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LEE, FRIEDA. The Effect of Utilizing a Badminton Shuttlecock Projecting Device on the Playing Ability of Beginning Badminton Players. (1971) Directed by: Dr. Gail Hennis. Pp. 87

It was the purpose of this study to determine the effectiveness of a badminton shuttlecock projecting device upon the skill achieved by a group of beginning badminton players.

The subjects were college students enrolled in two beginning badminton classes and one recreational sports class. The two badminton classes were designated as the experimental (N = 16) and control (N = 18) groups, both groups receiving class instruction. In addition, the experimental group practiced hitting shuttlecocks projected by the device. The recreational sports class was designated as the comparison group (N = 12).

Initial and final Miller Wall Volley Test scores assessed badminton ability at the beginning and conclusion of the study. A pre-instruction knowledge test was also administered. Scores were analyzed with the analysis of variance procedure followed by Scheffé tests which further assessed differences. The significance level was set at the .05 critical value.

Results revealed significant differences between the three groups on final badminton playing ability although the conservative Scheffé tests failed to pinpoint the exact nature of the differences. A significant improvement in playing ability was found for both the experimental and control groups.

It can be concluded, within the limitations of this study, that badminton instruction supplemented with the aid of a badminton shuttlecock projecting machine was as effective as badminton instruction alone.

THE EFFECT OF UTILIZING A BADMINTON SHUTTLECOCK  
PROJECTING DEVICE ON THE PLAYING ABILITY  
OF BEGINNING BADMINTON PLAYERS

by

Frieda Lee

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## CHAPTER I

## INTRODUCTION

Learning, as defined by Lawther, is:

. . . relatively permanent change in behavior resulting from experience, as contrasted with changes due to growth, aging, fatigue, or temporary physiological fluctuations. . . . Motor learning is usually defined as learning in which bodily movements play a major part; it is a term used to describe an adjustment of responses to some environmental situation, a considerable part of which adjustment consists of patterned muscular contractions, static and dynamic. (4:4)

A basic purpose of teaching physical activity is to facilitate learning. The teacher becomes a facilitator by developing effective learning situations which efficiently results in positive, substantial changes in the behavior of the student. Employing the traditional techniques is not enough for the modern teacher. He constantly searches for approaches which provide for more efficient utilization of learning time.

The use of instructional media to enhance the learning climate has been widely innovated in physical education. In tennis, for example, instructors have found the "Ball Boy" machine, a device for projecting the ball, as a valuable aid in the instruction of classes. The potential of a similar machine for projecting badminton shuttlecocks has not been explored.

If found successful, a badminton shuttlecock projecting machine could make several advances in the techniques of teaching and practicing the game. Repeatedly duplicating the flight of

each shuttle, the machine should provide an opportunity for more intensive concentration of stroke development. It could assist the instructor, hindered by inadequate court space in addition to large classes, by engaging the participation of many students. It could encourage the student to learn by enabling him to practice on his own.

This study used a machine that projected shuttlecocks to specific spots on the badminton court in an attempt to evaluate its effectiveness upon the skill achievement of beginning badminton players.

## CHAPTER III

### STATEMENT OF PROBLEM

The purpose of this study was to determine the effectiveness of a badminton shuttlecock projecting device upon the skill achieved by a group of beginning badminton players. The skill achieved by an experimental group which utilized the machine was compared to the skill achieved by control and comparison groups which were never introduced to the machine. Skill in all groups was assessed prior to instruction and again after twenty-five lessons by the Miller Wall Volley Test.

### DEFINITIONS

For purposes of this study, the following definitions were used:

1. beginning badminton player - an individual who scores below thirty-three on the Miller Wall Volley Test.
2. badminton device - "The birdie dropper" - a machine that projects badminton shuttlecocks to designated spots on the court at appropriate heights for respective shots.

### LIMITATIONS

The sample was limited to college men and women enrolled in two beginning badminton classes and one recreational sports

class at The University of North Carolina at Greensboro. Random selection of subjects was not possible. The instructional unit was limited to fourteen weeks.

Another limiting factor was the evaluation of badminton achievement. This evaluation was limited to the subject's ability to perform the Miller Wall Volley Test. In conjunction with this test, an additional limitation was the shuttlecocks used. New Timpé outdoor shuttlecocks (sponge end) which were used in the original Miller Wall Volley Test study were not available for this study. Instead, new nylon Carleton International shuttlecocks were used to rebound off the glazed brick wall surfacing of the gymnasium.

