hypotheses

1. The three techniques of instruction will produce no statistical significant difference among the post-test mean scores of boys on the hockey dribbling test.

2. The three techniques of instruction will produce no statistical significant difference among the post-test mean scores of boys on the hockey shooting test.

3. There will be no statistical significant difference among the final test mean scores of boys on the hockey dribbling test after a four-week of no practice.

4. There will be no statistical significant difference among the final test mean scores of boys on the hockey shooting test after a four-week of no practice.

Significance of the Study

The inclusion of physical education as one of the core subjects in the Junior Secondary School curriculum recognises the importance of physical education by the Nigerian National Policy on Education. The significance of this study, on the basis of this recognition, cannot be over-emphasized.

This study hopes to test the validity of the claims in earlier studies that a particular teaching technique is superior to others.

It is hoped that findings from the study will be invaluable to practitioners of motor skills and make them more efficient as

teachers and coaches.

Delimitations

The study was delimited to:

(i) ninety (90) Form I boys of a Secondary School in the Somolu Local Government of Lagos.

(ii) two 40 minutes of instructions and practices per week for four weeks for each of the skills under investigation.

(iii) data collected before the beginning of the treatment (pre-test scores), those collected immediately after the treatment (post-test scores), and those collected after four weeks of no practice (final-test scores).

Limitations

(i) The number of subjects used could be a limitation to the generalisation of the test data.

(ii) The tests were conducted or administered under practice conditions. That is, there were no opponents in the case of dribbling and no goal-keeper in the case of shooting.

(iii) The investigator had no control over the activities of the boys prior to the training and during the testing periods.

(iv) Time limitation did not permit the investigator to conduct the study in Forms II & III.

Definition of Terms

Dribbling: -- Moving the ball from one place to the other with the hockey stick while maintaining constant control of the ball.

Feedback: -- Information received by a learner from his performance either through an internal or external agent which permits him to profit from his experience.

Final-test Scores: -- Data collected from the subjects after a four-week of no practice. That is, data collected after the retention interval.

Form: -- A class in a Secondary School.

Impact: -- The period the subject executes a given task.

Inclusion Style: -- An instructional technique which has a number of levels for learning a skill and allows the learner to work at the level most suitable for him.

Motor Skills: -- Physical activities which involve the use of large muscle groups. All sports skills are motor skills.

Post-test: -- Data collected from the subjects immediately after the treatment period.

Practice Style: -- An instructional technique which allows many practice trials in the skill to be learnt.

Reciprocal Style: — An instructional technique in which learners form pairs. One performs, the other observes and gives feedback to the performer. They switch roles, i.e. the performer becomes the performer.

Retention Interval: — A period during which an individual is nor allowed to practise the skill.

Retention Loss: — This is got when the score after the retention interval is less than the score before it.

Spectrum: — A framework consisting of a number of interconnected instructional techniques.

Traditional Style: — An instructional technique in which the learner only obeys and performs the task to the command of the teacher or instructor.

CHAPTER II

REVIEW OF LITERATURE

Introduction

For the purpose of this study, motor skill activities include walking, running, swimming, riding a bicycle, driving a car and playing games etc. These are activities used in physical education, sports and recreation. Wells (1960) has classified motor activities which man is called upon to perform throughout life into:

I Skills of maintaining and regaining equilibrim.

II Skills of moving one's own body -

A. On land or other solid surface:

1. Arm, leg and trunk movements.
2. Locomotion.
3. Rotary movements of the body as a whole.

B. In water:

1. Swimming.
2. Acquatic stunts.
3. Boating.

C. In the air:

1. Diving
2. Trampoline and tumbling activities.

D. In Suspension:

1. Swinging activities on trapeze, flying rings etc.
2. Hand traveling on traveling rings, horizontal ladder etc.

III Skills of receiving impetus:

A. Of own body:

1. Landing from jumps and falls.

B. Of external objects:

1. Catching and trapping.

2. Receiving with an implement.
3. Receiving and spotting in stunts and apparatus events.

IV Skills of giving impetus to external objects:

A. Pushing, pulling, thrusting, lifting.
B. Throwing with hand or implement.
C. Striking, hitting, kicking etc.

V The selection and classification of skills related to prevention of injury:

A. The maintenance of equilibrium.
B. The range of motion.
C. The intensity and duration of muscular exercise.
D. The transmission of weight through the body segment and weight bearing joints.
E. The reception of one's own weight.
F. The lifting and carrying of heavy objects.
G. The impact of external forces. (p.336)

The ability to perform successfully in any of the activities mentioned above is contingent upon the acquisition of numerous motor skills. One question which logically arises, is, "How are motor skills acquired?"

Attempts to answer this question had been a concern of psychology since its birth as a scientific discipline. Scientific investigations into motor skill acquisition have largely been conducted by experimental psychologists. Physical educators have now joined the search for the answer. Irion (1966) identified three periods in the history of research on the acquisition of skills. These were:

(1) 1890 - 1927 - a period of definition,

(2) 1927 - 1945 - a period of experimental work and the emergence of several theoretical formulations,

and (3) 1945 - date - a period of exploration of research and publication.

It is the purpose of this chapter to present a literature review of some of the researches and publications.

Categories of Motor Skills

Motor skill investigators have used different criteria to categorize skills. Jensen and Fisher (1979), for example, have divided skills into, (1) accuracy skills, (2) power skills, and (3) manueverability skills.

Accuracy skills do not involve fast or vigorous movements, but require concentration and much practice of fine muscle coordination. Examples are shooting in basketball, target shooting, putting in golf and bowling etc. Under competitive conditions, some accuracy skills are performed at high speed. Slowing down the performance during practice aids in analysing the mechanics of the skill and improving movement patterns. For best results, however, accuracy skill should be practised extensively at the speed and intensity as they will be performed in competition.

Accuracy skills are both dependent on neuromuscular coordination and judgement of speed, distance and time. For example, in shooting a basketball, the player must correctly judge his distance from the basket, then be able to put the ball where he judges it should go. If a half-line player, in hockey, passes to an inside forward running into the shooting circle, he must judge the speed of the inside forward. When the inside forward gets the ball he must correctly judge his distance from the goal and put the ball where he judges it should go.

Putting the shot, long jumping, sprint swimming and sprint running are examples of power skills. They are performed with great speed and force (power). In developing power skills, the emphasis is on neuromuscular coordinations which result in fast and forceful movements. Some skills combine accuracy and power e.g. bowling in

cricket, pitching in base ball, batting in cricket and baseball and boxing.

Maneuverability skills include gymnastic performances, court games like lawn tennis, badminton, squash, basketball etc. and field games like hockey and soccer. In developing these skills, the emphasis is on agility (quick change of direction and body). The skills require the mobility of the required joints.

Magill (1980) categorizes skills into:

1. Fine motor skills- These skills require the contraction of the small muscles of the body. Examples are typing, writing, drawing and playing the piano. The skills involve hand-eye-coordination.

2. Gross motor skills- These involve the contraction of the large muscles of the body. Examples are soccer skills, hockey skills and most sports skills.

3. Discrete skills- A discrete skill requires a single exertion e.g. shooting, throwing the javelin or throwing a ball.

4. A Serial-skill- It is a combination of independent discrete movements. e.g. jumping, dribbling, roll and balance.

5. Continuous Skills- They have a distinct beginning and an end. A continuous skill may be a sequence of movements containing many repetitions of the same discrete skill. Examples are: swimming and running.

6. Open-loop skills- These are skills in which feedback cannot be used to modify an action during the actual performance but can be used to improve performance at the next attempt.

7. Close-loop skills- These are skills in which feedback information can be used to adjust an action during the performance itself.

8. Open skills - These are skills which take place under changing environment. Examples are team sports and racket sports. Whiting (1973) termed this category as externally-paced skills.

9. Closed skills - These skills take place in environments which are predictable and relatively unchanging. Examples are cart-wheel, head-stand, putting the shot, basketball free throw. Whitting (1973) styled them self-paced skills.

Fitt (1965) used the criteria of the degree of difficulty and the processes involved in categorizing skills. He identified three levels of difficulty and labelled them Levels I, II and III according to the degree of difficulty with Level III as the most difficult.

Level I are skills in which the performer and the object are stationary prior to the initiation of the action. An example is a golfer addressing a golf ball.

Level II are skills in which either the performer or the object is moving. Examples are a cricketer batting a ball, and a wicker keeper catching a ball.

Level III - In this level both the performer and the external objects are moving before the particular sequence begins e.g. A tennis player moving to return a forehand drive; a hockey player running to stop a passed ball.

Vanek and Cratty (1970) divided sports skills into five categories:

1. Sporting Activities Requiring Hand-eye coordination - These activities require that the performers have the ability to respond visually to cues from the target. Examples are archery and shooting in hockey.

2. Sporting Activities Requiring Total Body Coordination - These are skills which require the performer to move aesthetically through space. Examples are diving, and gymnastics. In this type of activities, the ability to balance and be aware of the location of the body in space are vital for success.

3. Sporting Activities Requiring Total Mobilization on Body Energy - These are skills which require physical power and endurance. Examples are running, swimming, rowing. Some of such skills require quick explosive mobilization of energy e.g. shot-putting, sprinting, high jumping etc.

4 Sporting Activities in which Injury or Death are Imminent - These activities call for sound judgement and quick reaction time. They involve speed and demand good control and self discipline. Examples are racing car driving and parachute jumping.

5 Sporting Activities Requiring the Anticipation of Movements of other people - The activities call for the ability to predict and anticipate the movement of other players. All team sports are examples of this category.

The Value of Skill Categorization

Putting skills into categories enables the teacher to specify to the learner what a particular skill calls for. From the category, the physical education teacher will have an understanding of the complex factors involved in various skills and would, therefore, be able to develop better instructional technique after reasonable effective and logical analysis of the skill.

Organisational Features of Motor Skill Acquisition

Motor skill acquisition has three organisational characteristics. These are hierarchical organisation, spatial organisation and

temporary organisation.

Hierarchical Organisation – This concept implies that it is possible to group phenomena into categories and that it is also possible to specify a restrictive relationship of order or sequence between categories.

Fitt and Posner (1967) suggest that hierarchical organisation of skill acquisition is the working of electronic computers. The operations of the computer is governed by an executive programme or subroutines. The executive programme regulates the execution of the execution of the subroutines. The subroutines of the programme are fixed sequences which are units of the whole programme which may be repetitions until a given point is reached or until stopped by the overall programme. This concept may be illustrated with scoring in hockey. The executive programme is scoring a goal while the various movement of the legs, the movements of the trunk, the shoulders, elbows and wrists are the subroutines. Skill acquisition consists of reorganising and repatterning of subroutines acquired through previous experience and practice and using them in the new task.

Miller, Galanter and Pribram (1960) support the notion of hierarchy of habits but use the term "Plan". According to them a "Plan" is "the process through which the organisation controls the order in which a sequence of operation is performed." They assert that in a skillful performance plans were originally voluntary but have become relatively inflexible and automatic through overlearning.

Spatial Organisation – This concept affirms that effective movement patterns are serial, that is, the 'subroutines' of the skill are arranged in consecutive order. In hockey shooting, for example, the muscles of the leg, the trunk and those of the shoulders

and arms have to move in a prescribed sequence otherwise an awkward movement pattern will result.

Temporal Organisation. This implies that there is a smoothness or "dovetailing" in connecting successive subroutines. It does not mean the speed at which a movement is performed or the total time taken for the whole movement. Temporal organisation is affected by pacing which may either be self-paced or externally-paced. In a self-paced task, the performer determines the rate of incoming information e.g. gymnastic activities, golf and archery. Externally-paced tasks are those in which external factors control the movement to a large extent. Examples are all court and field games. The principle of pacing is employed in team sports where a team seeks to force the opponents to play at its pace.

Another factor that affects temporal organisation is anticipation. There are two types of anticipation as opined by Poulton (1952, 1957). These are Receptor anticipation and Perceptual anticipation.

Receptor anticipation involves external information received by the performer from his immediate environment which helps him to programme his response. For example, a hockey player who sees that a dribbler wants to go in a direction receives a visual receptor information and this aids him to adjust his next movement.

Perceptual anticipation involves information from internal sources and relies on past memory and experience. Information received by an opponent from watching a videotape of a team at play will aid in anticipating possible moves that the team can make when it meets the opponent in future.

Characteristics of a Skillful Motor Performance

A skillful motor performance, when compared to its inexpert counterpart, is characterised by an appearance of ease, of smoothness of movement, of confidence and the comparative absence of hesitation. It frequently gives the impression of being unhuried, while the actual pace of activity may, of course, be quite high. It is also characterised by an anticipation of variations in the stimulus situation before they arrive and an ability to cope with these and other possible disturbances without destroying the performance. This is perhaps the most striking feature of high level proficiency - it involves being ready for a whole variety of events that may occur, when they occur - and these events include the consequences of the activity itself. A good tennis player, for example, moves into position much earlier than a beginner, reacting to and anticipating situations which are partly his own creation and partly that of the opponent.

Phases of Motor Skill Acquisition

How does the performer acquire the characteristics of a skillful performance described above? Fitts (1965), Fitts and Posner (1967) and Robb (1972) theorized that the acquisition of a motor skill involves three phases. They all agree that skill acquisition is a continuous process and that the phases are not marked by distinct boundaries. These phases are briefly described below:

Phase I. During this phase the learner tries to understand the nature of the skill, that is, the objective of the skill. He also tries to understand the sequence of the subroutines of the skill. Demonstration plays a major role during this phase by showing the sequential ordering of the subroutines, as well as giving information

about the executive programme. The teacher should, therefore, note that the demonstration must be perfect. It must be done where the learner will see the demonstrator. Usually the first attempt after the demonstration will not be particularly successful but in a few trials inappropriate strategies are discarded and the more appropriate ones are retained. In this phase of motor skill acquisition, the learner relies very heavily on visual feedback. The teacher should attempt to direct the learner's attention to the most important cues that will aid him to improve his performance. Fitts (1965) called this phase the cognitive phase. Fitts and Posner (1967) labeled it the early or cognitive phase while Robb (1972) termed it the plan formation phase.

Phase II. The second phase of skill acquisition according to Fitts (1965) is the fixation phase. Fitts and Posner (1967) designated the phase as the assotiative or intermediate phase and Robb (1972) labeled it as the practice phase. The phase is characterised by a period in which new patterns of movement begin to emerge. Large errors which were common in the first phase are gradually eliminated. The learner recognises when he makes errors without being told by the teacher or experimenter and he can correct them quickly and efficiently. Voluntary control is aided by the help of sensory feedback at this period. This phase of skill acquisition takes a longer period than the first phase. The length of time it takes, however, varies from skill to skill and from learner to learner. Factors such as prior experience with similar skills, complexity of the skill, instructional techniques, practice schedules, knowledge of results, capacities of the learner, and motivation of the learner will determine the length of this phase of skill acquisition.

Phase III. This period is characterised by an increase in the ease with which the movement is executed. There is a decrease in the stress and anxiety of the performer. The learner, at this time, is able to perform the skill almost without a conscious effort and with fairly consistent results. In other words, the performance becomes automatic. Fitts (1965) labeled this phase the automatic phase. Fitts and Pcsner (1967) designated it the final or autonomous phase while Robb (1972) called it the automatic execution phase. In this phase, each part of the task serves as a stimulus which brings the next one into play. Speed and accuracy improve as the learner begins to anticipate the next movement component. The eyes and ears are freed gradually from their control function and are now used to concentrate on monitoring the most delicate part of the pattern or they may remain vigilant for any emergency that may arise. The skill, at this time, can be performed in the presence of many distracting stimuli. That is, during this phase, the movement pattern is less subjected to extraneous activities in the environment.

Motor skill acquisition according to Adams (1971) has two phases. These are verbal-motor and motor phases. The Verbal-motor phase is the combination of Phases I & II described above while the motor phase is Phase III described above.

Skill acquisition according to Gentile (1972) has two stages. He referred to his stage I as "Getting the idea of the movement". This, like Adams' (1971) is the combination of Phases I & II. He denoted stage II as "Fixation/Diversification." In this stage the learner progresses and attempts to increase the consistency or refines his performance in the skill.

Variables Affecting Motor Skill Acquisition

There are many factors which account for the rate of motor skill acquisition. These include: prior experience, instructional technique, knowledge of mechanical principles, practice schedule, physical fatigue, feedback, motivation and individual differences.

Prior Experience. An individual begins the acquisition of a motor skill from the background of many already existing and highly developed general and specific skills. Sage (1971) quoting Mednick (1964) says:

> When learning to swim, a person knows how to kick, to move his arms around, to breathe in and out before he actually goes into water. (p.303)

Sage continues by saying that an entirely new skill is rarely learned. Instead it is "put together" out of existing repertoire of skills. The effects of these prior skills on the acquisition of new skills is evident in all three phases of motor skill acquisition discussed earlier.

In Phase I, past experiende provides the "raw material" from which the learner comes to understand the new skill.

It is in Phase II that the effect of previously learned movement responses comes to markedly affect the rate of motor skill acquisition. If the new skill requires a response opposite to a previously learned movement when the stimulus is similar the rate of acquisition may be slowed. If on the other hand, the new skill requires similar response to a similar stimulus situation, rate of acquisition is enhanced. If the former situation happens, it is called negative transfer of skill, (Sage 1971). This means that the previously learned skill is impairing the acquisition of the new skill. If the latter, however, occurs positive transfer is said to take place.

In Phase III a behaviour that was part of a previously learned motor skill occasionally re-appears. This usually occurs during period of stress as confirmed by Sage (1971). A good example is found in a basketball player who has recently changed his habit of bouncing the ball before shooting when confronted with an opponent during a competition he is likely to revert to his old habit of bouncing before shooting.

Instructional Technique. A basic tenet of physical education is concerned with achievement of competence in sports skills. The physical educators are interested in the ability of the student to profit from instruction. They are, therefore, continuously seeking efficient instructional technique by which they communicate to their students.

Instructional techniques are what Mosston (1966, 1981) calls teaching styles and what some other investigators and motor learning researchers call teaching methods. Examples are (Holt et. al. 1970), Mariani (1970) and McFarlane (1971). Ikulayo (1985) calls them instructional strategies. Whatever term is used, it refers to the procedure of making the learner acquire the desired skill. Mosston's teaching styles have been discussed in chapter I of this thesis. These are:

(a) The Command or Traditional Style.

(b) The Practice or Task Style.

(c) The Reciprocal Style.

(d) The Self-Check Style.

(e) The Inclusion Style.

(f) The Guided Discovery Style.

(g) The Divergent Style.

(h) Going Beyond.

According to Vannier and Fait (1965), whatever method of approach is used, the three D's of teaching motor skills are (1) demonstration, (2) diagnosis and (3) direction.

Demonstration

The objective of demonstration is to produce some model of a required performance. This may be a personal demonstration by the teacher/coach or by other learner. It may also be by the use of videotapes, films or film loops.

Demonstration, as said earlier, serves a major purpose in Phase I of the phases of skill acquisition. It is used to help the learner understand the objective or the purpose of the skill, as well as the sequential organisation of subroutines.

In Phase II of the phases of skill acquisition, demonstration aids the learner in smoothening out his performance. That is, it helps him master the temporal patterning of the skilled movement. Demonstration during this phase, may serve to point out errors. A demonstration that compares the correct sequence to the incorrect one can sometimes help the learner to see where his errors occured. So demonstration of the incorrect sequence may serve to focus attention on the incorrect sequence and this may result in its correction.

Whether demonstration is used to make the learner understand the objective of a skill or it is used to correct the performance Whitting (1973) says that the following procedure is involved:

1. The learner watches the demonstration performed either by the teacher/coach or by some other method of presentation with the aim of performing the skill later.

2. While observing the demonstration the learner puts certain information which he has abstracted from the display into short-term memory.

3. Very shortly after the demonstration, the learner is required to reproduce his interpretation of the demonstration. This makes the learner to select the response patterns.

4. With the aid of the internal and external feedback and aided by those given by the teacher/coach he makes some form of discrimination between his own performance and that of the model.

5. The feedback which the learner receives from (4) above is stored in the long-term memory for future use.

6. On the basis of the information, the learner is able to make a decision on whether to make the same response in subsequent occasion or to adopt a different movement pattern.

Whitting (1973) has suggested that the teacher/coach should know what cues to emphasise to the learner during demonstration. He goes further in his suggestion that since all the useful information cannot be got across to the learner in one demonstration, it should be repeated. After the demonstration the skill should be practised as soon as possible to avoid 'spontaneous decay' of the image.

Diagnosis. The teacher/coach should be an expert in diagnosing the difficulties which the learners have. Having discovered the difficulties, he should give the correct teaching/coaching points which will make the learner correct the fault(s). It is worthwhile to note that the teacher/coach will only be able to diagnose if he himself can perform the skill correctly; if he knows what the correct movement pattern is; if he has the experience and recognises that detection of fault is a vital part of the teaching-learning process which every educator must possess (Vannier and Fait, 1965).

Direction. After diagnosing the fault the teacher/coach should be able to direct the learner through the new movement pattern.

He can do this by describing what the learner should do. He should use appropriate words which the learner can comprehend. His voice should be clear and audible. He should bear in mind that "success quickens learning". If the learner is successful he is eager to repeat the new movement that is desired. The learner should, therefore, be motivated to discover his own most productive movement pattern. McAllister (1953), Knapp (1964), Cratty (1968, 1973 and 1975) seem to agree that good description of a skill will enhance learning of the skill. Berlin (1959) Rivenes (1961) and Lawther (1968) believe that description of a skill has limited value to beginners.

Each of the instructional techniques mentioned earlier is valuable but studies have shown that there are times when one is superior to another. The best technique to use depends on ever changing factors which the successful teacher learns to sense.

Miriani (1970) investigated the effectiveness of the Command method and the task method of teaching the forehand and backhand tennis strokes. Two groups of male college students had six weeks of tennis instruction. One group (N = 30) was instructed with the command method, and the other group (N = 30) with the task method. The class met two hours a week for a total of twelve hours of instruction. The subjects were given a pretest at the beginning of the experiment and a final test at the conclusion. The result revealed that the task method was superior to the command method in the teaching of the backhand but there was no significant difference between the two instructional techniques in teaching the forehand stroke. Both groups showed a significant improvement from pretest to the final test. A post-test after sixty days of no practice

showed that the two methods suffered a regression in achievement. The task method group showed a significantly greater retention for both groups.

Carter (1971) compared three instructional methods to determine their effectiveness in teaching basketball skills to male college students. The teaching methods were, the traditional method, videotape relay as an aid to the traditional method and loop films as an aid to the traditional method. Students were put into the three groups. The groups were kept as identical as possible with exception of the method. A comparison of the pretest and post-test data showed that the three methods produced significant improvement but there was no significant differences among the three instructional methods.

A study conducted by Green (1970) had 56 subjects registered for three classes in beginning swimming. The classes had a different instructor and assistant and met 3 days per week for 16 weeks. Subjects classified as beginners and advanced beginners, were randomly assigned to a traditional or TV replay treatment group in each class. Achievement was determined with the American National Red Cross Swimming Test. The result of the pretest and seven subsequent tests revealed that the two methods of instruction yielded significant improvement. The results also showed that the TV replay method was superior to the traditional method. Advanced beginners made more gains in achievement than beginners. The extent to which video replay was effective depended upon the teacher using it and the ability group he used.

Two methods of golf instructions (putting first and full swing first) were compared by Wurzer (1972) to determine their effects on knowledge, attitude and skills.

Forty-eight subjects were divided into two groups. Group I (16 males and 8 females) used putting first method, Group II (16 males and 8 females) used full swing first. The pretest and post-test results showed that there was no significant difference in the effectiveness of the two instructional methods both on the males and the females. The two methods of instruction seemed to be interchangeable, with some phases being taught by the whole method and some phases being taught by the part method.

Thaxton et al. (1977) designed a study to find out whether there was a difference in the effectiveness of the traditional method and the movement exploration method of teaching physical activities to elementary school girls. Four classes of 4th grade girls (N = 67) were randomly assigned to the experimental conditions. The skills taught were gymnastics and tumbling and basketball. The analysis of the data revealed that a combination of methods should be used in teaching elementary physical education activities.

Freshman and Sophomore College men (N = 140) were divided by Wills (1970) into four instruction groups: oral instruction with demonstration, oral instruction and loopfilm instruction with demonstration, written instruction, and written instruction and loop film instruction in learning a new motor skill of juggling three tennis balls. Each instruction group was randomly assigned to either the physical practice group or mental and physical practice. Each of the eight groups practised 3 days a week for 5 weeks. The result showed that in skill acquisition the best method was oral instruction with demonstration. It was followed by written instruction with loop-film and then by oral instruction with loop film. Written instruction only was the worst.

Singer and Pease (1976) placed forty-eight subjects in one of three groups to receive a guided instructional strategy, a discovery instructional strategy, or a combination discovery-guided strategy. Their effects were compared on initial task learning, retention and transfer to a second task. The tasks involved a computer-managed mover serial manipulation apparatus which contained eight manipulative objects and for foot pedals. The guided learning and combination learning groups performed significantly better than the discovery learning group in learning the first task. The opposite was true of retention test administered the following day. Discovery method and the combination strategy favoured transfer. It was concluded that the instructional strategy should be compatible with the objectives of the learning experience, with consideration for initial learning, retention and/or transfer possibilities.

Singer and Pease (1978) again assigned one hundred and twenty-eight female college students to either a guided or discovery condition for the learning of a primary task and then to one of four conditions for transfer-learning-discovery or guided, for a simple or complex transfer task - to learn computer managed serial motor tasks. Guided learning was most efficient in initial task learning. Efficiency in transfer learning was greatest when the strategy for transfer learning was the same as that used for primary learning. Neither of the learning strategies was more effective when considering a transfer task similar or of greater difficulty as compared with the original task.

Subjects who experienced discovery learning in the primary and transfer task conditions demonstrated a greater need for more time and trials in re-learning the primary task than did subjects experiencing guided methods.

Hazlett (1974) compared the results of three different methods of teaching tumbling - the trampoline method, mental practice method and the traditional method. The study was conducted for 30 minutes during each of 30 class periods. The trampoline group practised on the trampoline and then on tumbling for 15 minutes each. The mental practice group went through the skill mentally for 6 minutes, had a 3-minutes rest, then six minutes of additional mental practice. They then practised tumbling for 15 minutes. The traditional group practised for 30 minutes. The results showed that the trampoline method was significantly better than the mental and traditional methods.