## CHAPTER III

## REVIEW OF LITERATURE

The literature reviewed pertinent to this study was divided into two main sections. The first section consists of a review of devices, aids, and various instructional methods used in the teaching of badminton. The second section is an analysis of the tennis Ball Boy as an instructional aid.

EFFECT OF DEVICES, AIDS, AND VARIOUS  
INSTRUCTIONAL METHODS ON ACHIEVEMENT IN BADMINTONAudiovisual Aids

As early as 1947, Jones (26) studied the value of motion pictures taken of each student as an aid in learning to perform badminton skills. The experimental group, in addition to receiving the same oral explanations and demonstrations as the control group, had the benefit of viewing movies of themselves performing. Movies were retaken three times to check student progress. Out of the total twenty hours and thirty-six minutes each student spent in class, fifty minutes were apportioned in getting movie instruction. (26:34) Jones found no significant differences between the control and experimental groups as measured by the Wellesley Long Service Test (reliability .76, no validity established) and Scott's Short Service Test (reliability .88, validity .66). (26:24)

Twenty-two years later, in a similar study, Gasson (9) investigated the values of videotaping beginning badminton players. Every member of an experimental group, after being taped for one minute each day, viewed its playback. In mixed doubles' games, each team was taped for five minutes with immediate analysis and discussion concurrent with the playback. Gasson's findings did not establish the videotape recorder as a consequential teaching aid in the instruction of beginning badminton to university students.

The effectiveness of loop films in badminton instruction was investigated by Karsner (27) and Gray (23). Karsner, as cited by Gray, studied three experimental groups: group one-- explanation of a stroke, demonstration, followed by film; group two-- explanation of all strokes, demonstration, practice, followed by film; group three-- explanation, film as the only demonstration. He used seventeen 16 mm loop films which showed correct form and common errors in slow and normal motion. The forty-six male subjects were tested on a ninety item knowledge test, the McCloy General Motor Ability Test, and were also rated before and after instruction. Results of a ladder and round robin tournament were also recorded. Between the three experimental groups, no significant differences in mean gains were found on the knowledge scores, motor ability scores, or skill ratings. The tournament results revealed no significant difference in the playing ability of the groups. It was the opinion of this writer that a control group utilizing no film was needed for a more complete evaluation of the effectiveness of the film loops.

Gray (23) used home constructed 8 mm motion picture films of the long serve, short serve, clear, drive, footwork, drop, smash, and net shots in his study. The experimental group for five weeks viewed film loops for two minutes at the beginning of each class and two additional minutes during the class period. Subjects were then rated in a singles tournament. Those who were rated as "skill deficient" were directed to the loops' station for more viewing during the seventh and eighth weeks. Both control and experimental groups were tested on the Lockhart-McPherson Wall Volley Test, the Brumbach Short Serve Test, and the Brumbach Clear Test before, during, and at the end of the study. Results revealed no significant difference between the two groups in badminton playing ability at the end of eleven weeks. The experimental group did show a significant improvement in playing ability over the initial six week period of instruction.

After observing the effectiveness of music in industry, Bell (18) studied the use of music in teaching badminton to fifty-two college men. Music was played in the background during all classes of the experimental group. The author, however, failed to indicate what type of background music he played during classes (i.e., jazz, classic, rock and roll). Scores on the Brumbach Short Service Test, Brumbach Clear Test, and the Lockhart-McPherson Wall Volley Test, administered during the second, sixth, and eleventh weeks, revealed no significant differences between the control and experimental groups in badminton playing ability.



McLelland (29) studied the use of music as an aid in teaching the badminton serve. On the basis of Scott Motor Ability Test scores, she divided forty-one college women into two equated groups. The experimental group practiced with music while the control group did not. Throughout the study, long and short serving ability was tested on alternate days. The two groups showed no significant differences in serving skill.

#### Programmed Instruction

Self-instructional programs in badminton have only recently been explored. In 1965, Neuman (32) concluded that "programmed instruction was as effective as the class presentation method with respect to knowledge of badminton rules" (32:58); however, "programmed instruction was not as effective as the class presentation method of instruction with respect to total badminton knowledge." (32:58) On eight separate days, each of the nineteen subjects in the experimental group took a pretest, completed a program booklet, took a post-test, and then played using the information in the booklet. The seventeen subjects in the control group received instruction in rules through the class presentation method. Conclusions were based on a comparison of scores achieved on a knowledge test prepared by the author. Final Miller Wall Volley Test scores revealed no statistically significant differences in badminton playing ability between the two groups.