Garland (1970) compared the effects of movement exploration and traditional methods of teaching on acquisition of selected swimming and diving skills. The result showed that both were equally effective. There was no significant difference between the two methods.

Holt et al (1970) compared the effectiveness of the Red Cross and Silvia methods of teaching beginning swimming. Subjects were 76 women who were put into four classes. Two were taught by the Red Cross method and the other two by Silvia method. Two instructors taught one of each methods. The result showed that the Silvia method was superior to the Red Cross method.

Goldberger and Gerney (1982) examined Mosston's Practice, Reciprocal and Inclusion styles in terms of motor skills and social skill development of 5th grade children. Three groups with 32 children in each group were randomly assigned to one of the three treatment groups and taught an ice hockey accuracy task. Data were collected prior to, mid-way through and following training.

Analysis revealed that the three styles were effective in learning the type of motor skill. The reciprocal style, in addition, enhanced social skill development.

Russell (1967) conducted a study on the Windmill serve in volleyball. He had three groups of women physical education majors. One group learnt the skill with traditional method, the second group used the problem solving method with emphasis on mechanical principles and the third group received instruction through the problem-solving method with emphasis on movement education. There were 19, 17 and 19 women respectively in the groups. Each class met two times per week over a 10-week period. Each class lasted forty minutes. Serving skills were measured on the 8th, 13th and 18th days. The two problem solving methods were more effective than the traditional method.

Robins (1979) compared two methods of teaching swimming skills. The methods were the American Red Cross method for beginners and the Modified American Red Cross Method for beginners utilizing commercial training aids. Two groups used one of the two methods. The content material for the two groups was identical. The order of presentation was also the same. The training lasted nine weeks. Each group met three times a week for 60-min. instruction. The result showed that the Modified Teaching Model is not superior to the traditional Red Cross Model for teaching college age non-swimmer.

Knowledge of Mechanical Principles. The physical educator usually relies on a personal demonstration of the skill or the student's initiation of a skilled performer as the best method to teach a skill, with verbal cues to point out errors and to direct corrections, this is often the entire teaching method. For some time coaches and physical education teachers have recognised the need to know and

understand mechanical principles to facilitate the teaching of sports skills. Mohr and Barrett (1962) studied the learning of swimming strokes. They had two groups of learners. One group was given instructions on the mechanics of swimming, in terms of the laws that governed the propulsive and resistive forces in water. The other group was not provided with such an instruction. They found that the group that had the instruction performed better in the swimming tests than the group without such instruction. Schmidt (1975) reported that Broer (1958) came out with a similar results with various ball games.

Buch's (1972) investigation determined the value of teaching some principles of motion that governed a trampoline skill in contrast with conventional method of teaching the skill. The subjects were 7th and 8th grade boys and girls who were randomly assigned to two methods of teaching Swivel hips. The two groups were identical except for the treatment. One group learnt the mechanical principles while the other did not. The result showed that teaching mechanical principles to learners of the trampoline skills, Swivel hips, increased the degree of skill at which the learners performed over students who have not been taught the mechanical principles.

Schmidt (1975) opines that there is no sufficient evidence about usefulness and effectiveness of mechanical principles in learning skills. He predicts that the influence of mechanical knowledge might diminish as the task becomes well learned.

Practice Schedule. Personal experience of the investigator has shown that motor skills require a lot of practice before they can be done effectively and efficiently. It is the opinion of the investigator that observing a motor skill performed by another person or thinking or reading about it alone will bring about the mastery of

the skill. It is only through repetition of the desired movement pattern that skillful response sequences are developed.

One of the first topics to receive research attention in motor learning was practice schedule. Investigations were conducted to answer these questions: Should learner practise continuously on a skill without rest period? or should the learner practise for short periods with intervals of rest? Which practice schedule is best for speed of skill acquisition? Which practice schedule is best for retention of skill?

According to Schmidt (1975a) and Sage (1977) a practice schedule in which the inter-trial rest is shorter than the individual practice is termed "massed" or "Unspaced". When the inter-trial rest is as long or longer than the trial itself, the practice schedule is said to be "distributed" or "spaced".

Most investigations that have been completed on the effects of practice schedules on skill learning and retention have used rather simple motor tasks such as rotary pursuit, mirror tracing, and other fine motor skill tasks. These tasks make it possible to control many variables, but some questions arise as to the applicability of the findings to gross motor tasks such as those found in sports. However, several studies using gross motor skills have confirmed most of the basic findings obtained in studies using other fine motor tasks.

Adams and Reynolds (1954) studied massed and distributed practice on the pursuit rotor. They used five groups of subjects. One group had distributed practice throughout. All the other groups had some massed practice followed by a 5-min. rest and then distributed practice with the groups having either 5, 10, 15 or 20 massed trials before switching.

There was a great depression in performance while the subjects were under-going massed practice, but once they were allowed to rest and were shifted to the distributed conditions, the decrement nearly disappeared. By the third practice trial after the switch in every case the decrement was gone. The conclusion from the study was that massed practice had large and severe depressing effects on performance but that it has minimal effect on learning of the motor task. Stelmach (1969) and Whitley (1970) support the conclusion that massing does not affect the amount of learning in motor tasks.

McCabe (1971) assigned thirty physical education students to either a continuous practice schedule (N = 15) or an alternate practice schedule (N = 15) in learning to cradle a lacrosse stick on both sides of the body. Results indicated that there was no significant difference in the two practice schedules.

Singer (1965) used a novel gross motor skill (bouncing a basketball off the floor and attempting to make a basket) under massed and distributed practice schedules. He found that acquisition of the skill was significantly better under distributed practice conditions.

Wilson's (1970) study investigated the relationship between three distributions of practice, the difficulty of the gross motor skill and the speed of learning. The relationship between distribution of practice, difficulty of the motor skill and the retention of that skill was also investigated. One hundred and fifty subjects were divided into six groups to learn gymnastic skills previously rated into levels of difficulty. Three groups practised simple skills and three groups practised more difficult skills. The groups practised until they were able to perform three successful trials in

succession. The number of trials and the length of time for practising for each group was held constant. After the learning period the subjects practised until they reached the criterion level for the second time. The result indicated that distribution of time and trials into 5 days per week for simple skill was better than distribution of the same total time and number of trials into 1 day or 3 days per week. For the group that practised more difficult skills, there was no significant difference among them.

Drowatzky (1970) compared the effects of massed practice, distributed practice with a 20-sec. inter-trial rest and distributed practice with a 2-min. inter-trial rest in an attempt to determine if a difference existed in either the rate of build-up or rate of dissipation of the reactive inhibition affecting the acquisition of a tracking skill in normal and mentally retarded subjects. Thirty normal and twenty-nine mentally retarded subjects whose ages ranged from 12 to 45 years practised on a photo-electric pursuit rotor under one of the three experimental conditions. Differing rates in the build-up of inhibition were observed between normal and retarded subjects and between different practice schedules. Two classes of inhibiting factors appeared to operate upon the normals receiving distributed practice, one class of factor affected distributed practice with a 20-sec. inter-trial rest and the other operated on practice schedules with a 2-min. inter-trial rest.

Findings on the effectiveness of distributed versus massed practice schedules seem contradictory. This is probably not surprising considering the wide variety of motor tasks and research strategies which have been used. It appears that the nature of the task is important. Taking this into account, distributed practice

schedules do show a superiority over massed schedules on a variety of motor tasks.

Drawing from results of various investigations on practice schedules, Sage (1971) proposed several principles:

1. Distributed practice is more efficient and effective for motor skill acquisition.
2. Distributed practice is more efficient when the energy demands of the task are high, the task is complex, the length of task performance is great, the task is not meaningful, and when motivation of the learner is low.
3. Massed practice is preferable when the skill level of the learner is high and when peak performance on a well-learned skill is needed.
4. Massed practice may be effective when the skill is highly meaningful, when motivation is high, and when there is considerable transfer from previously learned tasks to the new task. (p.318).

Sage (1971) goes further to explain that distributed practice is more efficient and effective than massed schedules of practice because during the rest interval the learner mentally rehearses the skill.

Mental Practice. Literature on mental practice show that both novel motor skills and sports skills have been used in the investigations on mental practice. The concern of this section of the review is on sports skills.

The pioneer study on mental practice was reported by Vandell et al. (1943) who used junior-high-school, senior-high-school and college students as subjects and had them practise basketball

free-throw shooting and dart throwing. They found that the physical and mental practice groups improved, while the no-practice groups did not improve. The investigators concluded that mental practice was almost as effective as actual practice, for the conditions of their experiment.

Clark (1960) also found that physical practice and mental practice were equally effective in basketball, free-throw shooting with varsity and junior varsity high-school players, but a novice group seemed to profit more from physical practice.

Corbin (1967, 1967a) investigated the issue raised in Clark's (1960) study, viz, the effectiveness of mental practice with groups of different skill levels. Corbin's studies suggested that skilled performers benefited more from mental practice than beginners.

Arnold (1966) evaluated practice methods for over 100 grade 10 girls from three initial skill levels. Three random samples were drawn from each skill level. Nine days of practice were followed by a final test. Physical practice and alternating practice were equally effective in improving dart throwing scores, and both were superior to mental practice.

Comparison of mental, physical-mental and physical practice by Corbin (1966) showed that mental practice alone did not facilitate skill development but physical-mental and physical practice improved performance. There was no interaction between the type of practice and the skill level. No type of practice seemed to have a more lasting effect. The study concluded that physical practice was necessary if mental practice was to facilitate skill development.

Shick (1970) in his study on the effects of mental practice on serving and volleying skills in volleyball, found out that it

had no significant effect on volleying but had a significant result on serving. It showed that mental practice for serving was better than no practice and that 3 min. of mental practice was better than 1 min.

It is the suggestion of this researcher that physical educators and coaches should encourage their sportsmen and women to have mental practice of their individual skills because it will definitely improve their performance.

Retention of Motor Skill. Sports skills are learnt with the intention of performing them at a later time. Physical educator and sports coaches should, therefore, be concerned with retention of motor skill at the same degree as they are with motor skill acquisition.

Motor skill retention has been the subject of investigations over the years. The typical experimental design for the study of retention provides some practice for individuals to learn a motor skill; a period of no practice, otherwise called "retention interval", that is, a period during which the individuals are not allowed to perform the skill; and finally, "recall trials" of the skill. If the performance on the recall is less than the performance before the retention interval, the subjects are said to have suffered a "retention loss" (Schmidt 1975a).

Purdy and Lockhart (1962) investigating retention on ball toss, foot volley and bongo-board balance skills found virtually no loss in skill regardless of the retention interval of one year. Ryan (1962) also found that retention was high for both rotary pursuit and stabilometer tasks up to twenty-one days, although the pattern of retention was not the same for both skills.

In another study Ryan (1965) tested for retention on a stabilometer task after three months, six months and twelve months. The result showed significant loss on the first trial of the retest by the three groups, with the 12-month group suffering the most loss of proficiency. Meyers (1967), using the Bachman ladder climb task, found no significant loss in retention for lay-off periods varying from ten minutes to thirteen weeks. Whitehill (1966) found that four, eight, and twelve weeks of retention interval had no effect on the skill acquisition. The children used in the study retained a relatively high degree of the skill. Bell (1966) also found that five weeks of no practice had no significant difference in skill performance.

A number of studies have tried to determine the effect of certain variables on retention of motor skills. Naylon and Briggs (1961) found that motor skills arranged in an organised manner were retained better than arbitrarily arranged skills. Fleishman and Parker (1962) found that the initial level of skill was the most important factor in retention. They also found that the amount of verbal guidance during practice had no effect on retention; and that practice schedules had no effect on retention. Sparks (1963), however, reported that verbal incentives experienced during the learning period significantly enhanced retention of a volleyball skill. Singer (1965) reported that massed and relatively massed practice conditions yielded significantly better retention results than distributed condition one month after the last practice. Sage (1971), however, reported that for most tasks, distributed schedules were found to be better than massed schedules for retention.

Physical Fatigue. This is an important variable that affects motor skill acquisition and performance. According to the Dorland's Illustrated Medical Dictionary, (1974), fatigue is:

> A state of increased discomfort and decrease efficiency resulting from prolonged or excessive exertion; loss of power or capacity to respond to stimulation. (p.490).

Fatigue can either be peripheral (local) or central (general). It is peripheral if it is restricted to an area of the body e.g. the arm. It is central if it involves the central nervous system. In this case, the parasympathetic and the sympathetic nerves no longer function efficiently and as such the whole body becomes affected and neither physical nor mental activity can hardly be engaged in (Bell et al 1968).

The question of fatigue and its implication to motor skill acquisition has generated a number of investigations attempting to determine the effect of fatigue on motor skill acquisition and performance.

Phillips, Jr. (1962) using the rho task and the stabilometer, interpolated physical work during practice. Two learning tasks were studied and the result showed that interpolated heavy work during practice caused large and statistically decrease in the performance.

Similarly, Alderman (1965) using the rho task the pursuit rotor found that physical fatigue induced half way through the learning of each task resulted in 40% decrement in performance.

Royce (1962) investigated force-time relationships as some young men were tested on a hand dynamometer. He found that under the condition of fatigue, the rate of build-up of muscular force

decreased by 50%, and the rate of release decreased by 150%. Though, the investigator did not relate his findings to either learning or performance, it seems reasonable to conclude that in motor skills which require a quick muscular contraction, the end result (performance) of a muscle group whose rate of contraction decreased by 50%, would be poor.

Carron (1969) used the pursuit rotor as the learning task and the hand ergometer as the fatiguing task. He introduced two experimental groups. One of the experimental groups was fatigued early in the practice session. The result showed that fatigue interpolated both early and late was detrimental to subsequent performance.

Randomly assigning seventy-five male college students to one of three treatment groups to investigate effects of initial and initial-plus-interpolated total-body physical fatigue upon learning and performance of a gross motor skill, Cotten et al (1972), came out with a result which was in agreement with studies mentioned earlier. That is, fatigue had a substantial detrimental effect on performance but there was no noticeable change in the acquisition skill.

In a study conducted by Kroll (1973) it was shown that local physical fatigue induced to the knee extensor, caused a significant 24% decrement in strength of the muscles. From this study, it would not be unreasonable to conclude that decrement in muscle strength would decrease performance of a particular muscle or group of muscles.

The next set of studies are those that show that physical fatigue is detrimental to skill acquisition and/or performance.

In an attempt to investigate the hypothesis that fatigue is detrimental to learning, Godwin and Schmidt (1971) randomly divided

sixty-four women subjects into two groups of thirty-two women in each group. On Day 1, a group rotated the arm ergometer clockwise for 2 min. at 60 rpm. prior to the first practice trial. This was immediately followed by the first trial of the discrete sigma task. Following the sigma task the subjects resumed cranking the ergometer at 60rpm. For about 15 sec. The sigma task continued with crnking interpolated between each of twenty subsequent trials. The other group (non-fatigued group) also performed the twenty trials of the sigma task on Day 1 with the same inter-trial interval but without ergometer cranking. Instead they had a left-hand tapping task. On Day 2, (72 hr. later) all subjects performed the sigma task under non-fatigued conditions. The result of the study showed that there was a large decrement in performance on Day 1 and, a statistically significant small decrement in learning on Day 2.

Carron and Ferchuk (1971) examined the effects of induced physical fatigue upon performance and learning of a gross motor task, the stabilometer. Forty male subjects were sequentially assigned to a control or experimental group. All subjects were given thirty-two 20-sec. trials over three practice sessions with a 48-hr. rest interpolated between sessions. The first two trials were performed under no fatigue conditions. The experimental group was then transferred to a bicycle ergometer and was required to pedal for ten minutes until at least a heart rate of 180 beats per minute was attained. Subjects in the experimental group were then returned to the learning task to practise for an additional twelve trials. Between each of the twelve trials, a 2-min. exercise period was interpolated during which the heart rate was returned to the desired 180 beats per minute. The procedure for the second session (Trials 15-26) was the same as for the

first session. In session 3 (Trials 27-32), both groups had six trials under no fatigue conditions. The result of the analysis showed that physical fatigue was detrimental to both performance and learning of the experimental group.

Barnet et al (1973) used sigma task as the learning task and arm ergometer as the fatigue task. 104 right-handed female students were the subjects. On Day 1, all subjects were randomly divided into two groups and practised 20 trials of the sigma task either under the fatigued condition involved 2 min. of arm ergometer cranking during each of the subsequent inter-trial intervals. The control group used the same inter-trial interval as with the experimental group but subjects tapped a large 'X' for 2 min. prior to trial 1 and 14 sec. during each inter-trial interval. On Day 2 (1 week $\pm$ 3 hr. after Day 1), each of the two groups performed either under the same condition or opposite conditions as Day 1 for ten additional trials on the sigma task. The result showed that on Day 1 the fatigued group had a longer performance time. This means that performance was detrimentally affected. The two groups, however, improved considerably during Day 1. The Day 2 result also showed that fatigue had a detrimental effect on performance.

In a study which investigated the effect of various levels of physical fatigue on the learning and performance of a dynamic balance skill, Pack et al (1974) used the Bachman Ladder as the learning task. The fatigue task was exercise on the tread-mill. Forty-eight male students were randomly groupped into four. A level of fatigue determined by heart rate was assigned to each group. A group was the control group. The remaining three were respectively assigned 120 beats per minute (BPM), 150 BPM and 180 BPM.

Each subject was fatigued to his assigned level prior to the task and following each trial. On Day 1, he was given 20 trials to learn the task while at his designated level of fatigue. Each subject in the control group, instead of treadmilling, performed a simple manual task requiring mental concentration following each trial. On Day 2 (24 hr. later), all subjects, both experimental and control performed an additional twenty trials but this time, under non-fatigue condition and did the manual task following each trial. The result revealed that on Day 1, 150BPM and 180BPM impaired performance of the motor task. The learning scores also showed that 150 BPM and 180 BPM had a detrimental effect on learning of the task.

Sprague and Mann (1983) carried out a study in which 15 highly skilled male subjects ranging from 19-27 years and 1.76m - 1.93m in height were used. Their normal exercise ranged from 100m - 800m, their best performance also ranged from 10.3 sec. to 11.3 sec. in 100m; 20.7 sec. to 23.4 sec. in 200m; 45.9 sec. to 51.7 sec. in 400m and 1:50 sec. to 1:55.8 sec. in 800m. Phase I was maximal exertion in sprint of 50m. Phase II was maximal exertion sprint of 400m. 95% of the subjects' previous best average velocity for the 400m was used as the minimum acceptable average. Filming technique was used for the analysis. It was observed that the subjects demonstrated inferior anatomic running posture as fatigue set in. This consequently affected their performance adversely.

Some studies have found out that fatigue enhances or has no effect on learning and/or performance.

Phillips, Jr. (1963) had three groups, each consisting of twenty-five male college students.

Group A did arm exercise warm up. Group B did step-up exercise warm up and Group C was the control group. Each subject was given four trial practices on the criterion movement. Subjects in the control group rested for ten minutes and did sixty trials of arm exercise. Subjects in Group A rested for 7.5 min. and performed the arm exercise for 2.5 min., followed by 60 trials on the criterion task. Subjects in the step-up group had 10 min. of the arm exercise and 60 trials on the criterion movement. Three days later, all subjects were retested without introducing fatigue. The result showed that there was no significant difference in the performance.

Effects of fatigue on the acquisition of two motor tasks were investigated by Benson (1968). Two groups of subjects learnt a jumping skill and a juggling skill under different conditions of fatigue. The experimental group performed fatiguing exercise on the Monark bicycle ergometer to an intensity which developed a heart rate of 180 BPM. Exercise was continued for an additional 2 min. at that resistance. There were eleven practice periods for 6 weeks. During the learning phase, the experimental group practised the learning skill after exercising on the bicycle ergometer while the control group practised the learning skill before exercising. Final performance tests were administered two weeks following completion of the learning phase. All subjects performed the final test on the tasks without fatiguing exercise bouts. The results showed that:

1. learning of the speed component in the jumping task was impaired in the fatigue state;
2. learning of accuracy component in the jumping task was enhanced by practice in the fatigue state;

3. learning to juggle was also enhanced by practice performed in a fatigue state.

Welch (1969) gave a group of seventy undergraduates a series of motor coordination tests. The control group (N = 35) rested after 10 min. while the experimental group (N = 35) engaged in heavy muscular work to induce fatigue (600 step-up on an 18 in. bench). Scores of both groups were almost identical before the inter-relation of rest or exercise. The result showed that the interpolated heavy work caused considerable fatigue but the fatigue did not transfer to or impair reaction time or performance in the free turning rho task, the friction rho task, or the pursuit rotor task.

Bartz and Smith (1970) investigated the effect of a moderate standardized work load upon the learning of a gross motor skill. Non-exercised subjects performed ten 30-sec. trials on a stabilometer, rested and performed three addition trials. On the same apparatus, the exercise subjects performed an initial exercise bout in addition to exercise bouts between the first 30-sec. trials. Results showed that although the exercised subjects had an elevated heart rate, performance throughout the learning trials and the rested trials did not differ significantly from that of non-exercised subjects. Both groups showed significant improvement in performance. This showed that fatigue had no effect.

In the study by Cochran (1975), thirty-five female colleges students were distributed into two equated groups. The experimental group was subjected to learning the stabilometer task immediately following a heavy physical work bout on a bicycle ergometer. The control group was subjected to learning the task with no imposed physical exercise.

While the experimental group was engaged in ergometer riding between the trials, the control group engaged in a picture puzzle. Finding from the study showed that the experimental group, i.e., the group that performed the learning task in a fatigue state, performed significantly better than subjects in the control group except in test 4. The 5th test which was used as an index of learning also showed that the experimental group learned the motor task significantly better than the control group.

It is clear from all the experiments described under fatigue that there were conflicting results on the effects of fatigue on learning and performance of motor skills. The differences were probably due to the designs used, Phillips Jr. (1962) and Alderman (1965) seemed to have allowed their subjects to recover from fatigue and therefore had the same result from both groups.

In an attempt to minimize the problem some investigators e.g. Schmdt (1969); Cottem et al (1972) introduced the fatigue before the first trial and between each of the subsequent trials. Others like Carron (1969) introduced the fatigue early and late during the practice-session. They all came out with the same result.

The severity and duration of fatigue seems to be an important variable in the acquisition of a motor skill. Carron and Ferchuk (1971) and Godwin and Schmidt (1971) made their interpolated exercises fatigueing. In the experiment by Benson (1968) recovery from fatigue seemed quite unlikely. This was probably the reason why they had different results from those of Phillips Jr. (1963) and Alderson (1965).

That some investigators came to the conclusion that fatigue enhanced or had no effect on motor skill acquisition or performance or both is quite interesting.

It should, however, be noted that the type of performance tasks varied. Phillips Jr. (1963) used two different muscle groups for the fatigue exercise and the performance task. From Benson (1968) there were two results, one favourable to the learning of accuracy in jumping and juggling and the other detrimental to the learning of speed component in the jumping task. This seems to indicate that effect of fatigue will depend on the nature of task component. It should also be noted that in Welch (1969) the performance task after the heavy work was not another vigorous task. In Cochran's (1975) experiment it seems reasonable to suggest that the actions of the leg muscles in riding was quite different from their actions in the stabilometer task, therefore, the muscles were not working under a fatigue condition. The change of action of the muscle seems as good as a rest.

It is evident that physical fatigue has an effect on both learning and performance. Whether this effect is detrimental depends on the nature and intensity of the task after the fatigue bout.

The physical educator or the coach, as practitioners, should use his/her common sense to decide the optimal period of time his/her athlete should spend learning motor skills before fatigue effects make this time wasteful. Findings from the studies on fatigue that there are times when performance suffers under condition of fatigue are warning to coaches and physical education teachers. The investigator cannot agree more with Carron and Ferchuk (1971) when they said:

> It does seem reasonable that if physical fatigue is of sufficient intensity and duration, a point should be reached when subjects can no longer properly attend to the task, and motor learning as well as performance should suffer. (p.63).

Feedback. One of the variables which affect the efficiency and effectiveness of motor skill acquisition and performance is feedback. Several terms have been used interchangeably with feedback. These include: information feedback (Bilodeau, 1966) and Knowledge of result (Bilodeau and Bilodeau, 1961 and Holding 1969).

Fitts and Posner (1967) describe Feedback as "the information resulting from some response." According to Robb (1972) it is "the information about the consequence of a response that has just been performed." On Feedback Wiener (1961) as quoted by Robb (1972) says:

> --- when we desire a motion to follow a given pattern the difference between this pattern and the actual performed motion is used as view input to cause the part regulated to move in such a way as to bring its motion closer to that given by the pattern. (p.93).

For the purpose of this study feedback may be defined as the information an individual receives from his performance either through an internal or external agent which permits him to profit from his experience.

Most experts in motor learning, Bilodeau and Bilodeau (1969), Fitts and Posner (1967), Cratty (1968) and Siedentop (1976), agree that feedback is one of the strongest and most important variables controlling motor skill acquisition and performance.

Feedback can be intrinsic or extrinsic. Intrinsic feedback is that form of feedback which is provided to the performer as a result of the information inherent in the task itself (Rushall and Siedentop, 1972). To them intrinsic feedback allows the performer to evaluate his response. It provides a frame of reference so that error in the response can be detected and attempts made to correct them. It is the discrepancy between the actual response and the desired response that is, the errors, that acts as input for the

next response. Intrinsic feedback is very glaring in certain games like badminton, tennis, golf, and cricket. A good example is in bowling a cricket ball to the wicket. Where the ball lands in relation to the wicket provides the bowler with information.

Extrinsic or augmented feedback refers to information that is not usually available in the task. It is an extra information that is added by the teacher/coach or the investigator or any other person or thing in the environment.

According to Kamal and Gallahue (1980):

> Extrinsic feedback takes the form verbal cues from an instructor, an observer or some form of mechanical stimulus. (p.215).

Mechanical stimulus in this case may be television, photographs and video-tapes of one's performance (replay of tapes). The effect of both intrinsic and extrinsic cannot be over-emphasised. An example is in soccer corner kick, apart from the verbal comments of the coach as to why the player kicked the ball over the goal-line instead of playing it to the goal-area, the player himself is able to see that the ball did not go to the desired area.

Feedback may either be concurrent or terminal. In a concurrent feedback the information is presented from moment-to-moment as the performance is in progress. Concurrent feedback can be intrinsic or extrinsic in nature. According to Kamal and Gallahue (1980):

> Intrinsic concurrent feedback is the sensory information from the task itself that is supplied to the learner during performance, in other words getting the feel of it when performing a task. (p.216).

Extrinsic concurrent feedback involves information supplied to the performer during an activity from an external source for example,

a mirror.

Terminal feedback refers to information that is supplied or that arises after completing the task. This can also be intrinsic or extrinsic. Intrinsic terminal feedback is that which occurs as a consequence of the performer's actions; a miss in basketball shooting is a typical example of this. Extrinsic terminal feedback is that supplied by an external source, for example, by a coach or a video-tape.

It a person practises without knowing the result of his actions, improvement in his performance is unlikely. Knowledge of Result (KR) serves as a guide to the learner in his subsequent practices and functions as a basis of selection of what is good in that performance. The knowledge should be as precise as possible.

No matter whether the feedback is intrinsic or extrinsic, the learner is provided with information concerning the "goodness" or "correctness" of the movement. Knowledge of result is very important in skill acquisition. According to Bilodeau and Bilodeau (1961) as quoted by [illegible]nal and Gallahue (1980):

> Studies of ..... Knowledge of result show it to be the strongest, most important variable controlling performance and learning. It has been shown repeatedly that there is no improvement without knowledge of result, progressive improvement with it and deterioration after its withdrawal. (p. 216).

Knapp (1964) supports the above statement by saying:

> In general, knowledge of bad points helps a person to break down old habits and knowledge of good points to build up the new. (p.35.)

Knowledge of performance (KP) is another form of terminal feedback. It takes place primarily in both intrinsic and extrinsic

concurrent forms of feedback. The individual receiving intrinsic knowledge of performance is gaining information about the temporal, spatial and kinethetic aspects of the activity while the task is going on. Extrinsic information is supplied through the instructor or observer's comments during the activity. Gentile (1972) and Del Ray (1971) in Kamal and Gallahue (1980) affirmed that knowledge of performance is the most effective when dealing with closed skills. Figure I provides an overview of various aspects of feedback and their relationship to one another.

Feedback plays the role of information, motivation and reinforcement (Brown, 1949 and Ammons, 1956). It may inform an individual about what he should or should not do, or be doing. It may motivate the individual. It may reward the individual for correct performance or punish him for an incorrect performance. The information and reinforcement functions of feedback are reproduced from Kamal and Gallahue (1980) in Figures II & III.

FIGURE I

VARIOUS ASPECTS OF FEEDBACK AND THEIR RELATIONSHIP TO ONE ANOTHER

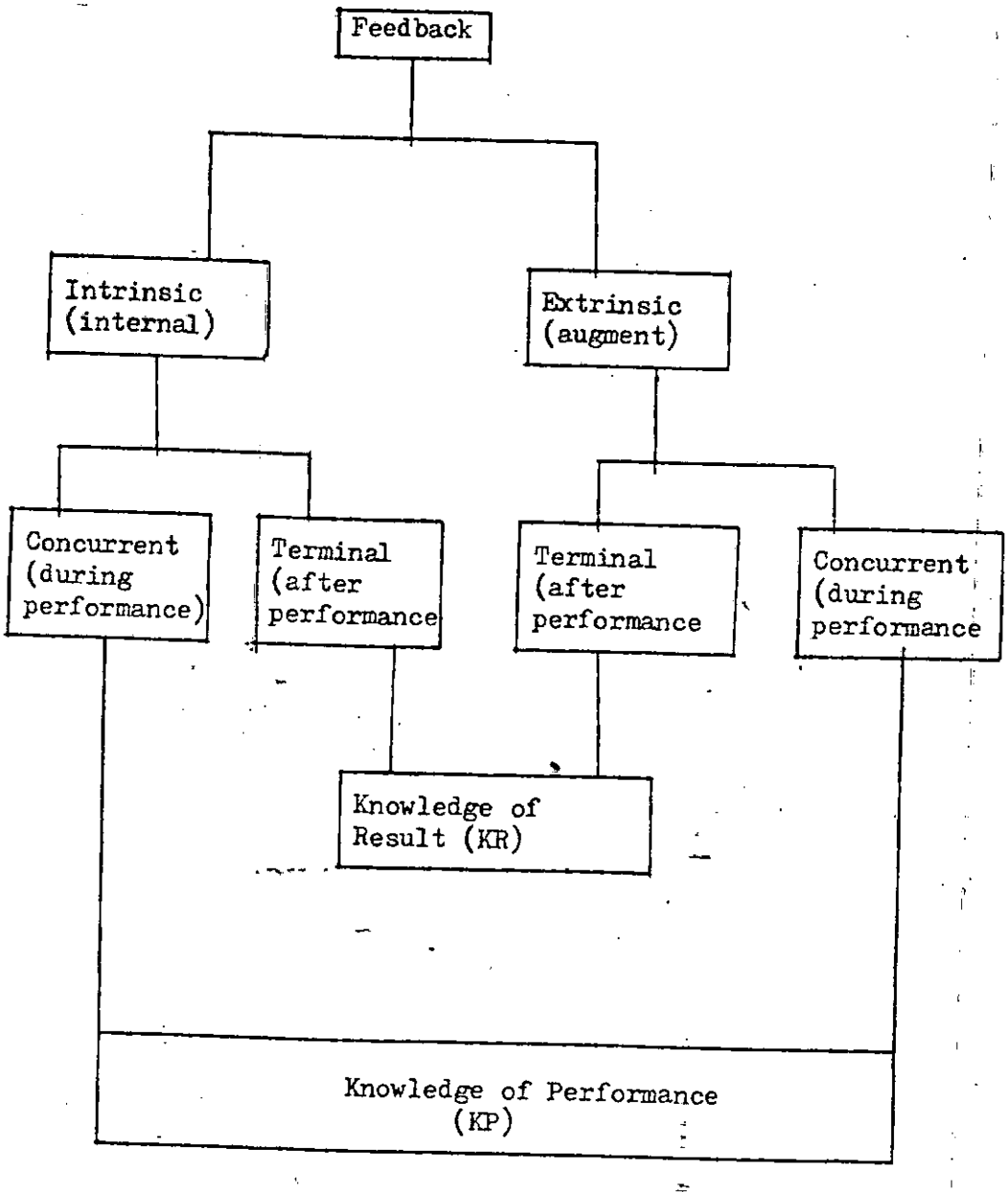


FIGURE II

INFORMATION EFFECT OF FEEDBACK ON FUTURE PERFORMANCE

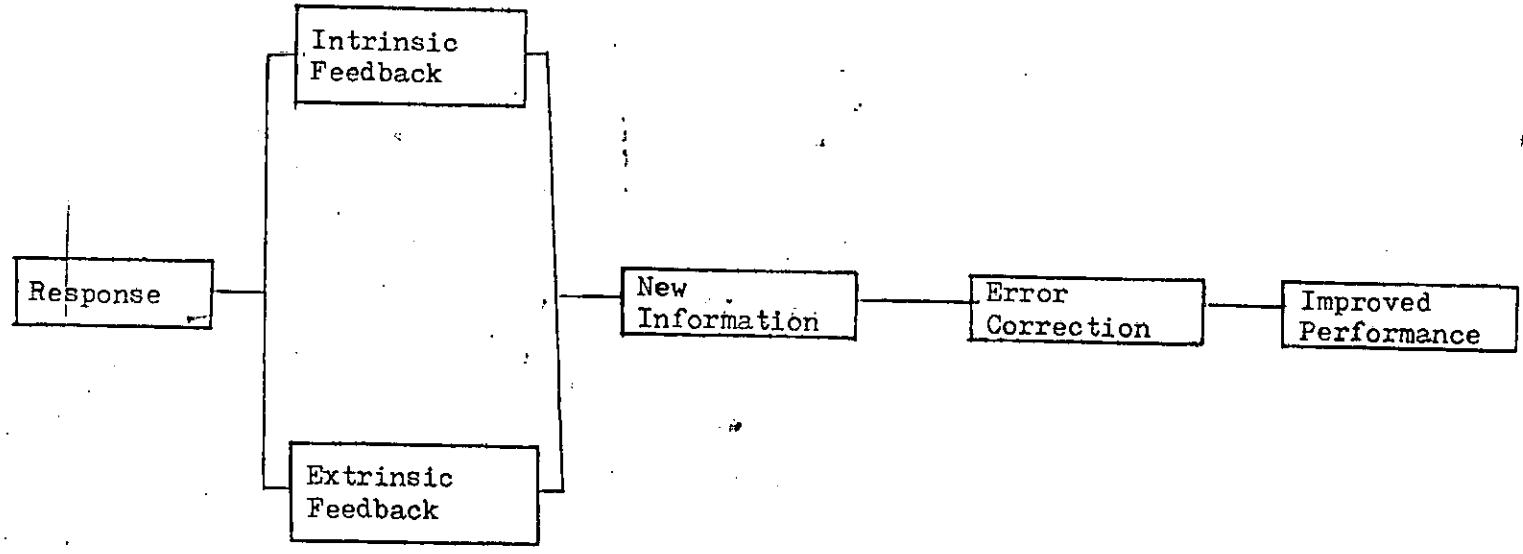
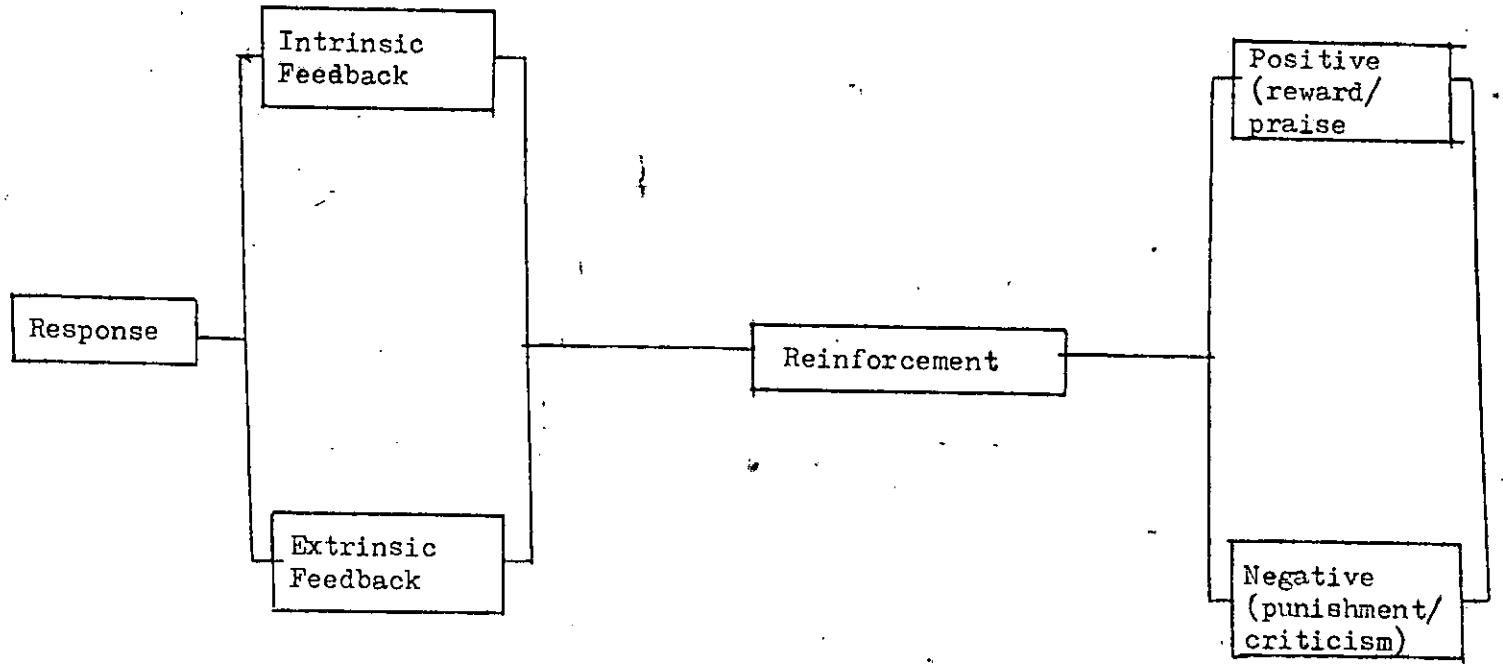


FIGURE III

REINFORCEMENT EFFECT OF FEEDBACK ON FUTURE PERFORMANCE



Studies have been conducted on the effect of the informational aspect of feedback on learning and performance. Pierson and Rasch (1967) carried out an experiment on 15 subjects in California College of Medicine on the "effect of knowledge of result on Isometric strength scores." They discovered that isometric strength scores were greater when the subjects had knowledge of their performance than when they did not.

Bilodeau, Bilodeau and Schumsky (1959) had two groups for an experiment. One group received knowledge of result after every practice trial while the other group received no knowledge of result at all. The group with knowledge of result showed considerable improvement in performance after 20 trials. The group with no knowledge of result did not improve. When the group without knowledge of result were given knowledge of result after the twentieth trial they showed nearly the same improvement as the group with knowledge of result. The experiment seemed to show that learning takes place only if there is some information about performance.

Bardwell (1981) conducted a study on feedback delay, expectation and development. Grades 4, 6 and 8 were used to assess whether feedback on a school related learning task served as an information or reinforcement function. The results indicated that feedback served an informational function and delayed feedback facilitated retention contrary to reinforcement theory rule.

The closed loop theory of motor learning proposed by Adams (1971) holds that the main role of feedback is to supply information to the learner concerning his performance rather than reinforcement. Martenuik's (1976) information processing model of motor learning holds that whether the intrinsic or extrinsic feedback each is a source of errors and which finally leads the learner to the correct response.

Motivational property of feedback has been researched into and investigators seem to agree that additional feedback information facilitates performance and increases interest level (Gibbs and Brown, 1955; Ammons, 1956; Smode, 1958; Locke, 1967; Locke et al., 1968 and Robb, 1972).

It is important to stress that physical education teachers and coaches should note that unless a certain rapport is established between them and their learners, knowledge of result may inhibit instead of motivating learning and performance.

Reinforcement has been defined by Sage (1971) as;

> an event following a response which increases the robability that the response will be made again when the same stimulus situation occurs (p.345).

The reinforcement theories of learning as proposed by Thorndike (1903), Skinner (1938), Miller and Dollard (1941), Hull (1952) and as applied to motor learning by Rushall and Diedentop (1972)hold that reinforcement is the primary role of feedback. They submit that reinforcement may either be positive (rewarding) or negative (punishing).

An investigation conducted by **Rosenbleeth** (1971) compared the effect of various reinforcement on the subjects' maximal motor performance. The investigation was concerned with

(a) Positive Reinforcement (b) Negative reinforcement (c) A Combination of positive and negative reinforcement and (d) A control group with no external reinforcement. The investigator used 7th grade, 8th grade and freshmen from a College. Each grade was sub-divided into four groups with 20 subjects in each group. One group received positive reinforcement, another group received negative reinforcement, the 3rd group received a combination of positive and negative reinforcement and the 4th received no external reinforcement. The task was a 20-second ride on a Monark frictional bicycle ergometer. The subjects were pretested and had nine additional test trials over a period of time. At the conclusion of the test day the treatment was given to each group. The study showed that all the methods of reinforcement improved performance for twenty seconds on the bicycle ergometer. Positive reinforcement, negative reinforcement or a combination of the two did not significantly affect performance.

Hurlock (1925) using addition problem as the learning task with four groups of children found that praised group performed best, the criticised group was second best, followed by ignored group, and finally the no-comment group.

Broughton and Nelson (1967) investigated the effects of reward and punishment on skilled motor performance. The subjects performed three motor tasks: grip strength, starting and running six feet, and a 60-second all out ride on a bicycle ergometer. The investigators used positive verbal reinforcement, neutral reinforcement or negative verbal reinforcement with the subjects. The results showed that the positive reinforcement performed best on all the three tasks.

Witte and Grossman (1971) administered a tactile discrimination

test to three groups of kindergarten children and found that the punishment only and reward/punishment groups performed superior to the reward only group.

From the studies reported above it would appear that in some situations the reinforcement property of praise and reward is greater than punishment or criticism and in other situations the reinforcement effects of punishment may be equal to or greater than those of reward.

On competitive behaviour, Garry (1963) warned that when reward is linked with competition, it may be reinforcing the wrong outcomes. He says as quoted by Sage (1971):

> Instead of behaviour appropriate to the learning task being reinforced, the effect is to reinforce a desire to defeat one's opponent (p.346).

Garry continues his warning to coaches that desirable values of competitive sports will be neglected if teams desire to win at all cost as a result of promised reward.

Research on feedback has begun since the early 1900's but surprisingly only very few controlled studies that use sport skills exist. Majority of the existing research has used fine motor tasks. This point is amplified in Sage's (1977) statement that:

> Studies using gross motor behaviour have been conspicously few, presumably because of the rigid control necessary when feedback is the critical issue. (p.413).

Studies have looked at the effects of providing or withdrawing information about one's performance during or after an activity for varying lengths of time. A few of such studies are reviewed below:

Lorge and Thorndike (1935) tested subjects who performed a ball-tossing task at unseen targets.

The subjects received information about their performance either following a delay of zero to six seconds or after the completion of an intervening throw. From their results, the investigators concluded that there must be some feedback following the performance if learning is to take place, but the presence of an intervening response eliminated the value of feedback and learning did not occur.

Bilodeau (1956) also studied the effect of delay of knowledge of results in an experiment in which additional responses had to be made during the delay. For example in 2-trial delay condition, knowledge of results of the first trial was given only after the third trial had been completed, knowledge of results of second trial were given after the fourth trial was completed. She found that the presence of intervening trials decreased the value of feedback and the performance error increased when intervening trials were added before knowledge of results was given. Her findings on the positioning-task experiment point to the importance of an intervening response in determining the effectiveness of delay in knowledge of results. In a similar Study Lavery and Suddon (1962) also found that eventually people can learn tasks even though intervening trials are present before feedback. They also found that subjects learning the task with intervening trials before feedback were able to retain the skill better than those persons learning the skill with no intervening trial before knowledge of their performance. These results further support the statement that knowledge of results that enhance cues inherent in the task will produce better retention of the skill being acquired.

Greenspoon and Foreman (1956) performed an experiment on the

effect of delaying knowledge of result on the learning of a 3-inch line drawing task with blind-folded subjects. The knowledge of result was delayed for 0, 10, 20 and 30 seconds and one group was not given knowledge of result. The study showed that increasing the length of delay of result reduced the rate of learning, but a delay up to 30 seconds produced better performance than no knowledge of result.

Alexander (1951) in a dart-throwing experiment showed that a delay of knowledge of result from zero to sixteen seconds had little or no effect upon learning when the number of hits or the score obtained on each trial was considered. The ability of the subjects to predict the results of their toss was, however, affected by the length of the delay. The poorest predictions came with either very short or very long delays. This result seems to indicate that moderate delay of knowledge of result enhances learning. The results of a study by Weinberg, Guy and Tupper (1964) on the effect of delays from one to twenty seconds on learning also gave backing to the conclusion that moderate delays in feedback were superior to very short or very long delays. They concluded that a 5-second delay was optimal in the facilitation of performance.

McGuigan (1959) asserted that improved performance noticed in the more moderate delay periods was probably due to the amount of rest between trials or the amount of time allowed between the knowledge of results and the next practice trial. This notwithstanding, the moderate delay periods still produced the optimal performances.

Bilodeau and Bilodeau (1961) concluded that when the periods between responses are free of special interpolated responses,

whether feedback was delayed or given immediately was immaterial to learning.

One method of providing visual feedback during the acquisition of motor skill is to provide motion pictures of one's performance. This type of feedback is delayed, accumulated, and terminal, Watkins (1963) used this technique to improve the batting performance of highly skilled university baseball players. The findings of the study showed that the players who observed their errors through motion picture projection reduced the errors more than the group of player who did not view their batting.

Gray and Brumbach (1967) used a variation of the motion picture-filming technique in a study of beginning badminton skill learning. They used various preconstructed film loops of each of the basic badminton strokes showing a skilled player executing the strokes in both normal and slow motion. The loops were continuously available to the students through daylight projection. The study revealed that at the end of the first 5 weeks of instruction, the students that had access to the film loops acquired a higher level of badminton than those who did not have access to the film loops. At the end of the tenth week, however, there was no significant difference between the performance of the two groups. This study seems to confirm that availability of a visual model facilitates a cognitive understanding of a new motor skill.

Thompson (1969) experimented with two groups of golf beginners. One group used a photographic technique, a Polaroid graph-check-sequence camera providing an immediate feedback. The other group did not have the feedback. The result showed that the photographic technique facilitated the initial acquisition of golf skills.

Again, this study like the earlier ones seems to show that feedback via photographic technique aids beginners to understand the requirement of a new motor skill.

Comparing the effectiveness of a videotape relay of a maze-tracing performance with that of viewing the completed tracing only, Eckert (1970) found no significant difference between the two types of terminal feedback and that within the limit of 7 to 30 seconds the delays had no effect on performance.

Oxendine (1973) cites several studies that show that augmented feedback via the instant replay facilitates the learning of skills by beginners. He, however, stresses that for effective use of the technique, personnels involved should have the technical skills. That is, they should be able to edit the material to give information about the components of the task and be able to teach the learner how to observe the videotape replay.

Physical education teachers and sport coaches should bear in mind that the use of television feedback, as an effective teaching aid requires careful planning.

Implication of Feedback to Teaching.

From the foregoing discussions, it is clear that feedback is very important in learning situation. Physical education teachers and sports coaches should exercise care to ensure that the learner recognises the aspects of the skill that are critical and the nature of feedback surrounding his performance. The teacher must teach the student how to evaluate and use the inherent feedback to modify responses. The successful use of augmented feedback requires careful planning rather than the adoption of a "hit-or-miss" approach. The teacher must study and investigate the different techniques available for use. He must recognise good teaching

criteria and make conscious efforts to include such in his teaching.

Motivation and Motor Skill Acquisition.

Motivation is the internal mechanisms which arouse and direct behaviour (Sage 1971). The investigator defines motivation as an inducement or incentive to action. The importance of motivation in learning has been stressed by authors and researchers. Sage (1971) says, "Learning without motivation will result in little change in behaviour." Robb (1972) says, "Motivation is a prerequisite to any learning and plays an important role during the entire process of acquiring a skill." To emphasize the importance of motivation, Gagne and Fleishman (1959) says "Motivation does not simply add to skill in producing performance, but rather multiplies with it." They suggest an equation, to show this relationship:

Performance = Skill x Motivation.

They said that there were many examples of where an individual or team of mediocre ability beat superior individuals or teams when motivation was high as cases where the equation seemed to apply.

Wilkinson (1966) randomly selected eighty boys from each of four age levels (7-8, 10-11, 13-14 and 16-17 years). He tested the subjects for muscular endurance of the right arm with an ergograph, and used the results to equate the subjects into three treatment groups and a control group. The test was repeated three weeks later. The "praise" groups were given verbal encouragement and the "reproof" groups were subjected to verbal disparagement during the latter part of the test. The "aspiration" groups set hoped for goals after being told their initial scores. The control groups had the initial instructions repeated. The analysis showed that verbal encouragement, verbal discouragement, and level of aspiration were

all highly effective motivators for 7-8 and 10-11 year olds. No motivational variable was significantly effective with the other two age groups. No significant difference was found between the variables, so they seemed equally effective motivators.

Team competition, teacher-imposed level of aspiration, and student-set level of aspiration were compared in college archery classes on the basis of improvement in scores by Clawson (1966). The most favourable condition early in the programme appeared to be individual student-set goals. The group with teacher-imposed goals improved less than the other two groups. Team competition produced positive improvements throughout the programme, especially in the latter phases. Student-set levels of aspiration followed by team competition appeared to be the most desirable sequence. Greater improvement occured before than after the mid-point in the programme. Students who consistently set attainable goals showed more consistent improvement than those who consistently set goals higher than their achievement.

Marten's (1970) study determined the effect of affiliation and task motivation on the success and satisfaction of college intramural basketball teams. Over 1,200 male students from 144 basketball teams responded to a pre- and post-season questioneer which assessed affiliation and task motivation as well as a team satisfaction. Teams were categorized into low, moderate, and high levels for both affiliation and task motivation. The number of games won determined success. The result of the analysis of the study showed that high task-motivated teams were more successful and more satisfied than moderate or low task-motivated teams. High affiliation motivated teams were less successful but more satisfied than moderate and

low-affiliation-motivated teams.

Tutko and Ogilvie (1967) interviewed hundred of coaches and reported that all agreed that motivation was from 50% to 90% their responsibility. They say, "The coach must know how to motivate individuals, and know how to motivate a team."

From the above it is clear that performance is enhanced when an individual is motivated. Everyone involved in the teaching or coaching of motor skill should, therefore, attempt to learn all that he can about motivation so that he can use the knowledge in improving the learning the learning and performance of the students under his direction.

Individual Variance in Learning. There are other variables, apart from those discussed earlier in this chapter, that affect skill acquisition and performance. These include sex, age, height, weight, vision, hearing and motor abilities. Motor abilities, according to Schmidt (1975a) are "inate, relatively stable characteristics of the individual that underlie a certain type of motor response." Experience has shown that individuals vary in capacities they bring to the learning situation. This variability affects the individual's response to instruction (teaching). An individual that has a weak ability will not be proficient in a skill that requires such an ability. In like manner, an individual that is very strong in a particular ability will show proficiency in a skill that requires that ability (Fleishman and Hempel, 1956).

Fitt and Posner (1967) and Sage (1977) opined that individuals vary in the levels of their motivation and their abilities to sustain attention. This variation may affect the rate of acquisition (learning) and consequently the performance of the individual.

The physical education teacher or the coach should be aware of all the variables that affect motor skill acquisition and performance and use his/her expertise to cope with them to the advantage of the learner.

Summary of Literature Review

Categorization of skills enables the physical education teacher or the sport coach to specify to the learner what is involved in a skill. He is also able to understand the complex factors involved in various skills and would, therefore, be able to develop better instructional technique.

Demonstration, diagnosis and direction are crucial in the teaching of motor skills. The teacher/coach should bear in mind that pupils learn more by copying what they see. It is, therefore, advisable that the teacher should be able to demonstrate all skills as perfectly as possible. If the teacher is unable to demonstrate the skill well, he could use a skilled player to demonstrate. Such a demonstration is better than a verbal instruction of how to do the skill. Demonstration must be done where the whole class can see the demonstrator and where the demonstrator can see the class. If a pupil is in difficulty, redemonstrate.

To acquire motor skills requires practice, but practice does not automatically result in improved proficiency. Practice does not make perfect. The learner must be guided in his/her practice and must be encouraged to have mental practice of the skill he is learning. Coaches and physical education teachers should also be concerned with motor skill retention. There are many instructional techniques from which the teacher or the coach can select. The one to use will depend on the changing factor which a successful teacher learns to sense.

Physical fatigue appears to have a negative effect on skill acquisition (learning) and performance. The physical education teacher or the coach should use his/her common sense to decide on the time to spend on learning a skill before fatigue affects performance.

Feedback is a "sine qua non" for motor skill acquisition. The practitioner in the field of motor skill acquisition must study and investigate the different techniques available for use and make conscious efforts to apply them in his teaching/coaching situations.

Motivation is the key to all learning. The primary task of the teacher or coach is to encourage students to want to learn. The teacher or coach should praise what the students do correctly so that they will keep trying until they master the skill. Each student should be motivated to do his best. The teacher or the coach should remember that students vary in their ability to assimilate and that they have different Physical Education background. All teachers must find out for themselves the best and most positive way to motivate the students under their directions. It is, however, advisable to use more reward technique than punishment technique.

There are some variables among individuals which result in different ways of processing information, resulting in different responses to stimuli and produce differences in performance. The physical education teachers or the coaches should take into account the individual differences in their students when planning their teaching/coaching sessions.

CHAPTER III

METHODS AND PROCEDURES

Introduction

This study compared three instructional techniques in terms of their ability to promote learning of dribbling and shooting in the game of hockey. The investigation was conducted in two stages. The first stage was the pilot study while the second was the main study.

The Pilot Study

The purpose of the pilot study was to determine the problems that might arise when conducting the main study. The second purpose was to refine the measuring instruments before conducting the main study. A third reason was to evaluate the measuring instruments.

The subjects for the pilot study were sixty Form I boys attending a Secondary School in the Somolu Local Government of Lagos State. The boys were randomly assigned to three treatment groups with twenty boys in each group. The groups were the practice group, the Reciprocal group and the Inclusion group. Each group had one 1-hr. period per week for three weeks on dribbling. The Practice Technique (PT) group had its training on Mondays, the Reciprocal Technique (RT) group had its on Wednesdays while the Inclusion Technique (IT) group had its own training on Fridays. At the end of the three weeks the boys were tested with the Adebayo Hockey Dribbling Test for Beginners to ascertain the effect of the treatments on learning outcomes. (See Appendix A-1 for the description of the test). The analysis of the results showed that the three techniques produced significant improvement ($p < .05$).

The three groups then had the same treatments for the skill of shooting in hockey. Again, they each had one 1-hr. a week for three weeks. At the end of the treatment period the learning outcome was measured with the Adebayo Hockey Shooting Test for Beginners. (See Appendix A-2 for the description of the test). The analysis of the results showed that there was no significant difference in the learning outcomes produced by the three techniques ($p < .05$).

During the pilot study, it was observed that some boys did not dribble round some of the markers which were originally single tins. This observation made the investigator to design the marker used for the main study (See Figure IV in the Appendix).

The original facility for the shooting test had no restraining circle. During the pilot study it was observed that some boys dribbled far into the shooting circle before shooting. The restraining circle included in the final facility for the test in the main study prevented the phenomenon (See Figure VI in the Appendix).

Evaluation of the Instruments

There are certain qualities which a measuring instrument must possess before one can have faith in it. These qualities are validity, reliability, objectivity and economy. Unless an instrument has all these qualities, it is of very limited use in an educational evaluation programme. In order to provide information about the worth of the instruments used in this study, their validity, reliability, objectivity and economy were established. (Baumgartner and Jackson, 1975).

Validity of the Instruments

Validity of a measuring instrument is the degree to which the instrument measures what it intends to measure (Obe, 1980).

To establish the validity of the instruments used in this study, face validity and subjective rating methods were used.

Three hockey coaches from the Lagos State Sports Council were invited to evaluate the instruments. All the three coaches agreed that the two instruments measured what they were intended to measure.

The three coaches were asked to subjectively score twenty boys from those used for the pilot study. The subjective ratings of the coaches were used as the criterion score as recommended by Baumgartner and Jackson (1975). The ratings by the coaches were converted to figures. In the conversion A = 5, B = 4, C = 3, D = 4 and E = 1. (See Appendix B for the rating scale). Using the Pearson Correlation Coefficient formula, the scores on the instruments were correlated with the composite scores by the coaches. The validity coefficient for dribbling was 0.70 while that for shooting was 0.83 (See Appendices C-2 for the computations). These coefficients were high enough for the investigator to conclude that the instruments for this study were valid.

Reliability of the Instruments

Reliability is the extent to which a test is dependable. That is, the degree to which similar results will occur when the instrument is repeated on the same subjects under similar conditions.

The test-retest method which has been described by Roscoe (1975) as "the most obvious method of determining reliability of a test" was used for this study.

Twenty boys from those used for the pilot study were tested on two occasions on each of the instruments. On a Monday at about 9.00 a.m. the boys were tested on dribbling. On Wednesday of the same week, the boys were re-tested at about the same time of 9.00 a.m. On Tuesday of the same week the boys were tested on shooting at 9.00 a.m. The following Thursday, at about 9.00 a.m. they were re-tested on the shooting test.

The Monday scores were correlated with the Wednesday scores using the Pearson Correlation Coefficient formula. The Tuesday and Thursday scores were also correlated to compute the reliability coefficient. From the computations the reliability coefficient for the Dribbling Test was 0.95 while the coefficient for the Shooting Test was 0.90 (See Appendices C-3 & C-4 for the computation). These coefficients were high enough for the investigators to conclude that the two instruments were reliable.

Objectivity of the Instruments

Objectivity is the degree of uniformity with which various persons score the same testee. It is a measure of the worth of the scores from a test.

Like validity and reliability it can be determined statistically. Two or more testers score the subjects concurrently and independently. The correlation coefficient obtained from the two set of scores indicates the objectivity of the test.

In establishing the objectivity of the measuring instrument for dribbling in this study, three physical education students of the University of Lagos, who had training in timing and who were judged to be very good by the lecturer in charge of track and field athletics, scored the boys. The three stop watches synchronized. The boys for the pilot study were scored and the scored and the scores from the three students were used to determine the objectivity of the instrument. The Pearson Correlation Coefficient Formula was used to correlate the scores from two of the students. The coefficient was 0.9. The scores from one of the two students was correlated with those of the third student and the coefficient was 0.9. These coefficients indicated that the scores from the three scorers were uniform.

For the shooting test, the physical education students and the investigator scored the boys for the pilot study. Objectivity had been built in the scoring system. That is, once a ball passed through any of the portions of the goal, the designated point was awarded. All the three scorers had the same scores from all the boys tested.

On the basis of the above the two instruments were judged to be objective.

Economy of the Instruments

Economy of an instrument refers to the cost of the testing materials, the time required for conducting the test and the feasibility of the test.

As far as the instruments for this study were concerned, they did not require expensive equipment.

The dribbling test required sticks, tins and stop watches.

The shooting test required bands and a stick as the marker. The additional marking required was a semi circle with broken lines.

The pilot study showed that the main study would be feasible and would not be time consuming. The dribbling test took about one hour for the twenty boys. While the shooting test took one and a half hours. The instruments were judged by the investigator as possessing economy.

TABLE 1

SUMMARY OF THE EVALUATION OF THE INSTRUMENTS

	DRIBBLING	SHOOTING
VALIDITY	0.70	0.83
RELIABILITY	0.95	0.90
OBJECTIVITY	0.99	0.99

The Main Study

In this study, junior secondary school boys learnt the skills of dribbling and shooting in the game of hockey using one of three instructional techniques. The techniques were the same as for the pilot study. These were: the Practice Technique (PT), the Reciprocal Technique (RT) and the Inclusion Technique (IT). The purpose was to determine the relative effectiveness of these alternative techniques of instruction on acquiring the skills of dribbling and shooting in hockey.

The Subjects of the Study

A boys' Secondary School in the same School Management Committee (SMC) as that used in the pilot study was chosen for the study. The school was chosen because of its nearness to the University of Lagos where the study was conducted. A second reason for selecting the school was that it had the facilities for the game under investigation.

From a population of six Form I classes, three were randomly selected. The reason for selecting classes was that the experiments were performed during the physical education periods on the school time-table. From each of the three classes, thirty boys were randomly selected. That is, a total of ninety boys were used for the study. The three classes were then randomly assigned to the treatment groups.

The ages of the boys ranged from 11-14 years. None of the boys had any experience with the skills used in this investigation.

Experimental Treatments

The boys learnt dribbling and shooting in the game of hockey under one of three experimental treatments. The treatments were:

1. The Practice Technique (PT).
2. The Reciprocal Technique (RT).
3. The Inclusion Technique (IT).

Each treatment group had two 40-min. periods of instruction and training for four weeks. The periods were the physical education lesson periods scheduled on the school time-table. The groups first learnt dribbling. After the experiment on dribbling had been completed, they learnt the skill of shooting in hockey.

In order to prevent variation in the teaching behaviour and in the personality of the teacher, the investigator did the teaching. A highly skilled player from the first team of the Lagos State Amateur Hockey Association, however, demonstrated the skills.

Experimental Design

A pre-test - post-test design was employed to determine the effects of the three techniques of instruction on skill acquisition and retention. Shown below is the model of the design:

TABLE 1(a)

MODEL OF THE DESIGN

Practice Technique	S_1	T	S_2	S_3
Reciprocal Technique	S_1	T	S_2	S_3
Inclusion Technique	S_1	T	S_2	S_3

KEY:

S_1 = Pre-test Score

S_2 = Post-test Score

S_3 = Final test Score

T = The treatment.

Dribbling in Hockey

The Practice Technique Group. The group met on Tuesday and Thursdays from 9.20 a.m. to 10.00 a.m. At the beginning of the first period, the investigator explained to the boys what they were expected to do and the roles which he had to perform during the impact period. He explained and described how to execute the skill of dribbling stressing the following teaching points:

(a) The left hand is on top of the stick while the right hand is a little way down the stick.

(b) Lean forward.

(c) Get the ball ahead of you and slightly to your right.

(d) Reverse the stick to bring the ball that goes to the left back to the right.

(e) Look away from the ball regularly to ascertain positions of other players.

After the explanation and description, the highly skilled player demonstrated. After the demonstration the investigator allowed the boys to ask questions on what they had heard and seen. After the questions had been answered the boys dispersed to the practice stations. Each boy selected a practice station and began his practice trials using the items in the task sheet shown in Appendix D-1. During the practice period the investigator moved about, observed the performance of each boy and offered feedback to individual learner. Some of the feedback were:

1. Keep your hands apart.

2. Reverse the stick to bring the ball to your right.

3. Increase your speed.

The Reciprocal Technique Group. The group met on Wednesdays and Fridays from 9.20 a.m. to 10.00 a.m. On the first day of the experiment, the investigator led the boys through the periods of explanation, description, demonstration and questions as he did with the Practice Technique Group. After their questions had been answered, the boys were asked to select a partner with whom they wanted to work and go to the practice station. At the practice station, they used the task sheet provided by the investigator (See Appendix D-2). As one performed the task the other carefully watched the performance of the partner, compared it with specific criteria/teaching points provided by the investigator, drew conclusions about the quality of what was observed and offered feedback to the performer. They then switched roles. That is, the performer became the observer and the observer became the performer. The investigator moved about from pair to pair, listened to the feedback offered by the observer, communicated with the observer in regard to the feedback offered and gave feedback to the observer and moved to the next pair. A sample of communication that went between the investigator and the observer was:

Investigator: "How is your partner doing?"

Observer: He is keeping his hands together."

Investigator: "Did you tell him?"

Observer: "I will tell him."

Investigator: "Let me hear you tell him."

Another one was:

Investigator: "How is your partner doing?"

Observer: "He is doing well."

Investigator: "What is he doing well?"

Observer: "He is reversing his stick to bring the ball to the right."

Investigator: "Your observation is correct."

Did you tell your partner?"

Observer: "Yes"..

Investigator: "Good".

The group used the task sheet throughout the four weeks of the experiment.

The Inclusion Technique Group. The boys met on Mondays from 9.20 a.m. to 10.00 a.m. and on Wednesdays from 10.10 a.m. to 10.50 a.m. On the day the group first met the investigator described and explained what the boys were to do and stressed the teaching points as given to the Practice Technique Group. The highly skilled player demonstrated and the boys were given the opportunity to ask questions on what they heard and saw. The questions were answered and the boys were given the task sheets (See Appendix D-3). They dispersed to their practice locations. At the practice locations they surveyed the choices offered by the levels of the performance and decided their individual entry points.

After the boys had started, the investigator moved about and offered feedback to the individual learner on whether or not he had selected the appropriate level. He avoided value feedback which might give the impression that he liked the level selected.

Whenever the investigator observed error in performance at any of the levels he asked the learner to refer to the task sheet and to check his performance again. Learners who chose low levels chose higher level when they felt that they were ready for the level. The sheet was used throughout the period of the experiment.

Shooting in Hockey

For this experiment, the same groups of boys as for the dribbling experiment were used. That is, the boys who had the Practice Technique treatment for dribbling also had Practice Technique treatment for shooting. The same was true of the other treatments.

The Practice Technique Group. The group met from 9.20 a.m. to 10.00 a.m. on Tuesdays and Thursdays. On the first day, as was done for the dribbling experiment, the investigator explained and described the execution of the skill stressing the following teaching points:

(a) The two hands are close together at the top of the stick.

(b) The left shoulder points to the direction the ball is expected to go.

(c) One foot must be in front at the time of taking the shot.

(d) Keep eyes on the ball.

(e) Swing the stick hard and follow through to the intended direction of the ball.

The highly skilled player used for the dribbling demonstrated the skill. After the demonstration the boys went to their

practice stations. They used the task sheet (See Appendix D-4) for their practices and the investigator offered feedback in the same manner as he did with this treatment for dribbling. The task sheet was used throughout the period of the experiment.

The Reciprocal Technique Group. The group had its teaching - learning sessions on Wednesdays and Fridays from 9.20 a.m. to 10.00 a.m. The group went through the routine of the first day as described in this treatment with dribbling. The task sheet shown in Appendix D-5 was used for the practice and throughout the period of the experiment. The roles of the learners were exactly the same as for dribbling. That is, they worked in pairs and switched roles. The investigator also performed the same role as he performed for the experiment on dribbling.

The Inclusion Technique Group. The boys met on Mondays from 9.20 a.m. to 10.00 a.m. and on Wednesdays from 10.10 a.m. to 10.50 a.m. On the first day of meeting, they went through the routine described under this technique used for dribbling. The task sheet used for their practices is shown in Appendix D-6. The task sheet was used for the four weeks of the experiment. The role of the investigator was exactly the same as his role for the Inclusion Technique under the dribbling experiment.

Data Collection

Before the beginning of the dribbling experiment the subjects were tested with the Adebayo Hockey Dribbling Test for Beginners. At the end of the fourth week they were tested with the same test to obtain the post test scores. After four weeks of no practice the test was administered to obtain the final test score. Each test was scored as described in Appendix A-1.

Scores for the shooting experiment were also collected, using the Adebayo Hockey Shooting Test for Beginners, before the beginning of the experiment, at the end of the fourth week and after four weeks of no practice. Again, the scores were obtained as described in Appendix A-2.

The pre-test, the post-test and the final test scores for each experiment were used for the analysis (See Appendices E-1 to E-6).

Method of Data Analysis

Analysis of variance (ANOVA) was used to determine whether there was any significant difference among the three groups,

(1) at the beginning of the study,

(2) after the treatment and

(3) after four weeks of no practice. Where there was a significant difference, the Tukey's Post Hoc Analysis method was used to compare the differences between pairs of the means. If a difference between a pair of means was greater than the Tukey value, the two means were said to be significantly different from each other.

Analysis of covariance (ANCOVA) was also used to determine whether the three techniques of instruction differ in effects on,

(1) the post-test scores from the two skills, after the effect of the pre-test had been controlled or neutralized, and

(2) the final-test scores from the two skills, after the effect of the post-test had been controlled or neutralized.

Again, where there was a significant difference, the Tukey's Post Hoc Analysis was used to compare the differences between pairs of the means.

To determine whether there was a significant improvement in each group after the treatment, t-test was done to determine the differences between the pre-test and post-test scores within each group. In like manner, t-test was done to determine whether there was any significant difference between the post-test and the final-test. This was done to determine whether there was any significant improvement or regression in the retention of the skills learned within each group.

The confidence level for all the analyses was set at 0.05.

CHAPTER IV

RESULTS, DATA ANALYSIS AND DISCUSSION

Intreduction

This chapter presents the results of the study conducted to determine the effect of three techniques of instruction on hockey dribbling and hockey shooting test scores of selected junior secondary school boys. The chapter is organised under the following headings: Effect of the three techniques on the acquisition of hockey dribbling Skill, Effect of the three techniques on the acquisition of hockey shooting skill. Effect of the three techniques on the retention of hockey dribbling skill. Effect of the three techniques on the retention of hockey shooting skill.

The relevant raw scores and computations are presented in the appendices.

EFFECT OF THE THREE TECHNIQUES ON THE ACQUISITION OF HOCKEY DRIBBLING SKILL.

Table 2 below gives the means and the standard deviation of the pretest and post-test scores for the three techniques of instruction:

TABLE 2

MEANS AND STANDARD DEVIATION OF THE PRETEST AND POST-TEST DRIBBLING SCORES IN SECONDS.

	Techniques of Instruction								
	Practice			Reciprocal			Inclusion		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Pre-test	30	23.4	±3.26	30	24.1	±4.14	30	23.6	±4.98
Post-test	30	21.3	±3.91	30	21.6	±3.93	30	20.6	±3.02

KEY: N = Number of Boys

SD = Standard Deviation.

Table 2 shows that at the pretest the practice group had the fastest mean time of 23.4 sec., the inclusion group was second with 23.6 sec. while the reciprocal group had the slowest time of 24.1 sec. Analysis of variance (Table 3) performed on the pretest mean scores revealed that there was no significant difference among the groups at the beginning of the study.

TABLE 3

SUMMARY TABLE FOR ANOVA ON THE PRETEST DRIBBLING SCORES

Source of Variation	DF	SS	MS	Fc	Ft
Between groups	2	7.72	3.86	$0.22^{N.S}$	3.07
Within groups	87	1525.23	17.86		
Total	89	1532.95	--		

$P < 0.05$

KEY: N.S. = Not Significant
DF = Degrees of Freedom
SS = Sum of Squares
MS = Mean Square
Fc = Computed F-ratio
Ft = Tabled F-ratio

Table 2 also shows that at the post-test the inclusion group with a mean score of 20.6 sec. was the fastest, the practice group with 21.3 sec. came second while the reciprocal group with a mean score of 21.6 secs. was the slowest. Analysis of variance (Table 4) shows that the differences among the scores from the three groups were not statistically significant.

TABLE 4

SUMMARY TABLE FOR ANOVA ON THE POST-TEST DRIBBLING SCORES

Source of Variation	DF	SS	MS	Fc	Ft
Between groups	2	15.45	7.73	$0.58^{N.S}$	3.07
Within groups	87	1154.55	13.27		
Total	89	1170.00	—		

$P < 0.05$

KEY: N.S. = Not Significant. DF = Degrees of Freedom

SS = Sum of Squares. MS = Mean Square

Fc = Computed F-ratio. F_t = Tabled F-ratio

TABLE 5

t-TEST RESULTS ON THE DIFFERENCE BETWEEN THE PRE-TEST AND POST-TEST DRIBBLING SCORES

TECHNIQUE	N	Mean	SD	tc	t
Practice	30	2.16	3.41	3.47*	
Reciprocal	30	2.59	3.15	4.50*	2.045
Inclusion	30	3.06	4.07	4.91*	

$P < 0.05$

KEY: N = Number of Pairs t = Tabled t

SD = Standard Deviation of Difference within Pairs tc = Computed t

* = Significant at 0.05 level of confidence.

Table 2 shows that the pretest time for each of the techniques was greater than the corresponding post-test time. This indicates that the boys were faster at the post-test than at the pre-test. A t-test analysis (Table 5) shows that there was a significant difference ($P < 0.05$) between the pre-test and the post-test scores of each of the groups.

Analysis of covariance performed on the pre-test and post-test scores (Table 6) revealed that the difference among the three groups was not statistically significant.

TABLE 6

SUMMARY TABLE FOR ANCOVA ON THE PRE-TEST AND THE POST-TEST DRIBBLING SCORES.

Source of Variation	DF	SSx	SP	SSy	DF^1	SS^1y	MS^1y	Fc	Ft
Between groups	2	7.72	3.47	15.45	2	14.38	7.19	$0.56^{N.S}$	3.07
Within groups	87	1525.23	303.68	1154.55	86	1094.48	12.73		
Total	89	1532.95	306.15	1170.00	88	1108.86	--		

$P < 0.05$

KEY: N.S. = Not Significant; DF^1 = Adjusted Degrees of Freedom.

DF = Degrees of Freedom. SS^1y = Adjusted Sum of Squares for Post-test.

SSx = Sum of Squares for Pre-test. MS^1y = Adjusted Mean Square for Post-test.

SP = Sum of Product. Fc = Computed F-ratio.

SSy = Sum of Squares for Post-test. Ft = Tabled F-ratio.

Effects of the Three Techniques on the Acquisition of Hockey Shooting Skill

Table 7 gives the means and the standard deviation of the pre-test and the post-test scores on hockey shooting for the three techniques of instruction.

TABLE 7

MEANS AND STANDARD DEVIATION OF THE PRETEST AND POST-TEST SHOOTING SCORES

	Techniques of Instruction								
	Practice			Reciprocal			Inclusion		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Pre-test	30	5.63	±1.73	30	4.87	±1.91	30	5.60	±1.96
Post-test	30	12.33	±2.82	30	10.67	±1.60	30	11.50	±1.70

KEY: N = Number of Boys. SD = Standard Deviation.

In Table 7, the practice group recorded the highest mean score of 5.63 at the pre-test. The inclusion technique with 5.60 was next while the reciprocal group recorded the least mean score of 4.87. Analysis of Variance (Table 8) showed that there was no significant difference among the three mean scores.

TABLE 8

SUMMARY TABLE FOR ANOVA ON THE PRE-TEST SHOOTING SCORES

Source of Variation	DF	SS	MS	Fc	Ft
Between groups	2	11.26	5.63	1.61 N.S.	3.07
Within groups	87	303.64	3.49		
Total	89	314.90	--		

$P < 0.05$

N.S = Not Significant.

TABLE 9

SUMMARY TABLE FOR ANOVA ON POST-TEST SHOOTING SCORES

Source of Variation	DF	SS	MS	Fc	Ft
Between groups	2	41.66	20.83	4.66*	3.07
Within groups	87	388.84	4.47		
Total	89	430.50	—		

$P < 0.05$

KEY: DF = Degrees of Freedom
SS = Sum of Squares
MS = Mean Square
Fc = Computed F-ratio
Ft = Tabled F-ratio
* = Significant at 0.05 level of confidence.

TABLE 10

POST HOC TEST ON POST-TEST SHOOTING SCORES

	PRACTICE 12.33	INCLUSION 11.50	RECIPROCAL 10.66*	TUKEY'S CRITICAL VALUE
12.33	—	$0.83^{N.S}$	1.66*	
11.50		--	$0.83^{N.S}$	1.30
10.67			—	

KEY: N.S. = Not Significant * = Significant at 0.05 level of confidence.

The post-test mean scores displayed in Table 7 shows that the practice group which recorded 12.33 was the best, while the inclusion group with a mean score of 11.50 was better than the reciprocal group that recorded 10.67.

Table 9, the result of the analysis of Variance (ANOVA) performed on the differences among the post-test scores, however, showed that the differences were statistically significant ($P < 0.05$). The result of the post hoc analysis (See Table 10) on the post-test scores revealed that the practice technique was significantly greater than the reciprocal technique (Tukey = $P < 0.05$), whereas there was no significant difference between the practice and inclusion techniques. Also, the reciprocal and the inclusion techniques did not differ significantly.

From Table 7 it could be seen that the post-test score for each technique was greater than its pre-test score. This indicated that the boys improved on their performances at the post-test. The t-test analysis (See Table 11) on the difference between the pre-test and the post-test scores, revealed that the improvements were statistically significant ($P < 0.05$).

TABLE 11

t-TEST RESULTS ON THE DIFFERENCES BETWEEN THE PRE-TEST AND POST-TEST SHOOTING SCORES.

TECHNIQUE	N	Mean	SD	tc	t
Practice	30	6.70	3.76	9.76*	2.045
Reciprocal	30	5.80	1.55	20.50*	
Inclusion	30	5.90	1.44	22.44*	

$P < 0.05$

KEY: N = Number of Pairs
SD = Standard Deviation of Difference within Pairs.
t = Tabled t
tc = Computed t
* = Significant at 0.05 level of confidence.

The summary table for the analysis of covariance on the pre-test and post-test scores (See Table 12) also revealed that a statistically significant difference ($P < 0.05$) existed among the three techniques. A post hoc analysis (Table 13) performed on the adjusted post-test scores showed that the difference between the practice and reciprocal groups was significantly different, while that between the practice and inclusion groups, on the one hand, and the one between the inclusion and reciprocal groups on the other were not significantly different.

TABLE 12

SUMMARY TABLE FOR ANCOVA ON

PRE-TEST AND POST-TEST SHOOTING SCORES.

Source of Variation	DF	SSx	SP	SSy	DF^1	SS^1y	MS^1y	Fc	Ft
Between groups	2	11.26	19.16	41.66	2	35.11	17.56	3.95*	3.07
Within groups	87	303.64	46.34	388.84	86	381.77	4.44		
Total	89	314.90	65.50	430.50	88	416.88	—		

$P < 0.05$

KEY:

DF = Degrees of Freedom

SSx = Sum of Squares for Pre-test

SP = Sum of Product

SSy = Sum of Squares for Post-test

* = Significant at 0.05 level of confidence

DF^1 = Adjusted Degrees of Freedom

SS^1y = Adjusted Sum of Squares for Post-test

MS^1y = Adjusted Mean Square for Post-test

Fc = Computed F-ratio

Ft = Tabled F-ratio.

TABLE 13

POST HOC TEST ON ADJUSTED POST-TEST SHOOTING SCORES

	PRACTICE 12.29	INCLUSION 11.46	RECIPROCAL 10.75	TUKEY'S CRITICAL VALUE
12.29	—	0.83 N.S.	1.54*	
11.46		--	0.71 N.S.	
10.75			--	1.29

P < 0.05

KEY: N. S. = Not significant. * = Significant at 0.05 level of confidence.

Effect of the Three Techniques on the Retention of Hockey Dribbling Skill

The final test was conducted four weeks after the end of the treatment. The result of the test and that of the post-test are shown in Table 14.

TABLE 14

MEANS AND STANDARD DEVIATION OF THE POST-TEST AND FINAL TEST DRIBBLING SCORES IN SECONDS

	Techniques of Instruction								
	Practice			Reciprocal			Inclusion		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Post-test	30	21.3	±3.91	30	21.6	±3.39	30	20.6	±3.02
Final-test	30	19.5	±3.22	30	21.1	±4.19	30	20.4	±3.62

KEY: N = Number of Boys.

SD = Standard Deviation.

Table 14 shows that at the final-test, the practice group with a mean score of 19.5 sec. was the fastest of the three groups. The inclusion group which recorded 20.4 sec. was second while the reciprocal group with a mean score of 21.1 sec. was the slowest of the three groups. ANOVA performed on the final-test mean scores (Table 15) showed that there was no statistically significant difference among the groups.

TABLE 15

SUMMARY TABLE FOR ANOVA ON FINAL-TEST DRIBBLING SCORES

Sources of Variations	DF	SS	MS	Fc	Ft
Between groups	2	34.70	17.35	$1.25^{N.S}$	3.07
Within groups	87	1210.16	13.91		
Total	89	1244.86	—		

$P < 0.05$

KEY: DF = Degrees of Freedom. Fc = Computed F-ratio

SS = Sum of Squares. Ft = Table F-ratio

MS = Mean Square. N.S. = Not Significant.

Table 14 also shows that each group performed better at the final-test than at the post-test. The t-test performed on the scores (Table 16) showed that the practice technique group was the only one whose difference was significant ($P < 0.05$).

TABLE 16

t-TEST RESULTS ON THE DIFFERENCES BETWEEN THE POST-TEST AND FINAL-TEST DRIBBLING SCORES.

TECHNIQUE	N	Mean	SD	tc	t
Practice	30	1.75	2.97	3.23*	
Reciprocal	30	0.49	2.31	1.16 N.S	2.045
Inclusion	30	0.17	2.46	0.38 N.S	

$P < 0.05$

KEY: N = Number of Pairs
SD = Standard Deviation of Difference within Pairs.
t = Table t
tc = Computed t
N.S. = Not Significant
* = Significant at 0.05 level of confidence.

Analysis of covariance (ANCOVA), Table 17, showed that there was a significant difference ($P < 0.05$) among the techniques. A post hoc analysis performed on the adjusted final-test scores (Table 18), however, revealed that none of the differences was statistically significant.

TABLE 17

SUMMARY TABLE FOR ANCOVA ON POST-TEST

AND FINAL-TEST DRIBBLING SCORES.

Source of Variation	DF	SSy	SP	SSz	DF^1	SS^1_{zz}	MS^1_z	Fc	Ft
Between groups	2	15.45	4.32	34.70	2	37.27	18.64	3.13*	3.07
Within groups	87	1154.55	897.92	1210.16	86	511.83	5.95		
Total	89	1170.00	902.24	1244.86	88	549.10	--		

$P < 0.05$

KEY: DF = Degrees of Freedom

SSy = Sum of Squares for Post-test

SP = Sum of Product

SSz = Sum of Squares for Final-test.

* = Significant

DF^1 = Adjusted Degrees of Freedom.

SS^1_z = Adjusted Sum of Squares for Final-test.

MS^1_z = Adjusted Mean Square for Final-test.

TABLE 18

POST HOC TEST ON ADJUSTED FINAL-TEST DRIBBLING SCORES.

	PRACTICE 19.40	RECIPROCAL 20.76	INCLUSION 20.84	TUKEY'S CRITICAL VALUE
19.40	--	$1.36^{N.S.}$	$1.44^{N.S.}$	
20.76		--	$0.08^{N.S.}$	1.50
20.84			--	

$P < 0.05$

KEY: N. S. = Not Significant.

Effect of the Three Techniques on the Retention of Hockey Shooting Skill.

The final-test scores were obtained after four weeks of no practice. The result of the final-test and the one obtained from the post-test are presented in Table 19.

TABLE 19

MEANS AND STANDARD DEVIATION OF THE POST-TEST AND FINAL-TEST SHOOTING SCORES.

	Techniques of Instruction								
	Practice			Reciprocal			Inclusion		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Post-test	30	12.33	±2.82	30	10.67	±1.60	30	11.50	±1.70
Final-test	30	11.47	±2.70	30	9.67	±2.12	30	10.77	±2.13

KEY: N = Number of Boys

SD = Standard Deviation.

Table 19 shows that at the final-test, the practice technique group had the highest mean score of 11.47. The inclusion technique group with a mean score of 10.77 was next while the reciprocal technique with a mean score of 9.67 was the least. ANOVA on the mean scores (Table 20) revealed that there was a significant difference among the three groups ($P < 0.05$). A post hoc test performed on the final-test scores (Table 21) showed that there was a significant difference between the practice and reciprocal groups (Tukey = $P < 0.05$). The analysis also showed that there was no significant difference between the practice and inclusion groups and between the inclusion and reciprocal groups.

From Table 19 one can observe that the final-test mean score for each of the groups was less than the post-test mean score for the group.

The t-test performed on the post-test and final-test mean scores (Table 22), however, revealed that in the practice technique group, the difference was not significantly different, whereas in the reciprocal and the inclusion groups, the differences were statistically significant ($P < 0.05$).

TABLE 20

SUMMARY TABLE FOR ANOVA ON FINAL-TEST SHOOTING SCORES

Source of Variation	DF	SS	MS	Fc	Ft
Between groups	2	49.39	24.70	4.54*	3.07
Within groups	87	473.51	5.44		
Total	89	522.90	—		

$P < 0.05$

KEY: DF = Degree of Freedom. Fc = Computed F-ratio
SS = Sums of Squares Ft = Tabled F-ratio
MS = Mean Square * = Significant at 0.05 level of Confidence.

TABLE 21

POST HOC TEST ON FINAL-TEST SHOOTING SCORES

	PRACTICE 11.47	INCLUSION 10.77	RECIPROCAL 9.67	TUKEY'S CRITICAL VALUE
11.47	—	0.70 N.S	1.80*	
10.77		—	1.10 N.S.	1.43
9.67			—	

$P < 0.05$

KEY: N.S. = Not significant. * = Significant at 0.05 level of confidence.

TABLE 22

t-TEST RESULTS ON THE DIFFERENCES BETWEEN THE POST-TEST AND FINAL-TEST SHOOTING SCORES.

TECHNIQUE	N	Mean	SD	tc	t
Practice	30	0.87	2.95	$1.62^{N.S}$	2.045
Reciprocal	30	1.00	1.53	3.58^{*}	
Inclusion	30	0.13	1.86	2.15^{*}	

$P < 0.05$

KEY: N = Number of Pairs
SD = Standard Deviation of Difference within Pairs
N.S = Not Significant.
t = Tabled t
tc = Computed t
* = Significant at 0.05 level of confidence

Analysis of covariance (See Table 23) on the post-test and final-test mean scores revealed that the scores were not significantly different from each other.

TABLE 23

SUMMARY TABLE FOR ANCOVA ON POST-TEST

AND FINAL-TEST SHOOTING SCORES

Source of Variation	DF	SSy	SP	SSz	DF^1	SSz^1	MSz^1	Fc	Ft
Between groups	2	41.66	45.00	49.39	2	11.70	5.85	$1.40^{N.S.}$	3.07
Within groups	87	388.84	210.50	473.51	86	359.56	4.18		
Total	89	430.50	255.50	522.90	88	371.26	—		

$P < 0.05$

KEY: DF = Degrees of Freedom.

SSy = Sum of Squares for Post-test

SP = Sum of Product

SSz = Sum of Squares for Final-test.

N.S = Not Significant

DF^1 = Adjusted Degrees of Freedom.

MSz^1 = Adjusted Mean Square for Final-test

SSz^1 = Adjusted Sum of Squares for Final-test.

Discussion

From the result of the study, it appeared, among other things, that the three techniques of instruction: the practice, the inclusion and reciprocal were equally appropriate for learning dribbling and shooting in hockey. All the groups improved on their pre-test scores, in both dribbling and shooting, after receiving treatment. This result was in agreement with previous studies which showed that there was significant improvement from pre-test to post-test. For example, Miriani (1970) found that in learning forehand and back-hand tennis strokes, the command method and the task method facilitated improvement in performance. Carter's (1971) study also revealed that in teaching basketball, the traditional method, video tape relay as an aid to the traditional and loop films as an aid to the traditional method produced a significant improvement from pre-test to post-test. Green (1970) taught swimming to beginners and found that both the traditional method and the T.V replay method yielded significant difference from pre-test to subsequent tests. Goldberger and Gerney (1982) found that the practice, the reciprocal and the inclusion styles produced significant improvement in learning ice hockey accuracy task from the pre-test to the mid-way test.

Though each group improved over the pre-test scores, in dribbling, at the post-test, a comparison of the three techniques showed that there was no significant differences among them. The techniques were therefore, interchangeable in the teaching of hockey dribbling. Previous studies gave support to this finding. Mariani (1970) found that there was no significant difference between the

task and command methods in teaching the forehand stroke. Carter (1971) discovered that there were no significant differences among the three instructional methods used in his study. Garland (1970) found that there was no significant difference between the traditional method and the movement exploration method of teaching swimming and diving skills. Goldberger and Gerney (1982) also found that there were no differences among the practice, the inclusion and the reciprocal styles in facilitating learning of Psychomotor skills. The result of the study by Robins (1979) showed that the traditional Red Cross Model and modified teaching model produced the same effect on swimming skills. Wurzer's (1972) finding showed that there was no significant difference between two methods of teaching golf: puting first and full swing first, both on the males and on the females.

In shooting skill acquisition, this study revealed that the practice technique was superior to the reciprocal technique. This seemed to agree with previous researchers that some methods of instruction proved better than others in the acquisition of some sports skills. Miriani (1970) reported that the task method, otherwise called the practice method was superior to the command method in the teaching of back-hand drive in tennis. Green (1970) found that T.V replay method was superior to the traditional method in beginning swimming. Wills (1970) also found that in acquiring a new skill of juggling three tennis balls, the best method was oral instruction with demonstration, second was written instruction with loop-film, third was oral instruction with loop-film while written instruction only was the worst. Hazlett (1974) compared the results of three methods of teaching tumbling: the traditional method,

the trampoline method and the mental practice method, and found that the trampoline method was significantly better than the mental and traditional method. Holt et al. (1970) showed that the Silvia method was superior to the Red Cross method in beginning swimming. Russell (1967) found that in learning the wind-mill serve in Volleyball, the problem solving method was more effective than the traditional method.

The result of the study showed that after the interval of four weeks when the boys did not have training in dribbling, the groups still improved. The improvement was, however, not significant. That the boys improved, on their post-test scores after the 'retention interval' was in agreement with Whitehill (1966) who reported that four, eight and twelve weeks of 'retention interval' had no effect on the acquisition of stabilometer task. Bell (1966), like in this study, found that five weeks of no practice had no significant difference in badminton performance. That the mean gain scores observed in this study was not significant seemed to indicate that there would be no significant improvement in dribbling if there was no training. It was interesting to note the relationship between the mean gains at post-test and those at the final test was a perfect linear negative correlation.

It was observed that in the shooting skill, the boys suffered a 'retention loss'. The loss for the practice group was not significant. This finding was consistent with what was found out in dribbling, that is, the post-test and final test scores were statistically the same. Meyers (1967) came to the same conclusion when he found no significant loss in retention of Bachman ladder climb task after lay-off periods varying from ten minutes to thirteen weeks.

The losses for the reciprocal and the inclusion techniques were significant. This finding ran counter to the finding of Purdy and Lockhart (1962) who found no loss in ball toss, foot volley and bongo board balance skills. It, however, agreed with Ryan (1965) who found a significant loss in stabilometer task after three months, six months and twelve months of 'retention interval'.

The reciprocal group learnt the two skills equally well as the other groups but learnt them under a condition which provided the boys with half the number of actual performance trials. It should however be remembered that the other half of the trials was of the mental practice type. The result of this study in terms of the reciprocal group seemed to suggest that alternating mental practice with physical practice could be equally effective in improving motor skill acquisition.

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study compared three techniques of instruction to determine their effects on the acquisition and retention of dribbling and shooting skill in hockey. The subjects were ninety junior secondary school boys and the techniques were the practice, the reciprocal and the inclusion techniques.

The boys were randomly assigned to the three technique groups. Each group was given four weeks of instruction and training in dribbling. They met for two periods of 40 min. each per week. The boys were tested (1) at the beginning of the study, (2) after the treatment and (3) after a 4-week of no practice.

The boys then received instruction and training in shooting, with the same technique as they did in dribbling. They again met twice a week for four weeks and for 40 min. per period. Pre-test, post-test and final-test scores on the skills were collected from the boys.

The results of the data analysis showed that:

1. The three groups showed a statistical significant improvement ($P < 0.05$) from pre-test to post-test in both the dribbling and shooting skills.

2. The three groups improved from post-test to final-test in dribbling, though the improvements were not statistically significant.

3. The three groups suffered a regression in the retention of the shooting skill. The loss for the practice technique was not statistically significant. Those for the reciprocal and the inclusion techniques were statistically significant ($P < 0.05$).

4. There was no statistical significant difference among the three techniques in facilitating the acquisition of dribbling and shooting skills.

Conclusions

The following conclusions were drawn from the study:

The three techniques were effective in facilitating the acquisition of dribbling and shooting in hockey.

The three techniques produced remarkable effect on the retention of dribbling skill.

Loss of proficiency occured in shooting after a retention interval with the reciprocal and inclusion techniques. The subjects instructed with the practice technique maintained the learned skill.

The reciprocal technique seemed appropriate when immediate feedback is desired as at the initial stage of acquiring a new skill.

The inability of the learner to select the appropriate level to start working was an inherrent difficulty in the inclusion technique.

Retention interval negatively affected motor skill acquisition.

Recommendations

In the light of the findings from this study, the following recommendations are made:

1. Since all techniques of instruction produce improvement in the acquisition of a motor skill, physical education teachers and sports coaches should master properly any technique they use.

2. Physical education teachers and sport coaches should develop in their learners the ability to select the appropriate level of difficulty in which they can work.

3. Further investigation be conducted with the three techniques of instruction such that variables as the size of classes, number and length of class periods and sex are taken into consideration. Groups should also be made to change their instructional groups at the beginning of learning a new skill.

4. Investigations be conducted, using the techniques in the teaching of other Physical education activities, to determine their effects on such motor skills.

5. Practices should be close enough to competitions for best performance.

REFERENCES

Adams, J. A. (1971) "A Closed-loop Theory of Motor Learning," Journal of Motor Behaviour 3: 111-150.

Adams, J. A. and Reynolds, B. (1954) "Effect of Shift in Distribution of Practice Conditions Following Interpolated Rest." Journal of Experimental Psychology, 47: 32-36.

Aiken, E. C. and Lau, A. W. (1967) "Response Prompting and Response Confirmation. A Review of Recent Literature," Psychological Bulletin, 5: 330-341.

Alderman, R. B. (1965) "Influence of Local Fatigue on Speed and Accuracy in Motor Learning." Research Quarterly, 36: 131-140.

Alexander, L. T. (1951) "Knowledge of Result and Temporal Gradient of Reinforcement." American Psychologist, 6: 292-293.

Ammons, R. B. (1956) "Effects of Knowledge of Performance: A Survey and Tentative Theoretical Formulation," Journal of General Psychology, 54: 279-299.

Anderson, B. F. (1971) The Psychology Experiment. An Introduction to the Scientific Method. Belmont, Calif.: Brooks-Cole Printing Co.

Annett, J. (1970) "The Role of Action Feedback in the Acquisition of Simple Motor Responses." Journal of Motor Behaviour, 2: 217-222.

Arnold, E. L. (1966) "The Relationship Between Physical and Mental Practice and Initial Ability in Learning a Simple Motor Skill." Completed Research in Health, Physical Education, and Recreation, 8: 54

Aten, R. (1970) "The Effects of Repeated Trials with Score Information Provided or With-held on Throwing Velocity of High and Low Performers," Completed Research in Health, Physical Education, and Recreation, 13: 228.

Bardwell, R. (1981) "Feedback: How Does It Function?," Journal of Experimental Education, 50: 4-9.

Barnett, M. L., Ross, D., Schmidt, R. A. and Todd, B. (1973) "Skill Learning and Specificity of Training Principle," Research Quarterly, 44: 440-447.

Bartz, D. W. and Smith, L. E. (1970) "Effect of Moderate Exercise on the Performance and Learning of Gross Motor Skill," Perceptual and Motor Skills, 37: 187-190.

Baumgartner, T. A. and Jackson, A. S. (1975) Measurement for Evaluation in Physical Education. Boston: Houghton Mifflin Company.

Bell, G. H, Davidson, J.N. and Emslie-Smith, D. (1968) Textbook of Physiology. Baltimore: William and Wilkins Company.

Bell, V. L (1966) "Augmented Knowledge of Results Related to Constant and Variable Errors and Its Effect Upon Acquisition of Projectile Skill," Research Quarterly, 41: 15-18.

Benson, D. W. (1968) "Influence of Imposed Fatigue on Learning a Jumping Task and Juggling Task." Research Quarterly, 39: 251-257.

Berlin, P. (1959) "Effects of Varied Training Emphasis During Early Learning on Acquisition of Selected Motor Skills." Unpublished Ph.D. Dissertation, Pennsylvania State University.

Bilodeau, E. A. and Bilodeau, I. M. (1961) "Motor Skill Learning." In P. R. Fransworth (Ed), Annual Review of Psychology, 12: 243-250

Bilodeau, E. A. and Bilodeau, I. M. (1969) Principles of Skill Acquisition. New York: Academic Press.

Bilodeau, E. A., Bilodeau, I. M. and Schumsky, D. A. (1959) "Some Effects of Introducing and Withdrawing Knowledge of Results Early and Late in Practice." Journal of Experimental Psychology, 58: 142-144.

Bilodeau, I. M. (1956) "Accuracy of a Simple Positioning Response with Variation in the Number of Trials by Which Knowledge of Result is Delayed." Americal Journal of Psychology, 69: 434-437.

Birkin, T. A. (1971) "Toward a Model of Instructional Process." In I. Westburg and A. A. Bellack (Eds.), Research into Classroom Processes. New York: Teacher's College Press.

Bourg, M. S. (1974) "The Effects of Peer Presence Upon the Learning of a Gross Motor Task by Third Grade Children," Dissertation Abstract International, Vol. 34 (9-A-pt.1): 5684A.

Broer, M. (1958) "Effectiveness of a General Basic Skills Curriculum for Junior High School Girls." Research Quarterly, 29: 379-388.

Broer, M. R. (1979) Efficiency of Human Movement. Philadelphia, W. B. Saunders Co.

Broughton, B and Nelson, D. O. (1967) "Verbal Conditioning in Selected Skills" Scholastic Coach, 37 (44 etseq): 38-40.

Brown, J. S. (1949) "A Proposed Program of Research on Psychological Feedback (Knowledge of Results) in the Performance of Psychomotor Tasks," In Research Planning Conference on Perceptual and Motor Skills, AFHRRC Conference Report, Rept. 49-2, 81-87 U.S. Air Force, San Antonio, Texas).

Duck, R. R. (1972) "Knowledge of Mechanical Principles Facilitate Learning a Trampoline Skill Using Television as an Evaluation Aid," Dissertation Abstract International, 34 (5.A): 2145A.

Campbell, D. T. and Stanley, J. C. (1963) Experimental and Quasi-Experimental Designs for Research. Chicago: Rand Mcnally College Publishing Co.

Carron, A. V. (1969) "Physical Fatigue and Motor Learning." Research Quarterly, 40: 682-686.

Carron, A. V. and Ferchuk, A. D. (1971) "The Effects of Fatigue on Learning and Performance of a Gross Motor Task," Journal of Motor Behaviour, 3: 62-68.

Carter, G. F. (1971) "A Comparison of Selected Instructional Methods in Teaching Basketball Skills," Dissertation Abstract International, 32 (3-A): 1319A

Clark, L. V. (1960) "Effect of Mental Practice on the Development of a Certain Motor Skill," Research Quarterly, 31: 560-569.

Clarke, D. H. and Clarke, H. H. (1970) Research Processes in Physical Education, Recreation and Health. New Jersey: E.C. Prentice-Hall Inc.

Clarke, H. H. (1976) Application of Measurement to Health and Physical Education. New Jersey E. C. Prentice-Hall Inc.

Clawson, A. L. (1966) "The Effect of Thrree Types of Competitive Motivating Conditions Upon the Scores of Archery Students," Completed Research in Health, Physical Education and Recreation, 8: 107.

Cochran, B. J. (1975) "Effect of Physical Fatigue on Learning to Perform a Novel Task," Research Quarterly, 46: 243-249.

Corbin, C. B. (1966) "The Effect of Mental Practice on the Development of a Unique Motor Skill," Completed Research in Health, Physical Education and Recreation, 8: 66.

Corbin, C. B. (1967) "Effect of Mental Practice on Skill Development after Controlled Practice," Research Quarterly, 38: 534-538.

Corbin, C. B. (1967a) "The Effects of Covert Rehearsal on the Development of a Complex Motor Skill," Journal of General Psychology, 76: 143-150.

Cotten, D. J., Thomas, J. R. Spieth, W.R. and Biasiotto, J. (1972). "Temporary Fatigue Effects in a Gross Motor Skill," Journal of Motor Behaviour, 4: 217-222.

Cratty, B. J. (1968) Psychology and Physical Activity. New Jersey: Prentice-Hall, Inc.

Cratty, B. J. (1973) Teaching Motor Skills. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

Cratty, B. J. (1975) Movement Behaviour and Motor Learning. Philadelphia: Lea & Febiger.

Daugherty, G. and Lewis, C. G. (1979). Effective Teaching Strategies in Physical Education. Philadelphia: W. B. Saunders Co.

Del Rey, P. (1970) "The Effects of Video-taped Feedback and Environmental Certainty on Form, Accuracy and Latency During Skill Acquisition," Completed Research in Health, Physical Education and Recreation, 13: 92-93.

Del Rey, P. (1971) "The Effects of Video-taped Feedback on Form, Accuracy and Latency in an Open and Closed Environment," Journal of Motor Behaviour, 3:281-288

Del Rey, P. (1972) "Appropriate Feedback for Open and Closed Skill Acquisition," Quest, XVII: 41-51.

Del Rey, P. (1976) "The Task Method of Teaching Tennis Skill Using Video-Taped Relays," The Physical Educator, 33 (4): 194-197.

Dickenson, J. (1977) A Behavioural Analysis of Sports Princeton: Books Company.

Dorland, W.A.N. (Ed.) (1974) Dorland's Illustrated Medical Dictionary. Mexico: W.B. Saunders Co.

Doyle, W. (1978) "Paradigms For Research on Teacher Effectiveness," In L. S. Shulman (Ed.), Review of Research in Education,

Dowell, L. T. (1975) Strategies for Teaching Physical Education. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

Drowatzky, J. N. (1970) "Effect of Massed and Distributed Practice Schedules Upon the Acquisition of Pursuit Rotor Tracking by Normal and Mentally Retarded Subjects," Research Quarterly, 41: 32-38.

Drowtzky, J. N. (1975) Motor Learning Principles and Practices. Minneapolis: Burgess Publishing Co. pp. 85-105.

Dunham Jr., P. "Specificity and Extended Practice," Research Quarterly, 41: 484-488.

Eckert, H. M. (1970) A Comparison of Delayed Static and Dynamic Visual Feedback, Research Quarterly, 41: 39-43.

Fitts, P. M. (1965) "Factors in Complex Skill Training," In Robert Glasser (Ed.), Training Research and Education. New York: John Wiley & Sons Inc. pp. 177-197.

Fitts, P. M. and Posner, M. I. (1967) Human Performance Belmont, Calif.: Brooke-Cole Publishing Co.

Flanders, N. A. (1970) Analyzing Teaching Behaviour. Reading, M. A: Addison - Wesley.

Fleishman, E. A. and Hempel, W. E. (1956) "Factorial Analysis of Complex Psychomotor Performance and Related Skills," Journal of Experimental Psychology, 64: 215-222.

Fleishman, E. A. and Parker, J. F. (1962) "Factors in the Retention and Relearning of Perceptual motor skill," Journal of Experimental Psychology, 64: 215-226.

Gage, N. L. (1974) The Scientific Basis of the Art of Teaching. New York: Teachers' College, Press. p.14.

Gagne, R. M. (1974) Essential of Learning for Instruction. Hinsdale, Illinois: Dryden Press.

Gagne, R. M. (1977) The Condition of Learning. New York: Holt, Rinehart and Winston.

Gagne, R. M. and Fleishman, E. A. (1959) Psychology of Human Performance. New York: Holt, Rinehart and Winston.

Garland, I. (1970) "Effectiveness of Problem-Solving Method of Learning Swimming," Unpublished Masters Thesis, University of California, Los Angeles.

Garry, R. (1963) The Psychology of Learning. Washington: The Centre for Applied Research in Education.

Gentile, A. M. (1972) "A Working Model of Skill Acquisition with Application to Teaching," Quest, XVII: 3-23.

Gibbs, C. B. and Brown, T. D. (1955) "Increased Production from the Information Incentive in a Receptive Task," Medical Research Council, Applied Psychological Research Unit, Great Britain, No. 230.

Gilford, J. P. and Fruchter, B. (1973) — Fundamental Statistics in Psychology and Education. Tokyo: McGraw-Hill, Kogakusha Ltd.

Gilmore, G. B. (1973) — "An Experimental Study to Determine Which of Five Different Practice Procedure is More Effective in the Acquisition of Complex Motor Skill," Dissertation Abstract International, Vol. 34 (2-A): 605A.

Godwin, M. A. and Schmidt, R. A. (1971) — "Muscular Fatigue and Learning a Discrete Motor Skill," Research Quarterly, 42: 374-382.

Goldberger, M. and Gerney, P. (1982) — The Effect of Three Styles of Teaching on the Psychomotor Performance and Social Skill Development of Fifth Grade Children," Research Quarterly For Exercise and Sports, 53 (2): 116-124.

Gould, D. R. and Roberts, G. C. (1982) — "Modelling and Motor Skill Acquisition," Quest, 33 (2): 214-230.

Gray, C. A. and Brumbach, W. B. (1967) — "Effect of Daylight Projection of Film Loops on Learning Badminton," Research Quarterly, 38: 562-569.

Green, W. B. (1970) — "The Effectiveness of Television Replay as a Technique in Teaching Beginning Swimming Skills," Completed Research in Health, Physical Education and Recreation, 13: 76.

Greenspoon, J. and Foreman, S. (1966) — "Effect of Delay of Knowledge of Result on Learning a Motor Task," Journal of Experimental Psychology, 51: 226-228.

Hazlett, R. M. (1974) — "A Comparative Study of Three Methods of Teaching Tumbling," Dissertation Abstract International, Vo. 35 (1-A); 245A.

Holding, D. H. (1969) — Principles of Training. Oxford: Pergamon Press.

Holt, A., Thorpe, J. and Holt, L. (1970) — "Two Methods of Teaching Beginning Swimming," Research Quarterly, 41: 371-377.

Hornak, J. (1971) — "The Effects of Three Methods of Teaching on the Learning of a Motor Skill," Unpublished Doctoral Dissertation, University of Northern Colorado.

Hull, C. A. (1952) — A Behaviour System. An Introduction to Behaviour Theory Covering the Individual Organism. New Haven: Yale University Press.

Hull, C. L. (1943) — Principles of Psychology. New York: Appleton-Century Crofts.

Hurlock, E. B. (1925) — "An Evaluation of Certain Incentives in School Work," Journal of Educational Psychology, 16: 145-159.

Hyman, R. T. (1974) — Ways of Teaching. Philadelphia: J. B. Lippincott Co.

Ikulayo, P. B. (1985) — "The Comparative Effectiveness of Different Instructional Strategies on the Learning of Gross Motor Skills," An Unpublished Ph.D. Thesis, University of Lagos.

Irion, A. L. (1966) — "A Brief History of Research on the Acquisition of Skill," In E. A. Bilodeau (Ed)., Acquisition of Skill. New York: Academic Press. Chapter 1.

Jackson, C. L. (1974) — "The Effects of Video-tape Feedback and Audio-video-tape Feedback Upon the Acquisition and Retention of Sport Type Motor Skills." Dissertation Abstract International Vol. 34 (9-A, pt. 1): 5689A.

Jensen, C. R. and Fisher, A. G. (1979) — Scientific Basis of Athletic Conditioning. Philsdelphia: Lea & Febiger p. 273.

Jones, M. R. (1970) — Rate and Terminal Processes in Skill Acquisition. American Journal of Psychology, 83: 222-236.

Joyce, B. R. and Weil, M. (1972) — Models of Teaching. Englewood Cliffs New Jersey: Prentice-Hall.

Kamal, F. and Gallahue, D. L. (1980) — "Feedback: A Developmental Overview." The Physical Educator, 37 (4): 215-219.

Keitmann, H. M. and Kneer, M. E. (1976) — Physical Education Instructional Techniques: An Individualized Humanistic Approach. Englewood Cliffs New Jersey: Prentice-Hall. Inc.

Kingley, J. L. (1970) "The Effectiveness of Teaching Large Motor Skills by Spaced Unit Method as Compared with the Continuous-Unit Method." Completed Research in Health, Physical Education and Recreation. 13: 139.

Knapp, B. (1964) Skill in Sport. London: Routledge and Kegan Paul.

Kroll, W. (1973) "Effects of Local Muscular Fatigue Due to Isotonic and and Isometric Exercises Upon Fractionated Reaction Time Components." Journal of Motor Behaviour. 5: 81-83.

La Plante, M. (1965) "A Study of the Problem-Solving Method of Teaching," Completed Research in Health, Physical Education and Recreation. 8: 69.

Lavery, J. J. (1960) The Effect of one-Trial Delay in Knowledge of Results on the Acquisition and Retention of a Tossing Skill," American Journal of Psychology. 77: 437-443.

Lavery, J. J. and Suddon, F. H. (1962) "Retention of Simple Motor Skills as a Function of the Number of Trials by Which Knowledge of Result is Delayed," Perceptual and Motor Skills, 15: 231-237.

Lawther, J. D. (1968) The Learning of Physical Skills. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

Lewis, A. E. (1965) "A Comparison of Three Methods of Teaching Bowling to College Women," Completed Research in Health, Physical Education and Recreation, 8: 48.

Locke, E. A. (1967) "Towards a Theory of Task Motivation and Incentives," Organismic Behaviour and Human Performance, 3: 157-289.

Locke, E. A., Cartledge, N. and Koeppel, J. (1968) "Motivational Effects of Knowledge of Result: A Good Setting Phenomenon," Psychological Bulletin, 70: 474-485.

Lorge, I. and Thorndike, E. L. (1935) "The Influence of Delay on the After-effect of a Connection," Journal of Experimental Psychology, 18: 186-194

Magill, R. A. (1980) Motor Learning, Concepts and Application. Dubuque IOwa: Wm. C. Brown Co.

Marteniuk, R. G. (1976) Information Processing in Motor Skills. New York: Holt Rinehart and Winston.

Marteniuk, R. G. and Carron, A. V. (1970) Efficiency of Learning as a Function of Practice Schedule and Initial Ability," Journal of Motor Behaviour, 2: 140-148.

Martens, R. (1970) "Influence of Participation Motivation on Success and Satisfaction in Team Performance," Research Quarterly, 41: 510-518.

McAllister, D. E. (1953) "The Effects of Various Kinds of Relevant Verbal Pre-training on Subsequent Motor Performance," Journal of Experimental Psychology, 46: 329-336.

McCabe, J. F. (1971) A Comparison of Two Practice Schedules to Achieve Bilateral Skill in Lacrosse Cradling," Completed Research in Health, Physical Education and Recreation, 13: 204.

McFarlane, D. J. (1971) "Comparison of Two Methods of Teaching Forehand Tennis Stroke to Nine and Ten-Year-Old," Completed Research in Health, Physical Education and Recreation, 13: 236.

McGuigan, F. J. (1959) "Delay of Knowledge of Results: A Problem in Design, Psychological Reports, 5: 241-243.

Mednick, S. A. (1964) Learning. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

Meyers, J. L. (1967) "Retention of Balance Co-ordination Learning as Influenced by Extended Lay Offs," Research Quarterly, 38: 72-78.

Miller, G. A., Galanter, E. and Pribram, K. (1960) Plans and the Structure of Behaviour. New York: Holt, Rinehart & Winston Inc.

Miller, N. E. and Dollard, J. (1941) Social Learning and Imitation. New Havens: Yale University Press.

Miriani, T. (1970) "A Comparison of the Effectiveness of the Command Method and the Task Method of Teaching the Forehand and Backhand Tennis Strokes," Research Quarterly, 41: 171-174.

Mosston, M. (1966) Teaching Physical Education. Columbus, OH. Charles E. Merril Publishing.

Mosston, M. (1972) Teaching from Command to Discovery. Belmont, C. A. Wadsworth Publishing.

Mosston, M. (1981) Teaching Physical Education. Columbus, OH. Charles E. Merril Publishing.

Naylor, J. C. and Briggs, G. E. (1961) "Long-term Retention of Learned Skills, and Review of the Literature," Lab of Aviation Psychology, Ohio State University Foundation.

Newell, K. M. (1974) "Knowledge of Results and Motor Learning," Journal of Motor Behaviour 6: 235-244.

Obe, E. O. (1980) Educational Testing. Lagos: Premier Press and Publisher.

Oxendine, J. B. (1973) "The Use of Television in Physical Education," National College Physical Education Association for Men Proceedings, 76: 121-127.

Pack, M, Cotten, D.J. and Biasiotto, J.L. (1974) "Effects of Four Fatigue Levels on Performance and Learning of Novel Dynamic Balance Skill," Journal of Motor Behaviour, 6: 191-198.

Petsch, Jr., V.E. (1970) "Comparison of Selected Instructional Techniques Involved in Learning a Single Skill of Kinesthetic Balance," Completed Research in Health, Physical Education and Recreation, 13: 90-91.

Phillips, Jr. W. H. (1962) "The Effect of Physical Fatigue on Two Motor Learning Tasks," Unpublished Doctoral Dissertation, University of California, Berckeley.

Phillips, Jr. W. W. (1963) "Influence of Fatigueing Warm-Up Exercises on Speed of Movement and Recreation Latency," Research Quarterly, 34: 370-378.

Pierson, W. R. and Rasch, P. J. (1964) "Effect of Knowledge of Result of Isometric Strength Scores," Research Quarterly, 25: 313-315.

Poulton, E. C. (1952) "Perceptual Anticipation in Tracking with Two-pointed and One-pointed Displays," British Journal of Psychology, 43: 222-229.

Poulton, E. C. (1957) "On Pridiction of Skilled Movements," Psychological Bulletin, 54: 467-473.

Purdy, B. J. and Lockhart, A. (1962) "Retention and Relearning of Gross Motor Skills after Long Period of no Practice," Research Quarterly, 33: 265-272.

Rivenes, R. S. (1961) "Effects of Motor Skill Acquisition on Retention of Teaching by Demonstration with and Without Verbal Explanation," Unpublished Masters Thesis, Pennsylvania State University.

Robb, M. D. (1968) "Feedback and Skill Learning," Research Quarterly, 39: 175-183.

Robb, M. D. (1972) The Dynamics of Motor - Skill Acquisition. New Jersey, E. C.: Prentice-Hall.

Robins, T. W. (1979) "A Comparison of the Effects of Two Instructional Methods on the Acquisition of Skills in Beginning Swimming," Dissertation Abstract International, 39 (7-A): 4125-A.

Roscoe, J. T. (1975) Fundamental Research Statistics for the Behavioural Sciences. New York: Holt, Rinehart and Winston Inc.

Rosenbleeth, R. J. (1971) "The Effect of Positive and Negative Reinforcement Upon Motor Performance of Students from Selected Grade Levels," Dissertation Abstract International, 32 (4-A): 1960A.

Royce, J. (1962) "Force-Time Characteristics of the Exertion and Release of Hand Grip Strength under Normal and Fatigued conditions," Research Quarterly, 33: 444-450.

Rushall, B. S. and Siedentop, D. (1972) The Development and Control of Behaviour in Sports and Physical Education. Philadelphia: Lea and Febiger.

Russell, M. (1967) "Effectiveness of Problem Solving Methods in Learning a Gross Motor Skill," An Unpublished Masters Thesis University of Washington.

Ryan, E. D. (1962) "Retention of Stabilometer and Pursuit Rotor Skills," Research Quarterly, 33: 593-598.

Ryan, E. D. (1965) "Retention of Stabilometer Performance over Extended Periods of Time," Research Quarterly, 36: 46-51.

Sage, G. H. (1971) Introduction to Motor Behaviour a Neuropsychological Approach. Reading, Massachussetts: Addison-Wesley Publishing Company.

Sage, G. H. (1977) Introduction to Motor Behaviour a Neuropsychological Approach. Massachussetts: Addison-Wesley Publishing Company.

Salvendy, G. and Harris, D. R. (1973) "Effects of Different Modes of Feedback on the Acquisition and Retention of Psychomotor Skills," Ergonomics, 16: 33.

Schmidt, R. A. (1975) "A Schema Theory of Discrete Motor Skill Learning," Psychological Review, 82: 225-260.

Schmidt, R. A. (1975a) Motor Skills. New York: Harper & Row, Publisher.

Shavelson, R. J. (1973) "What is the Basic Teaching Skill?", Journal of Teacher Education, 24: 144-151.

Shavelson, R. J. and Dempsey, N. (1976) "Generalizability of Measures of Teaching Behaviour," Review of Educational Research, 46: 553-561.

Shick, J. (1970) "Effects of Mental Practice in Selected Volleyball Skills for College Women," Research Quarterly, 41: 88-94.

Siedentop, D. (1976) Developing Teaching Skills in Physical Education. U.S.A. Houghton: Mifflin Co.

Singer, R. N. (1965) "Massed and Distributed Practice. Effects on the Acquisition and Retention of a Novel Basketball Skill," Research Quarterly, 36: 68-77.

Singer, R. N. (1975) Motor Learning and Human Performance. New York: Macmillan.

Singer, R. N. and Gaines, L. (1975) "Effect of Prompted and Problem-Approaches on Learning and Transfer of Motor Skills," American Educational Journal, 12: 395-413.

Singer, R. N. and Gerson, R. F. (1981) "Task Classification and Strategy Utilization in Motor Skills," Research Quarterly, 52: 100-116.

Singer, R. N. and Pease, D. (1976) "A Comparison of Discovery Learning and Guided Instructional Strategies on Motor Skill Learning, Retention and Transfer," Research Quarterly, 47: 785-796.

Singer, R. N. and Pease, D. (1978) "Effect of Guided Versus Discovery Learning Strategies on Initial Motor Task Learning, Transfer and Retention," Research Quarterly, 49(2): 206-217.

Siknner, B. F. (1938) The Behaviour of Organism. New York: Appleton-Century Craft.

Smith, K. U. (1962) Delayed Sensory Feedback and Behaviour. Philadelphis, Pa: Saunders.

Smith, K. U. and Cybernetic Principles of Learning and Education. New York: Holt Rinehart and Winston Inc.

Smode, A. (1958) "Learning and Performance in a Tracking Task under Two Levels of Achievement Information Feedback," Journal of Experimental Psychology, 56: 297-304.

Solley, W. H. and Borders, S. (1965) "Effects of Two Methods of Teaching the Forehand Drive in Tennis," Research Quarterly, 36: 120-122.

Sparks, J. L. (1963) "Relative Effects of Various Verbal Incentives on Learning and Retention of a Gross Motor Skill," Unpublished Masters Thesis Pennsylvania State University.

Sprague, P. and Mann, R. V. (1983) "The Effect of Muscular Fatigue on the Kinetics of Sprints Running," Research Quarterly For Exercise and Sport, 54: 60-66.

Stelmach, G. E. (1969) "Efficiency of Motor Learning as a Function of Intertrial Rest," Research Quarterly, 40: 198-202.

Summers, J. F. (1981) "Motor Programs", In D. H. Holding (Ed), Human Skills, Chienster, New York: John Willey & Sons.

Thaxton, A. B. Rothstein, A. L. and Thaxton, N. A. (1977) "Comparative Effectiveness of Two Methods of Teaching Physical Education to Elementary School Girls," Research Quarterly, 48. 420-435.

Thompson, D. H. (1969) "Immediate External Feedback in Learning of Golf Skills," Research Quarterly, 40: 589-594.

Thorndike, E. C. (1903) Educational Psychology. New York: Lamcke and Buechner.

Thorpe, J., West, C. and Davies, D. (1971) "Learning Under a Traditional and an Experimental Schedule Involving Master Classes," Research Quarterly, 42: 83-89.

Tutko, T. A. and Ogilvie, B. C. (1967) "The Role of the Coach in Motivation of Athletes." In Slovenka, R. and Knight, J. A. (Eds.), Motivation in Play, Games, and Sports. Springfield Illinois: Charles C. Thomas.

Vanek, M. and Cratty, R. J. (1970) Psychology and the Superior Athlete. Toronto: The Macmillan Co.

Vannier, M. and Fait, H. F. (1965) — Teaching Physical Education in Secondary Schools. Philadelphia: W. B. Saunders Company.

Verabioff, L. T. (1974) — "The Effect of Post Knowledge of Results Intervals and Interpolated Verbal Activity on Performance and Retention of Motor Skill," Dissertation Abstract International, Vol. 34 (11-A): 7032A.

Watkins, D. L. (1963) — "Motion Pictures as an Aid in Correcting Basketball Batting Faults," Research Quarterly, 34: 228-233.

Weber, J. C. and Lamb, D. R. (1970) — Statistics and Research in Physical Education. St. Louis: The C. V. Mosby Company.

Seinberg, D. R., Guy, D. E. and Tupper, R. U. (1964) — "Variation of Post Feedback Interval in Simple Motor Learning," Journal of Experimental Psychology, 67: 98-99.

Welch, M. (1969) — "Specificity of Heavy Work Fatigue: Absence of Transfer from Heavy Leg Work to Coordination Tasks Using the Arms," Research Quarterly, 40: 402-406.

Wells, K. F. (1960) — Kinesiology. Philadelphia: W. B. Saunders Company.

Whitehill, M. P. (1966) — "The Effects of Mental Practice on Children's Learning and Retention of Gross Motor Skills," Completed Research in Health, Physical Education and Recreation, 8:81.

Whiting, H. T. A. (1972) — "Theoretical Frameworks For An Understanding of the Acquisition of Perceptual Motor Skills," Quest, XVII: 24-33.

Whiting, H. T. A. (1973) — Acquiring Ball Skill. Philadelphia: Lea & Febiger.

Whitley, J. D. (1970) — "Effects of Practice Distribution on Learning a Fine Motor Task," Research Quarterly, 41: 576-583.

Wiener, N. W. (1961) — Cybernetics. Cambridge, Massachussetts: M.I.T. Press.

Wilkinson, R. E. (1966) "Effect of Motivational Conditions Upon the Performance of Boys of Different Age Levels," Completed Research in Health, Physical Education and Recreation, 8: 103.

Wills, K. C. (1971) "Effect of Different Methods of Instruction and Practice on Skill Acquisition of a Motor Task," Completed Research in Health, Physical Education and Recreation, 13: 209.

Wilson, G. G. (1970) "The Effect of Various Distribution of Practice on the Learning and Retention of Gross Motor Skill of Varying Level of Difficulty," Dissertation Abstract, 32 (2-A): 778A.

Witte, K. L. and Grossman, E. E. (1977) "The Effects of Reward and Punishment Upon Children's Attention, Motivation and Discrimination Learning," Child Development, 92: 534-542.

Woods, J. B. (1967) "The Effects of Varied Instructional Emphasis Upon the Development of a Motor Skill," Research Quarterly, 38: 132-142.

Wurzer, D. J. (1972) "A Comparison of Methods in Teaching the Skills of Golf," Dissertation Abstract International, 33 (3-A): 1012A.

Ziegler, Y. P. (1965) "A Comparison of Two Methods of Teaching Gymnastics," Completed Research in Health, Physical Education and Recreation, 8:125.

APPENDICES

APPENDIX A.

TEST INSTRUMENTS

1. Adebayo Hockey Dribbling Test for Beginners.
2. Adebayo Hockey Shooting Test for Beginners.

N. B. The test instruments have been standardized but norms are yet to be developed.

APPENDIX A-1

ADEBAYO HOCKEY DRIBBLING TEST FOR BEGINNERS.

Purpose

To measure the ability of the player to control the ball wi the hockey stick when dribbling fast.

Equipment

A hockey stick for each testee, hockey balls, three stop watches, a score card for each testee (See Table 24), and five markers. Each marker was a stick 1.0m in length and mounted on two tins of equal heights (See Figure IV).

TABLE 24

SCORE CARD FOR ADEBAYO HOCKEY DRIBBLING TEST FOR BEGINNERS.

Name _____

Age _____ Date _____

Trials	1st Watch	2nd Watch	3rd Watch	Official Time
1				
2				
3				

SCORE ON THE TEST _____ Sec.

_____

SCORER'S NAME & DESIGNATION

_____

SCORER'S SIGNATURE

DATE _____

Testing Area.

A course for the test was marked on the hockey field as shown in Figure V. The markers were arranged in a straight line with a distance of 3.0m between one marker and the next. That is, the distance from the first marker to the fifth marker was 12.0m. The first marker was on a level with the starting line. A starting mark 2.0m from the base of the first marker was made on the starting line.

Personnel

Three testing assistants served as the time-keepers. The investigator was the starter and the recorder.

Description

The ball was placed on the starting mark. The testee stood behind the starting line with his hockey stick. At the signal, "Ready, Go!" the time-keepers started the watches and the testee started to dribble simultaneously. The testee dribbled to the left of the second marker and continued to dribble in an out alternately around the markers in the direction of the arrows shown in Figure V until he returned to the starting line with the ball when the time keepers stopped the watches. The testee had three trials.

Scoring

The score for each trial was the median time of the three watches, in seconds and tenths of seconds, taken for the entire course. Three trials were timed and recorded. The score on the test was the best of the three trials.

Rules

1. The ball was on the starting mark at the beginning of each trial.

2. The testee's feet and stick were behind the starting line at beginning of each trial.
3. Legal dribble was used throughout the test.
4. Three trials were allowed.
5. When a testee committed a foul e.g. taking a wrong direction the testee was made to bring the ball to the place where the foul was committed and start his dribbling from there. The watches continued to run until he returned to the starting line with the ball.

Instruction

On the signal, "Ready Go!" dribble in and out of the markers, as fast as you can.

APPENDIX A-2

ADEBAYO HOCKEY SHOOTING TEST FOR BEGINNERS.

Purpose

To determine the accuracy and consistency with which a hockey player can score goals.

Equipment

A hockey stick for each testee, hockey balls, a score card for each testee (See Table 25), bands to demarcate target areas in the goal, and a marker.

TABLE 25

SCORE CARD FOR ADEBAYO HOCKEY SHOOTING TEST FOR BEGINNERS.

Name ----------

Age ----------Date----------

Trials	Scores
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total	

SCORER'S NAME & DESIGNATION

SCORER'S SIGNATURE

DATE ----------

Testing Area

A restraining circle with broken lines and of radius 11.0m was drawn concentric to the regular shooting circle (See Figure VI). A band was tied to the cross-bar of the goal at a point 1.0m from one of the up-rights and pegged perpendicularly on the goal-line i.e the peg was also 1.0m from the goal-post. Another band was similarly tied and pegged from the other up-right. The goal was thus divided into three portions. A cricket stump which was used as the marker was fixed at a point 11.89m in front of the centre of the goal i.e. on the mid-point of the shooting circle. A starting point was marked 16.89m in front of the centre of goal i.e 5.0m from the marker.

Personnel

Two testing assistants served as ball retrievers. The investigator was the starter and scorer.

Description

The ball was placed on the starting point. The testee stood with his stick behind the ball. On the signal, "Ready, Go!", the testee dribbled towards the marker which represented an opponent. As he got close to the 'opponent' he executed a reverse stick, dodged to his own right to enter the shooting circle and took a hard shot at the goal. The shot was taken before getting to the restraining circle. The testee had ten trials.

Scoring

A ball that passed through the space to the right scored 3 points. The ball that passed through the space to the left scored 2 points. One that passed through the middle space scored 1 point. A ball that did not pass through the goal scored no point.

A ball that hit the band scored the higher of the adjacent scores. The score on the test was the sum of the points from the ten trials. That is, the maximum point a testee could score was 30.

Rules

1. The ball was on the starting point at the beginning of each trial.
2. Legal dribble was used.
3. Shot was taken immediately the testee entered the circle and before reaching the restraining circle.
4. A swing at the ball, whether it was hit or not, was the end of a trial.
5. Ten trials were allowed for each testee.
6. Dribbling was not allowed after entering the circle.

Instruction

On the signal, "Ready, Go!", dribble towards the marker, as you get close, reverse the stick, dodge to your right and take a hard shot at goal as soon as you enter the circle and before getting to the restraining circle.

FIGURE IV

A MARKER FOR ADEBAYO HOCKEY DRIBBLING TEST FOR BEGINNERS.

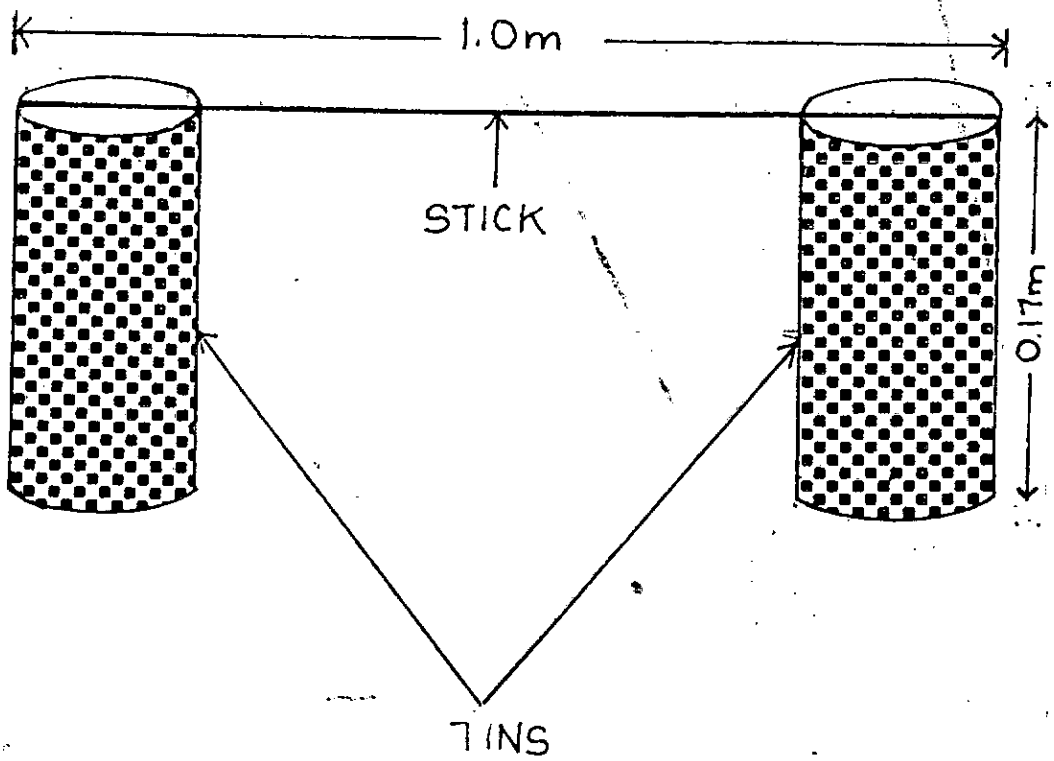


FIGURE V

COURSE FOR ADEBAYO HOCKEY DRIBBLING TEST FOR BEGINNERS.

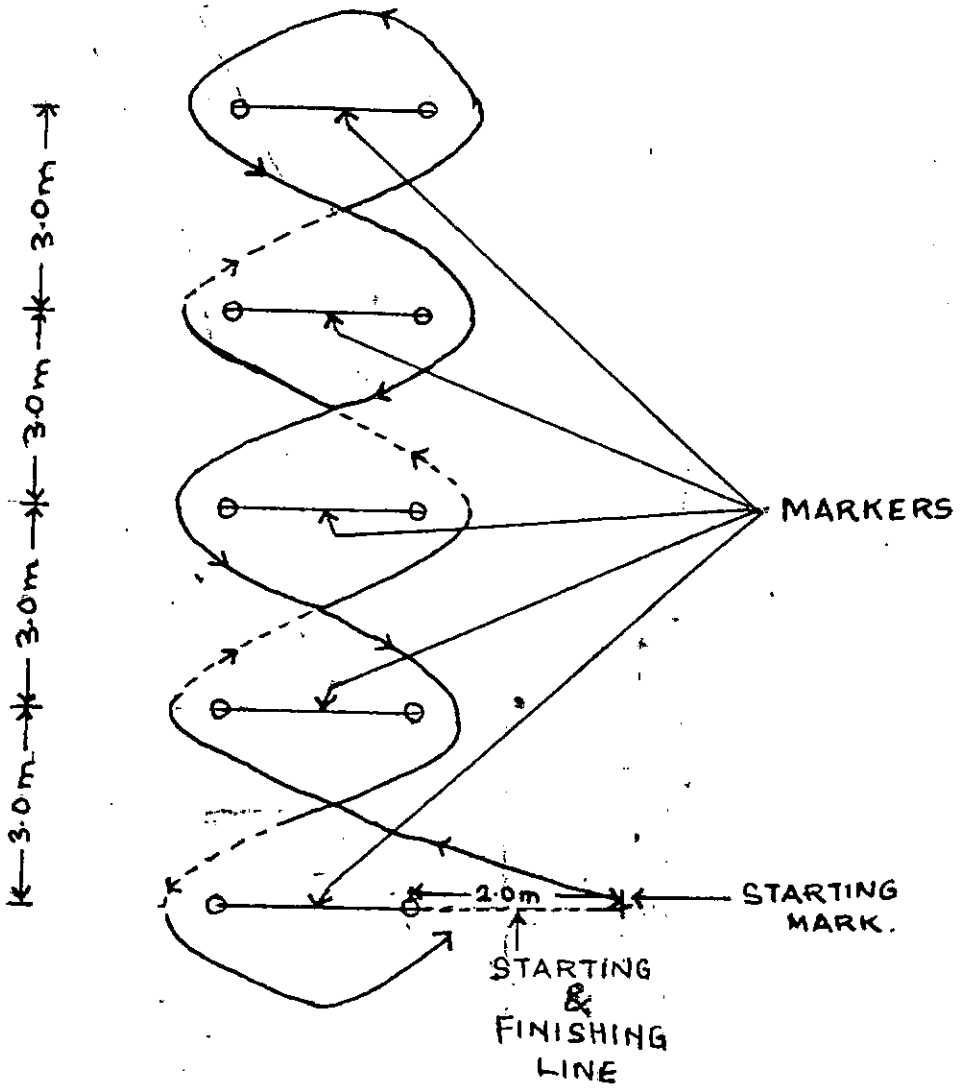
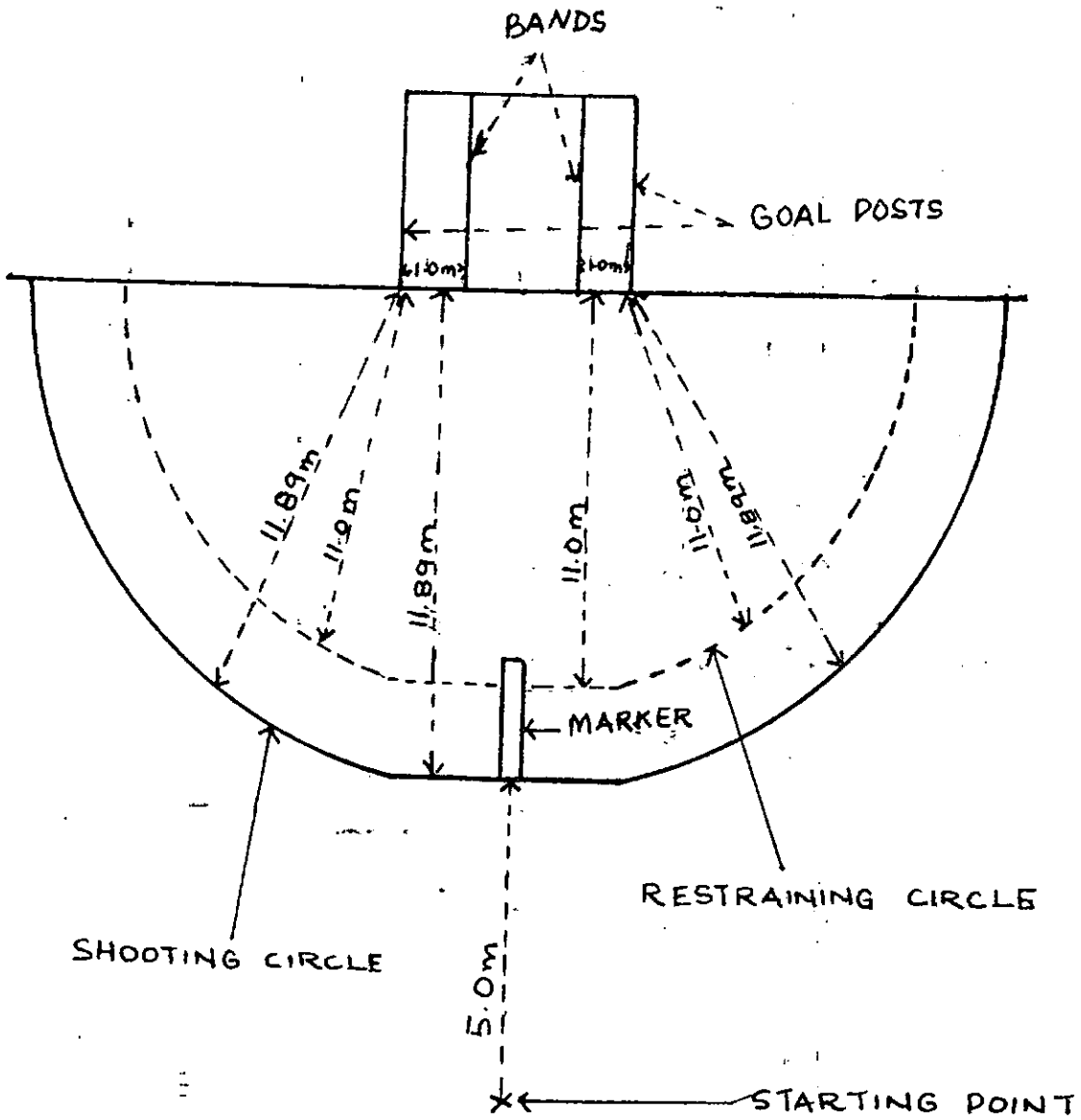


FIGURE VI

MARKINGS FOR ADEBAYO HOCKEY SHOOTING TEST FOR BEGINNERS.



APPENDIX B

RATING SCALE.

APPENDIX B

RATING SCALE

NAME OF TESTEE _____

Circle the appropriate rating for each item

DRIBBLING

1.	Position of the hands	A	B	C	D	E
2.	Body lean	A	B	C	D	E
3.	Position of ball from dribbler	A	B	C	D	E
4.	Ball distance from the stick	A	B	C	D	E
5.	Split vision	A	B	C	D	E
6.	Speed of dribbling	A	B	C	D	E

SHOOTING

1.	Position of the hands	A	B	C	D	E
2.	Direction of the left shoulder	A	B	C	D	E
3.	Position of the feet at the shot	A	B	C	D	E
4.	Swing coordination	A	B	C	D	E
5.	Eye-ball-stick coordination	A	B	C	D	E
6.	Force behind the ball	A	B	C	D	E
7.	Direction of follow through	A	B	C	D	E
8.	Accuracy of placement	A	B	C	D	E

Guide to Rater:

A _____ Exceptional ability, near perfect for the age of the testee.

B _____ Above average ability, not perfect but quite skilliful for the age of the testee.

C _____ Average ability, typical for the age of the testee.

D _____ Below average ability, characterized by more mistakes than is typical performance for the age of the testee.

E _____ Inferior ability, far below typical performance for the age of the testee.

_____
Rater's Name & Designation

_____ _____
Rater's Signature & Date

APPENDIX C

DATA FOR EVALUATION OF THE TESTING INSTRUMENTS.

1. Validity Coefficient for the Dribbling Test Instrument.
2. Validity Coefficient for the Shooting Test Instrument.
3. Reliability Coefficient for the Dribbling Test Instrument.
4. Reliability Coefficient for the Shooting Test Instrument.

APPENDIX C-1

COMPUTATION OF THE VALIDITY COEFFICIENT OF THE ADEBAYO HOCKEY DRIBBLING TEST.

SUBJECTS	X	Y	X^2	X^2	Xy
1	25.2 Sec	14	635.04	196	352.8
2	21.0 "	15	441.00	225	315.0
3	19.2 "	12	368.64	144	230.4
4	24.0 "	13	576.00	169	312.0
5	24.0 "	15	576.00	225	360.0
6	18.0 "	12	324.00	144	216.0
7.	24.0 "	11	576.00	121	264.0
8	24.0 "	15	576.00	225	360.0
9	18.2 "	11	331.24	121	200.2
10	20.4 "	12	416.16	144	244.8
11	18.6 "	11	345.96	121	204.6
12	24.4 "	14	595.36	196	341.6
13	19.0 "	12	361.00	144	228.0
14	18.0 "	11	324.00	121	198.0
15	18.6 "	10	345.96	100	186.0
16	18.3 "	12	334.89	144	219.6
17	19.8 "	10	392.04	100	198.0
18	18.2 "	11	331.24	121	200.2
19	24.1 "	14	580.81	196	337.4
20	19.8 "	12	392.04	144	237.6
Total (Σ) x =416.8 "		Σ247	8823.38	3101	5206.2

$$r = \frac{20 \times 5206.2 \div 416.8 \times 247}{\sqrt{20 \times 8823.38 - (416.8)^2 \quad 20 \times 3101 - (247)^2}}$$

$$r = \frac{104124 - 102949.6}{\sqrt{27647.6 - 173722.24 \quad 62020 - 61009}}$$

$$r = \frac{1174.4}{\sqrt{(2745.36)(1011)}} = \frac{1174.4}{1666.0008} = 0.70$$

APPENDIX C-2

COMPUTATION OF THE VALIDITY COEFFICIENT OF THE ADEBAYO HOCKEY SHOOTING TEST

SUBJECTS	X	Y	X^2	Y^2	XY
1	12	13	144	169	156
2	9	11	81	121	99
3	8	9	64	81	72
4	7	10	49	100	70
5	12	12	144	144	144
6	6	10	36	100	60
7	10	11	100	121	110
8	11	12	121	144	132
9	9	10	81	100	90
10	10	11	100	121	110
11	11	12	121	144	132
12	13	14	169	196	182
13	12	14	144	196	168
14	10	10	100	100	100
15	11	11	121	121	121
16	9	9	81	81	81
17	8	10	64	100	80
18	10	11	100	121	110
19	8	9	64	81	72
20	10	12	100	144	120
Total (Σ)	196	221	1984	2485	2209

$$r = \frac{20 \times 2209 - 196 \times 221}{\sqrt{20 \times 1984 - (196)^2 \quad 20 \times 2485 - (221)^2}}$$

$$= \frac{44180 - 43316}{\sqrt{(39680 - 38416)\ (49700 - 48841}}$$

$$= \frac{864}{\sqrt{(1264)\ (859)}} = \frac{864}{1.042} = 0.83$$

APPENDIX C-3

COMPUTATION OF THE RELIABILITY COEFFICIENT OF THE ADEBAYO HOCKEY DRIBBLING TEST

SUBJECTS	X	Y	X^2	Y^2	XY
1	33.5	31.2	1122.25	973.44	1045.2
2	29.0	27.0	841.00	729.00	783.0
3	28.0	25.8	784.00	665.64	722.4
4	25.1	26.2	630.01	656.21	657.62
5	24.7	24.3	610.09	590.49	600.21
6	24.5	25.6	600.25	655.36	627.2
7	28.6	26.9	817.96	723.61	769.34
8	26.0	25.5	676.00	650.25	663.0
9	31.1	29.2	967.21	852.64	908.12
10	35.2	30.8	1239.04	948.64	1084.16
11	27.1	27.5	734.41	756.25	745.25
12	26.2	25.2	686.44	635.04	660.24
13	30.2	27.7	912.04	767.29	836.54
14	29.8	31.8	888.04	1011.24	947.64
15	28.2	27.7	795.24	767.29	781.14
16	28.9	27.3	835.21	745.29	788.97
17	25.8	26.9	665.64	723.61	694.02
18	31.3	28.0	979.69	784.00	876.4
19	24.6	25.4	605.16	645.16	624.84
20	30.3	32.3	918.09	1043.29	978.69
Total (Σ)	=568.1	=552.3	=16302.77	=15323.74	=15793.71

$$r = \frac{20 \times 15793.71 - 568.1 \times 552.3}{\sqrt{20 \times 16307.77 - (568.1)^2 \quad 20 \times 15323.74 - (552.3)^2}}$$

$$= \frac{2112.57}{\sqrt{(3417.79)\ (1439.51)}} = \frac{2112.57}{\sqrt{4919942.8}}$$

$$= \frac{2112.57}{2218.0944} = 0.952 = 0.95$$

APPENDIX C-4

COMPUTATION OF THE RELIABILITY COEFFICIENT OF THE ADEBAYO HOCKEY SHOOTING TEST

SUBJECTS	X	Y	X^2	Y^2	XY
1	8	9	64	81	72
2	6	5	36	25	30
3	9	11	81	121	99
4	12	13	144	169	156
5	6	6	36	36	36
6	5	6	25	36	30
7	9	9	81	81	81
8	10	10	100	100	100
9	7	8	49	64	56
10	2	3	4	9	6
11	5	9	25	81	45
12	9	8	81	64	72
13	7	9	49	81	63
14	9	10	81	100	90
15	11	12	121	144	132
16	6	6	36	36	36
17	11	11	121	121	121
18	4	4	16	16	16
19	9	8	81	64	72
20	10	10	100	100	100
Total (Σ)	=155	=167	=1331	=1529	=1413

$$r = \frac{20 \times 1413 - 155 \times 167}{\sqrt{20 \times 1331 - (155)^2 \quad 20 \times 1529 - (167)^2}}$$

$$= \frac{28260 - 25885}{\sqrt{(26620 - 24025)\ (30580 - 27889)}}$$

$$= \frac{2375}{\sqrt{(2595)(2691)}} = \frac{2375}{2642.564} = .8987483$$

$$= .90$$

APPENDIX D

TASK SHEETS

1. Task sheet for PT on Dribbling.
2. Task sheet for RT on Dribbling.
3. Task sheet for IT on Dribbling.
4. Task sheet for PT on Shooting.
5. Task sheet for RT on Shooting.
6. Task sheet for IT on Shooting.

APPENDIX D-1

TASK SHEET FOR PRACTICE TECHNIQUE ON DRIBBLING

Name ----------

Date ----------

To the Learner: 1. Your task is to practise the following skills as described and as demonstrated.

2. I'll be around to offer you feedback on the execution of the task.

The Task:

1. Dribble the ball straight for a distance of 10.0m.
2. Dribble the ball as in (1) and return to the starting point.
3. Repeat (2) Five times to make a set, and have 5 sets with ten-seconds intervals between sets.
4. Zig-zag dribbling in and out of 5 obstacles.
5. Repeat 1, 2, 3 and 4. as many times as possible.

APPENDIX D-2

TASK SHEET FOR RECIPROCAL TECHNIQUE ON DRIBBLING.

Name ----------

Date ----------

Doer: 1. Practice dribbling as explained and demonstrated for a distance of 10.0m and back.

2. Dribble in and out of 5 obstacles.

3. Repeat 1 and 2 many times.

Observer: 1. Observe the performance using the criteria below to analyse performance and offer feedback to the doer at the end of a to and fro dribble.

2. Switch roles at the end of 5 to and fro dribbles.

3. Offer feedback at the end of a to and fro zig-zag dribble.

4. Switch roles at the end of a set of 5 to and fro zig-zag dribbling.

CRITERIA

1. The left hand is on top of the stick while the right is a little way down the stick.
2. Lean forward.
3. Get the ball ahead of you and slightly to your right.
4. Reverse the stick to bring the ball that goes to the left back to the right.
5. Look away from the ball regularly to ascertain position of other players.

APPENDIX D-3

TASK SHEET FOR INCLUSION TECHNIQUE ON DRIBBLING.

Name ----------

Date ----------

Task	Factor	Level 1	Level 2	Level 3
1. Perform the straight dribbling	Distance of dribble	Dribble for 5.0m and back	Dribble for 7.5m and back	Dribble for 10.0m and back.
2. Perform the zig-zag dribbling	Distance of dribble and number of obstacles.	Dribble in and out of 2 obstacles	Dribble in and out of 3 obstacles	Dribble in and out of 5 obstacles.

APPENDIX D-4

TASK SHEET FOR PRACTICE TECHNIQUE ON SHOOTING.

Name _____

Date _____

To the Learner:

1. Your task is to practise the following skills as described and demonstrated.
2. I'll be around to offer you feedback on the execution of the task.
3. Record your result.

The Task:

1. Dribble into the shooting circle and aim at the target area in the middle five times.
2. Dribble into the shooting circle and aim at the farther target area five times.
3. Dribble into the shooting circle and aim at the nearer target area five times.
4. Repeat 1, 2, and 3 as many times as you can.

APPENDIX D-5

TASK SHEET FOR RECIPROCAL TECHNIQUE ON SHOOTING.

Name ----------

Date ----------

Doer: 1. Dribble into the shooting circle and aim at the target area in the middle 5 times.

2. Dribble into the shooting circle and aim at the farther target area 5 times.

3. Dribble into the shooting circle and aim at the nearer target area 5 times.

4. Repeat 1, 2, and 3 as many times as the time allows.

Observer: 1. Observe the performance using the criteria below to analyse performance and offer feedback to the doer at the end of each shot.

2. Switch roles at the end of every 5 shots.

CRITERIA

1. The two-hands are close together at the top of the stick.
2. The left shoulder points to the direction intended for the ball.
3. Feet must be in the boxer's stance at the time of taking the shot.
4. Keep eyes on the ball.
5. Swing the stick hard and follow through to the intended direction of the ball.

APPENDIX D-6

TASK SHEET FOR INCLUSION TECHNIQUE ON SHOOTING.

Name _____

Date _____

Task	Factor	Level 1	Level 2	Level 3
Perform shooting at the goal	Distance from the goal	Shooting within a radius of 7.0m.	Shooting within a radius of 11.0m.	Shooting within a radius of 11.89m.

APPENDIX E

RAW SCORES ON TESTS

1. Pretest Raw Scores on Dribbling.
2. Post-test Raw Scores on Dribbling.
3. Final-test Raw Scores on Dribbling.
4. Pre-test Raw Scores on Shooting.
5. Post-test Raw Scores on Shooting.
6. Final-test Raw Scores on Shooting.

APPENDIX E-1

PRE-TEST RAW SCORES ON THE ADEBAYO HOCKEY DRIBBLING TEST FOR BEGINNERS.

SUBJECTS	TECHNIQUES OF INSTRUCTION		
	Practice Tech.	Reciprocal Tech.	Inclusion Tech.
1	23.9 sec.	20.0 sec.	27.0 sec.
2	21.6 "	33.0 "	22.1 "
3	23.5 "	29.0 "	21.9 "
4	21.8 "	19.5 "	22.1 "
5	26.0 "	38.4 "	21.4 "
6	23.6 "	30.5 "	41.0 "
7	27.1 "	25.4 "	23.0 "
8	34.0 "	23.0 "	20.0 "
9	23.1 "	22.5 "	24.3 "
10	25.8 "	22.9 "	20.0 "
11	23.3 "	26.5 "	23.5 "
12	22.5 "	24.2 "	28.0 "
13	23.0 "	22.5 "	25.0 "
14	20.0 "	22.3 "	23.0 "
15	25.2 "	23.2 "	21.0 "
16	23.9 "	20.9 "	20.5 "
17	26.0 "	23.0 "	22.5 "
18	28.3 "	21.3 "	20.1 "
19	21.6 "	24.8 "	25.0 "
20	26.8 "	23.5 "	30.9 "
21	18.0 "	23.9 "	25.1 "
22	21.0 "	21.4 "	23.3 "
23	22.8 "	21.5 "	36.0 "
24	24.4 "	25.2 "	17.0 "
25	21.2 "	24.8 "	22.1 "
26	18.5 "	18.6 "	20.8 "
27	22.0 "	21.5 "	22.1 "
28	23.2 "	26.0 "	22.0 "
29	17.5 "	20.2 "	20.0 "
30	23.8 "	24.6 "	18.0 "
Totals	703.4 "	724.1 "	708.7 "
Mean ($\bar{X}$)	23.4 "	24.1 "	23.6 "
Standard Deviation (S.D)	$\pm$ 3.26	$\pm$ 4.14	$\pm$ 4.98

APPENDIX E-1

POST-TEST RAW SCORES ON THE ADEBAYO HOCKEY DRIBBLING TEST FOR BEGINNERS.

	TECHNIQUES OF INSTRUCTION		
SUBJECTS	PT	RT	IT
1	17.0 sec.	22.0 sec.	22.5 sec.
2.	18.5 "	24.5 "	24.0 "
3	22.0 "	24.5 "	19.0 "
4	22.0 "	22.0 "	21.8 "
5	18.5 "	34.0 "	18.0 "
6	16.3 "	27.5 "	18.0 "
7	26.0 "	20.0 "	20.0 "
8	29.0 "	21.5 "	17.5 "
9	20.5 "	20.0 "	22.0 "
10	26.0 "	21.8 "	22.0 "
11	31.5 "	23.5 "	19.5 "
12	18.4 "	24.0 "	24.2 "
13	18.6 "	20.0 "	20.2 "
14	20.1 "	20.1 "	17.0 "
15	21.2 "	20.0 "	19.0 "
16	20.4 "	22.5 "	16.8 "
17	22.9 "	15.6 "	17.0 "
18	27.9 "	16.2 "	22.0 "
19	19.4 "	22.5 "	24.6 "
20	28.5 "	20.8 "	26.8 "
21	18.4 "	31.0 "	21.0 "
22	17.2 "	17.8 "	19.2 "
23	20.0 "	20.0 "	29.0 "
24	20.1 "	19.4 "	16.0 "
25	20.5 "	23.0 "	20.0 "
26	18.0 "	17.5 "	22.0 "
27	19.5 "	17.5 "	18.0 "
28	20.5 "	21.3 "	20.0 "
29	17.9 "	16.5 "	20.0 "
30	21.8 "	19.5 "	20.0 "
Totals	638.6 sec	646.5 sec	617.1 sec
$\bar{X}$	21.3 "	21.6 "	20.6 "
Standard Deviation (S.D)	± 3.91	± 3.93	± 3.02

APPENDIX E-3

FINAL TEST RAW SCORES ON THE ADEBAYO HOCKEY DRIBBLING TEST FOR BEGINNERS.

	TECHNIQUES OF INSTRUCTION		
SUBJECTS	PT	RT	IT
1	18.8 secs.	28.2 secs.	18.7 secs.
2	19.5 "	25.2 "	23.0 "
3	19.0 "	20.0 "	19.0 "
4	18.0 "	18.5 "	19.4 "
5	18.0 "	33.4 "	18.2 "
6	14.5 "	28.5 "	19.2 "
7	19.0 "	17.0 "	19.5 "
8	28.7 "	19.8 "	19.9 "
9	19.0 "	18.3 "	18.2 "
10	18.5 "	19.8 "	19.0 "
11	19.6 "	25.2 "	18.0 "
12	19.0 "	21.4 "	28.5 "
13	19.0 "	18.2 "	18.4 "
14	19.2 "	19.9 "	18.5 "
15	17.2 "	19.5 "	16.0 "
16	20.0 "	18.3 "	16.0 "
17	18.9 "	19.0 "	18.0 "
18	29.8 "	16.5 "	26.3 "
19	18.5 "	19.9 "	28.9 "
20	27.8 "	19.5 "	26.7 "
21	18.8 "	29.5 "	18.6 "
22	16.5 "	17.5 "	18.6 "
23	18.0 "	20.0 "	25.9 "
24	20.5 "	18.6 "	18.8 "
25	18.0 "	25.2 "	19.0 "
26	18.0 "	18.8 "	26.0 "
27	19.2 "	18.0 "	19.8 "
28	19.0 "	19.8 "	18.2 "
29	18.2 "	18.2 "	18.8 "
30	18.0 "	20.0 "	18.8 "
Totals	586.2	631.7	611.9
$\bar{X}$	19.5	21.1	20.4
Standard Deviation (S.D)	± 3.32	± 4.19	± 3.62

APPENDIX E-4

PRE-TEST RAW SCORES ON THE ADEBAYO HOCKEY SHOOTING TEST FOR BEGINNERS.

SUBJECT	TECHNIQUES OF INSTRUCTION		
	Practice Technique	Reciprocal Technique	Inclusion Technique
1	05	05	03
2	03	05	05
3	09	06	06
4	03	04	05
5	02	05	04
6	06	02	08
7	06	04	05
8	04	09	07
9	05	03	10
10	07	06	08
11	05	03	09
12	07	05	04
13	07	08	06
14	06	07	03
15	08	05	06
16	07	07	04
17	05	06	06
18	06	07	07
19	09	04	05
20	05	02	06
21	04	05	08
22	07	08	04
23	05	02	06
24	04	05	06
25	07	06	05
26	04	04	07
27	04	03	08
28	05	02	04
29	07	03	02
30	07	02	03
Totals	169	146	168
$\bar{X}$	5.63	4.87	5.6
Standard Deviation (S.D)	±1.73	±1.91	±1.96

APPENDIX E-5

POST-TEST RAW SCORES ON THE ADEBAYO HOCKEY SHOOTING TEST FOR BEGINNERS.

SUBJECTS	TECHNIQUES OF INSTRUCTION		
	Practice Technique	Reciprocal Technique	Inclusion Technique
1	12	11	16
2	09	12	10
3	14	13	10
4	06	10	12
5	09	12	11
6	12	10	13
7	13	09	10
8	12	12	11
9	08	11	13
10	19	12	12
11	09	10	14
12	13	10	13
13	12	12	11
14	14	13	12
15	12	11	11
16	15	10	10
17	14	13	13
18	11	13	10
19	19	08	08
20	11	10	10
21	10	11	09
22	13	12	13
23	12	12	12
24	13	08	12
25	16	09	13
26	13	11	11
27	10	08	11
28	12	10	09
29	14	09	12
30	13	08	13
Totals	370	320	345
$\bar{X}$	12.33	10.67	11.50
Standard Deviation (S.D)	$\pm$2.82	$\pm$1.60	$\pm$1.70

APPENDIX E-6

FINAL TEST RAW SCORES ON THE ADEBAYO HOCKEY SHOOTING TEST FOR BEGINNERS.

SUBJECTS	TECHNIQUES OF INSTRUCTION		
	Practice Technique	Reciprocal Technique	Inclusion Technique
1	09	14	18
2	09	11	12
3	10	11	13
4	06	11	11
5	09	12	08
6	10	10	12
7	10	05	09
8	08	10	09
9	08	09	08
10	12	08	11
11	12	10	13
12	10	08	09
13	10	10	12
14	12	12	09
15	10	10	12
16	14	10	09
17	16	14	12
18	20	11	10
19	14	07	08
20	12	10	10
21	10	10	08
22	11	10	12
23	12	12	10
24	13	09	09
25	13	06	11
26	13	10	12
27	14	08	10
28	12	07	11
29	13	08	13
30	12	07	12
Totals	344	290	323
$\bar{X}$	11.47	9.67	10.77
Standard Deviation (S.D)	$\pm$2.70	$\pm$2.12	$\pm$2.13

APPENDIX F.

DATA FOR ANOVA, ANCOVA AND t-TEST

1. Data from Pretest Dribbling Scores for ANOVA.
2. Data from Post-test Dribbling Scores for ANOVA.
3. Data from Final-test Dribbling Scores for ANOVA.
4. Data from Pretest Shooting Scores for ANOVA.
5. Data from Post-test Shooting Scores for ANOVA.
6. Data from Final-test Shooting Scores for ANOVA.
7. Data for ANCOVA from Pretest and Post-test Dribbling Scores.
8. Data for ANCOVA from Post-test and Final-test Dribbling Scores.
9. Data for ANCOVA from Pretest and Post-test Shooting Scores.
10. Data for ANCOVA from Post-test and Final-test Shooting Scores.
11. Data from Pretest and Post-test Dribbling Scores for t-Test on PT.
12. Data from Pretest and Post-test Dribbling Scores for t-Test on RT.
13. Data from Pretest and Post-test Dribbling Scores for t-Test IT.
14. Data from Post-test and Final-test Dribbling Scores for t-Test on PT.
15. Data from Post-test and Final-test Dribbling Scores for t-Test on Reciprocal Technique RT.
16. Data from Post-test and Final-test Dribbling Scores for t-Test on IT.

TABLE 26

DATA FROM PRETEST DRIBBLING SCORES FOR ANOVA

Subjects	Techniques of Instruction			
	Practice	Reciprocal	Inclusion	
1.				
2				
3				
..				
.				
.				
.				
30				Grand Total
Totals	703.4	724.1	708.7	2136.2
Means	23.4	24.1	23.6	-
Sum of Squares	16,800.78	17,975.25	17,460.81	52236.84
$\frac{\text{Total}^2}{n}$	16,492.39	17,477.36	16,741.86	50711.61

n = Number of subjects in the group.

TABLE 27

DATA FROM POST-TEST DRIBBLING SCORES FOR ANOVA

Subjects	Techniques of Instruction			
	Practice	Reciprocal	Inclusion	
1				
2				
3				
.				
.				
.				
.				
30				Grand Total
Totals	638.6	646.5	617.1	1,902.2
Means	21.3	21.6	20.6	-
Sum of Squares	14,037.06	14,379.08	12,957.91	41,374.05
$\frac{\text{Total}^2}{n}$	13,593.67	13,932.08	12,693.75	40,219.5

n = Number of subjects in the group.

TABLE 28

DATA FROM FINAL DRIBBLING SCORES FOR ANOVA.

Subjects	Techniques of Instruction			
	Practice	Reciprocal	Inclusion	
1 2 3 30				Grand Total
Totals	586.2	631.6	611.9	1,829.8
Means	19.5	21.1	20.4	-
Sum of Squares	11,774.68	13,811.43	12,860.61	38,446.72
$\frac{\text{Total}^2}{n}$	11,454.35	13,301.50	12,480.72	37,236.57

n = Number of subjects in each group.

TABLE 29

DATA FROM PRETEST SHOOTING SCORES FOR ANOVA

Subjects	Techniques of Instruction			
	Practice	Reciprocal	Inclusion	
1				
2				
3				
4				
.				
.				
.				
.				
30				Grand Total
Totals	169	146	168	483
Means	5.63	4.87	5.60	-
Sum of Squares	1039	816	1052	2907
$\frac{Total^2}{n}$	952.03	710.53	940.8	2603.36

n = Number of subjects in the group.

TABLE 30

DATA FROM POST-TEST SHOOTING SCORES FOR ANOVA.

Subjects	Techinques of Instruction			
	Practice	Reciprocal	Inclusion	
1 2 3 30				Grand Total
Totals	370	320	345	1,035
Means	12.33	10.67	11.50	
Sum of Squares	4794	3488	4051	12,333
$\frac{\text{Total}^2}{n}$	4563.33	2413.33	3967.50	11,944.16

n = Number of subjects in the group.

TABLE 31

DATA FROM FINAL TEST SHOOTING SCORES FOR ANOVA.

Subjects	Techniques of Instruction			
	Practice	Reciprocal	Inclusion	
1				
2				
3				
.				
.				
.				
.				
30				Grand Total
Totals	344	290	323	957
Means	11.47	9.67	10.77	-
Sum of Squares	4156	2934	3609	10,699
$\frac{\text{Total}^2}{n}$	3944.53	2803.33	3477.63	10,222.49

n = Number of subjects in the group.

TABLE 33

DATA FOR ANCOVA FROM POST-TEST AND FINAL TEST DRIBBLING SCORES.

	Techniques of Instruction									
	Practice			Reciprocal			Inclusion			
Subjects	Y	Z	YZ	Y	Z	YZ	Y	Z	YZ	
1										
2										
3										
.										
.										
.										
.										
30										
										Grand Totals
Totals	638.6	586.2	12,734.75	646.5	631.7	14,022.76	617.1	611.9	12,818.57	ΣY = 1902.2
										ΣZ = 1,829.8
										ΣYZ = 39,576.08
Means	21.3	19.5	-	21.6	21.1	-	20.6	20.4	-	ΣY^2 = 41,373.05
Sums of Squares	14,036.06	11,774.68	-	14,379.08	13,811.43	-	12,957.91	12,860.61	-	ΣZ^2 = 38,446.72

Y = Post-test Scores

Z = Final Test Scores

YZ = Product of Post- and Final-Test Scores

Σ = Sum of --

TABLE 32

DATA FOR ANCOVA FROM PRETEST AND POST-TEST DRIBBLING SCORES.

Subjects	Techniques of Instruction: Practice X	Practice Y	Practice XY	Reciprocal X	Reciprocal Y	Reciprocal XY	Inclusion X	Inclusion Y	Inclusion XY	Grand Totals
1										
2										
3										
•										
•										
•										
30										
Totals	703.4	638.6	15213.62	724.1	646.5	15,469.91	708.7	6171	14,774.51	$X = 2,136.3$
Means	23.4	21.3	-	24.1	21.6	-	23.6	20.6	-	$Y = 1902.2$
Sums of Squares	16,800.78	14,036.06	-	17,975.25	14,379.08	-	17,460.81	12,957.91	-	$XY = 45,458.04$ $X^2 = 52,236.84$ $X^2 = 41,373.05$

X = Pretest Scores

Y = Post-test Scores

XY = Product of Pre- and Post-Test Scores

Σ = Sum of

TABLE 34

DATA FOR ANCOVA FROM PRETEST AND POST-TEST SHOOTING SCORES

Subjects	Techniques of Instruction									
	Practice			Reciprocal			Inclusion			
	X	Y	XY	X	Y	XY	X	Y	XY	
1										
2										
3										
.										
.										
.										
30										
Totals	169	370	2183	146	320	1611	168	345	1826	Grand Totals
Means	5.63	12.33	-	4.87	10.67	-	5.60	11.50	-	ΣX = 483
Sums of Squares	1039	4794	-	816	3488	-	1052	4051	-	ΣY = 1035 ΣXY = 5620 ΣX^2 = 2907 ΣY^2 = 12333

X = Pretest Scores

Y = Post-test Scores ...

XY = Product of Pre- and Post-Test Scores.

TABLE 35

DATA FOR ANCOVA FROM POST-TEST AND FINAL SHOOTING TEST SCORES.

Subjects	Techniques of Instruction									
	Practice			Reciprocal			Instruction			
	Y	Z	YZ	Y	Z	YZ	Y	Z	YZ	
1										
2										
3										
.										
.										
.										
30										
Totals	370	344	4337	320	290	3151	345	323	3773	Grand Totals
Means	12.33	11.47	-	10.67	9.67	-	11.50	10.77	-	$\Sigma Y = 1035$
Sums of Squares	4794	4156	-	3488	2934	-	4051	3609	-	$\Sigma Z = 957$
										$\Sigma YZ = 11,261$
										$\Sigma Y^2 = 12,333$
										$\Sigma Z^2 = 10,699$

Y = Post-test Scores

Z = Final test Scores

YZ = Product of Post- and Final-Test Scores.

TABLE 36

DATA FROM PRETEST AND POST-TEST DRIBBLING SCORES FOR t-TEST ON PRACTICE TECHNIQUE.

	Pretest	Post-test	Difference (d)	d^2
1	23.9	17.0	6.9	47.61
2	21.6	18.5	3.1	9.61
3	23.5	22.0	1.5	2.25
4	21.8	22.0	-0.2	0.04
5	26.0	18.5	7.5	56.25
6	23.6	16.3	7.3	53.29
7	27.1	26.0	1.1.	1.21
8	34.0	29.0	5.0	25.00
9	23.1	20.5	2.6	6.76
10	25.8	26.0	-0.2	0.04
11	23.3	31.5	-8.2	67.24
12	22.5	18.4	4.1	16.81
13	23.0	18.6	4.4	19.36
14	20.0	20.1	-0.1	0.01
15	25.2	21.2	4.0	16.00
16	23.9	20.4	3.5	12.25
17	26.0	22.9	3.1	9.61
18	28.3	27.9	0.4	0.16
19	21.6	19.4	2.2	4.84
20	26.8	28.5	-1.7	2.89
21	18.0	18.4	-0.4	0.16
22	21.0	17.2	3.8	14.44
23	22.8	20.0	2.8	7.84
24	24.4	20.1	4.3	18.49
25	21.2	20.5	0.7	0.49
26	18.5	18.0	0.5	0.25
27	22.0	19.5	2.5	6.25
28	23.2	20.5	2.7	7.29
29	17.5	17.9	-0.4	0.16
30	23.8	21.8	2.0	4.00
Totals (Σ)	703.4	638.6	64.8	477.84
Means	23.4	21.3	2.16	—

TABLE 37

DATA FROM PRETEST AND POST-TEST DRIBBLING SCORES FOR t-TEST ON RECIPROCAL TECHNIQUE.

	Pretest	Post-test	Difference (d)	d^2
1	20.0	22.0	-2.0	4.00
2	33.0	24.5	8.5	72.25
3	29.0	24.5	5.5	30.25
4	19.5	22.0	-2.5	6.25
5	38.4	34.0	4.4	19.36
6	30.5	27.5	3.0	9.00
7	25.4	20.0	5.4	29.16
8	23.0	21.5	1.5	2.25
9	22.5	20.0	2.5	6.25
10	22.9	21.8	1.1	1.21
11	26.5	23.5	3.0	9.00
12	24.2	24.0	0.2	0.04
13	22.5	20.0	2.5	6.25
14	22.3	20.1	2.2	4.84
15	23.2	20.0	3.2	10.24
16	20.9	22.5	-1.6	2.56
17	23.0	15.6	7.4	54.76
18	21.3	16.2	5.1	26.01
19	24.8	22.5	2.3	5.29
20	23.5	20.8	2.7	7.29
21	23.9	31.0	-7.1	50.41
22	21.4	17.8	3.6	12.96
23	21.5	20.0	1.5	2.25
24	25.2	19.4	5.8	33.64
25	24.8	23.0	1.8	3.24
26	18.6	17.5	1.1	1.21
27	21.5	17.5	4.0	16.00
28	26.0	21.3	4.7	22.09
29	20.2	16.5	3.7	13.69
30	24.6	19.5	5.1	26.01
Totals(Σ)	724.1	646.5	77.6	487.76
Means	24.1	21.6	2.59	—

TABLE 38

DATA FROM PRETEST AND POST-TEST DRIBBLING SCORES

FOR t-TEST ON INCLUSION TECHNIQUE

	Pretest	Post-test	Difference (d)	d^2
1	27.0	22.5	4.9	24.01
2	22.1	24.0	-1.9	3.61
3	21.9	19.0	2.9	8.41
4	22.1	21.8	-0.3	0.09
5	21.4	18.0	3.4	11.56
6	41.0	18.0	23.0	529.00
7	23.0	20.0	3.0	9.00
8	20.0	17.5	2.5	6.25
9	24.3	22.0	2.3	5.29
10	20.0	22.0	-2.0	4.00
11	23.5	19.5	4.0	16.00
12	28.0	24.2	3.8	14.44
13	25.0	20.2	4.8	23.04
14	23.0	17.0	6.0	36.00
15	21.0	19.0	2.0	4.00
16	20.5	16.8	3.7	12.69
17	22.5	17.0	5.5	30.25
18	20.1	22.0	-1.9	3.61
19	25.0	24.6	0.4	0.16
20	30.9	26.8	4.1	16.81
21	25.1	21.0	4.1	16.81
22	23.3	19.2	4.1	16.81
23	36.0	29.0	7.0	49.00
24	17.0	16.0	1.0	1.00
25	22.1	20.0	2.1	4.41
26	20.8	22.0	-1.2	1.44
27	22.1	18.0	4.1	16.81
28	22.0	20.0	2.0	4.00
29	20.0	20.0	0.0	0.00
30	18.0	20.0	-2.0	4.00
Totals(Σ)	708.8	617.1	91.7	873.5
Means	23.6	20.6	3.06	—

TABLE 39

DATA FROM POST-TEST AND FINAL-TEST DRIBBLING SCORES FOR t-TEST ON PRACTICE TECHNIQUE.

	Post-test	Final-test	Difference (d)	d^2
1	17.0	18.8	-1.8	3.24
2	18.5	19.5	-1.0	1.00
3	22.0	19.0	3.0	9.00
4	22.0	18.0	4.0	16.00
5	18.5	18.0	0.5	0.25
6	16.3	14.5	1.8	3.24
7	26.0	19.0	7.0	49.00
8	29.0	28.7	0.3	0.09
9	20.5	19.0	1.5	2.25
10	26.0	18.5	7.5	56.25
11	31.5	19.6	11.9	141.61
12	18.4	19.0	-0.6	0.36
13	18.6	19.0	-0.4	0.16
14	20.1	19.2	0.0	0.81
15.	21.2	17.2	4.0	16.00
16	20.4	20.0	0.4	0.16
17	22.9	18.9	4.0	16.00
18	27.9	29.8	-1.9	3.61
19	19.4	18.5	0.9	0.81
20	28.5	27.8	0.7	0.49
21	18.4	18.8	0.4	0.16
22	17.2	16.5	0.7	0.49
23	20.0	18.0	2.0	4.00
24	20.1	20.5	-0.4	0.16
25	20.5	18.0	2.5	6.25
26	18.0	18.0	0.0	0.00
27	19.5	19.2	0.3	0.09
28	20.5	19.0	1.5	2.25
29	17.9	18.2	-0.3	0.09
30	21.8	18.0	3.8	14.44
Totals(Σ)	638.6	586.2	52.4	348.26
Means	21.3	19.5	1.75	--

TABLE 40

DATA FROM POST-TEST AND FINAL-TEST DRIBBLING SCORES FOR t-TEST ON RECIPROCAL TECHNIQUE.

	Post-test	Final-test	Difference (d)	d^2
1	22.0	28.2	-6.2	38.44
2	24.5	25.2	-0.7	0.49
3	24.5	20.0	4.5	20.25
4	22.0	18.5	3.5	12.25
5	34.0	33.4	0.6	0.36
6	27.5	28.5	-1.0	1.00
7	20.0	17.0	3.0	9.00
8	21.5	19.8	1.7	2.89
9	20.0	18.3	1.7	2.89
10	21.8	19.8	2.0	4.00
11	23.5	25.2	-1.7	2.89
12	24.0	21.4	216	6.76
13	20.0	18.2	2.8	7.84
14	20.1	19.9	0.2	0.04
15	20.0	19.5	0.5	0.25
16	22.5	18.3	4.2	17.64
17	15.6	19.0	-3.4	11.56
18	16.2	16.5	-0.3	0.09
19	22.5	19.9	2.6	6.76
20	20.8	19.5	1.3	1.69
21	31.0	29.5	1.5	2.25
22	17.8	17.5	0.3	0.09
23	20.0	20.0	0.0	0.00
24	19.4	18.6	).8	0.64
25	23.0	25.2	-2.2	4.84
26	17.5	18.8	-1.3	1.69
27	17.5	18.0	-0.5	0.25
28	21.3	19.8	1.7	2.25
29	16.5	18.2	-1.7	2.89
30	19.5	20.0	-0.5	0.25
Totals(Σ)	646.5	631.7	14.8	162.24
Means	21.6	21.1	0.49	—

TABLE 41

DATA FROM POST-TEST AND FINAL-TEST DRIBBLING SCORES FOR t-TEST ON INCLUSION TECHNIQUE.

	Post-test	Final-test	Difference (d)	d^2
1	22.5	18.7	3.8	14.44
2	24.0	23.0	1.0	1.00
3	19.0	19.0	0.0	0.00
4	21.8	19.4	2.4	5.76
5	18.0	18.2	-0.2	0.04
6	18.0	19.2	-1.2	1.44
7	20.0	19.5	0.5	0.25
8	17.5	19.9	-2.4	5.76
9	22.0	18.2	3.8	14.44
10	22.0	19.0	3.0	9.00
11	19.5	18.0	1.5	2.25
12	24.2	28.5	-4.3	18.49
13	20.2	18.4	1.8	3.24
14	17.0	18.5	-1.5	2.25
15	19.0	16.0	3.0	9.00
16	16.8	16.0	0.8	0.64
17	17.0	18.0	-1.0	1.00
18	22.0	26.3	-4.3	18.49
19	24.6	28.9	-4.3	18.49
20	26.8	26.7	0.1	0.01
21	21.0	18.6	2.4	5.76
22	19.2	18.6	0.6	0.36
23	29.0	25.9	3.1	9.61
24	16.0	18.8	-2.8	7.84
25	20.0	19.0	-2.8	1.00
26	22.0	26.0	-4.0	16.00
27	18.0	19.8	-1.8	3.24
28	20.0	18.2	1.8	3.24
29	20.0	18.8	1.2	1.44
30	20.0	18.8	1.2	1.44
Totals (Σ)	617.1	611.9	5.2	175.92
Means	20.67	20.4	0.17	--

TABLE 42

DATA FROM PRETEST AND POST-TEST SHOOTING SCORES FOR t-TEST ON PRACTICE TECHNIQUE.

	Pretest	Post-test	Difference (d)	d^2
1	05	12	07	49
2	03	09	06	36
3	09	14	05	25
4	03	06	03	09
5	02	09	07	49
6	06	12	06	36
7	06	13	07	49
8	04	12	08	64
9	05	08	03	09
10	07	19	12	144
11	05	09	04	16
12	07	13	06	36
13	07	12	05	25
14	06	14	08	64
15	08	12	04	16
16	07	15	08	64
17	05	14	09	81
18	06	11	05	25
19	09	19	10	100
20	05	11	06	36
21	04	10	06	31
22	07	13	06	36
23	05	12	07	49
24	04	13	09	81
25	07	16	09	81
26	04	13	09	81
27	04	10	06	36
28	05	12	07	49
29	07	14	07	49
30	07	13	06	36
Totals (Σ)	169	370	201	1,467
Means	5.63	12.33	6.70	—

TABLE 43

DATA FROM PRETEST AND POST-TEST SHOOTING SCORES FOR t-TEST ON RECIPROCAL TECHNIQUE.

	Pretest	Post-test	Difference (d)	d^2
1	05	11	06	36
2	05	12	07	49
3	06	13	07	49
4	04	10	06	36
5	05	12	07	49
6	02	10	08	64
7	04	09	05	25
8	09	12	03	09
9	03	11	08	64
10	06	12	06	36
11	03	10	07	49
12	05	10	05	25
13	08	12	04	16
14	07	13	06	36
15	05	11	06	36
16	07	10	03	09
17	06	13	07	49
18	07	13	06	36
19	04	08	04	16
20	02	10	08	64
21	05	11	06	34
22	08	12	04	16
23	05	12	07	49
24	05	08	03	09
25	06	09	03	09
26	04	11	07	49
27	03	08	05	25
28	02	10	08	64
29	03	09	06	36
30	02	08	06	36
Totals(Σ)	146	320	174	966
Means	4.87	10.67	5.80	$\frac{}{}$

TABLE 44

DATA FROM PRETEST AND POST-TEST SHOOTING SCORES FOR t-TEST ON INCLUSION TECHNIQUE.

	Pretest	Post-test	Difference (d)	d^2
1	03	16	13	169
2	05	10	05	25
3	06	10	04	16
4	05	12	07	49
5	04	11	07	49
6	08	13	05	25
7	05	10	05	25
8	07	11	04	16
9	10	13	03	09
10	08	12	04	16
11	09	14	05	25
12	04	13	09	81
13	06	11	05	25
14	03	12	09	81
15	06	11	05	25
16	04	10	06	36
17	06	13	07	49
18	07	10	03	09
19	05	08	03	09
20	06	10	04	16
21	08	09	01	01
22	04	13	09	81
23	04	12	08	64
24	06	12	06	36
25	05	13	08	64
26	07	11	04	16
27	08	11	03	09
28	04	09	05	25
29	02	12	10	100
30	03	13	10	100
Totals(ξ)	168	345	177	1,251
Means	5.6	11.5	5.9	—

TABLE 45

DATA FROM POST-TEST AND FINAL-TEST SHOOTING SCORES FOR t-TEST ON PRACTICE TECHNIQUE

	Post-test	Final-Test	Difference (d)	d^2
1	12	09	3	09
2	09	09	0	00
3	14	10	4	16
4	06	06	0	00
5	09	09	0	00
6	12	10	2	04
7	13	10	3	09
8	12	08	4	16
9	08	08	0	00
10	19	12	7	49
11	09	12	-3	09
12	13	10	3	09
13	12	10	2	04
14	14	12	2	04
15	12	10	2	04
16	15	14	1	01
17	14	16	-2	04
18	11	20	-9	81
19	19	14	5	25
20	11	12	-1	01
21	10	10	0	00
22	13	11	2	04
23	12	12	0	00
24	13	13	0	00
25	16	13	3	09
26	13	13	0	00
27	10	14	-4	16
28	12	12	0	00
29	14	13	1	01
30	13	12	1	01
Totals(Σ)	370	344	26	276
Means	12.33	11.47	0.87	

TABLE 46

DATA FROM POST-TEST AND FINAL-TEST SHOOTING SCORES FOR t-TEST ON RECIPROCAL TECHNIQUE.

	Post-test	Final-test	Difference (d)	d^2
1	11	14	-03	09
2	12	11	01	01
3	13	11	02	04
4	10	11	-01	01
5	12	12	00	00
6	10	10	00	00
7	09	05	04	16
8	12	10	02	04
9	11	09	02	04
10	12	08	04	16
11	10	10	00	00
12	10	08	02	04
13	12	10	02	04
14	13	12	01	01
15	11	10	01	01
16	10	10	00	00
17	13	14	-01	01
18	13	11	02	04
19	08	07	01	01
20	10	10	00	00
21	11	10	01	01
22	12	10	02	04
23	12	12	00	00
24	08	09	-01	01
25	09	06	03	09
26	11	10	01	01
27	08	08	00	00
28	10	07	03	09
29	09	08	01	01
30	08	07	01	01
Totals(Σ)	320	290	30	98
Means	10.33	9.67	1.00	

TABLE 47

DATA FROM POST-TEST AND FINAL-TEST SHOOTING SCORES FOR t-TEST ON INCLUSION TECHNIQUE

	Post-test	Final-test	Difference (d)	d^2
1	16	18	-02	04
2	10	12	-02	04
3	10	13	-03	09
4	12	11	01	01
5	11	08	03	09
6	13	12	01	01
7	10	09	01	01
8	11	09	02	04
9	13	08	05	25
10	12	11	01	01
11	14	13	01	01
12	13	09	04	16
13	11	12	-01	01
14	12	09	03	09
15	11	12	-01	01
16	10	09	01	01
17	13	12	01	01
18	10	10	00	00
19	08	08	00	00
20	10	10	00	00
21	09	08	01	01
22	13	12	01	01
23	12	10	02	04
24	12	09	03	09
25	13	11	02	04
26	11	12	-01	01
27	11	10	01	01
28	09	11	-02	04
29	12	13	-01	01
30	13	12	01	01
Totals (£)	345	323	22	116
Means	11.50	10.77	0.73	