Lutz (28), in 1966, designed a badminton programmed instruction course consisting of rules, strategy, and history of

badminton. He divided his 111 subjects into the following four groups: group one used a selected textbook; group two read and studied the programmed textbook outside of class; group three listened to lectures covering material of selected textbooks; group four read programmed textbook in class under teacher supervision. Using Hooks' Standardized Knowledge Test on badminton (reliability split halves .74, Spearman Brown .85) (28:26), Lutz found a significant difference between classroom contained programmed text and homework programmed text in favor of the latter. He concluded that programmed instruction was an effective means of dispensing knowledge of badminton in activity courses. Self-instruction left the students with more time to actively participate in learning the skills.

Four beginning badminton classes at Southern Colorado State College served as subjects in Stutters' (15) 1968 study. Seventy-two subjects were placed in two classes of traditional instruction and two classes of programmed text instruction without an instructor. Placement, for the purpose of equating groups, was based on scores achieved in the Barrow Motor Ability Test, Adams Sport Type Motor Educability Test, and American College Test. After a ten-week period, the French Short Serve Test and Lockhart-McPherson Badminton Wall Volley Test were administered to assess skill achievement. Stutters found (a) no significant difference in skill levels between the four classes; (b) motor ability seemed to exert a positive significant influence on badminton skill

achievement; (c) an individual's academic aptitude did not affect his acquisition of badminton skills.

#### Mechanical Principle Centered Instruction

Mikesell (30) determined the similarity of her experimental and control groups with results from the Scott Motor Ability Test. She taught both groups using the traditional approach. In the experimental group, however, emphasis was on mechanical principles ". . . and their application to each phase of instruction in the traditional method." (30:45) No significant difference was found between the two groups on either the initial or final test of the high clear, high serve, and wall volley skill tests. Since the experimental factor did not deter from the final scores achieved by the experimental group, Mikesell concluded that understanding and applying mechanical principles did not negatively affect the learning of basic badminton skills.

#### Inclusion of Exercises

Carr (20) examined the effect of certain exercises on selected aspects of physical fitness and badminton achievement of college women. Experimental Group A did progressive body conditioning exercises for fifteen minutes at the beginning of each class meeting followed by regular badminton instruction. Experimental Group B did isometric contractions for five minutes each day followed by regular badminton instruction. Control Group C took no time out for exercises and had regular badminton instruction. All three groups were pre- and post-tested on

physical fitness, badminton skill, and badminton knowledge. Indicators of physical fitness included: curl-ups, pull-ups, squat thrusts, toe-touches, and the Illinois Agility Run. The Miller Wall Volley Test, the Scott and French Short Serve Test, and Fox's Beginning Badminton Written Examination assessed badminton skill and badminton knowledge, respectively. No significant differences were indicated among the three groups on the criterion measures. Carr concluded that badminton instruction and participation in itself, or following either five minutes of isometric contractions or fifteen minutes of progressive body conditioning exercises, could be used to maintain a level of physical fitness. The loss of instruction time to performance of exercises was not detrimental to the class.

In a study using the same design, Donaghe (21) considered the effect of rope jumping exercises. In comparison to Carr's study, only one experimental group was used. Each subject in this group rope jumped for ten minutes at the beginning of each class period, followed by regular instruction. The control and experimental groups were not significantly different at the end of the study as far as the degree of physical fitness, badminton knowledge, and acquisition of badminton skill were concerned.

Harris (25) considered the inclusion of agility activities in the course content of her beginning badminton class. During the study, the Badminton Agility Group played sixty-six minutes less than the control group. (25:15) On the basis of post-test scores obtained from the Scott Obstacle Race, the groups were not

significantly different in agility; nor on the basis of the Lockhart-McPherson Test scores were the groups significantly different in badminton playing ability. Addition of agility activities did not seem to handicap students in their efforts to achieve badminton skill nor did it appear to enhance performance.

In a two part study using 126 women enrolled in seven badminton classes, Bartee (17) delved into ". . . the effect of deliberate applications of the principle of overload on the development of skill." (17:3) In Experiment I, five groups, comprised of a total of eighty-four subjects, were taught by the traditional method with regular practice. Four groups devoted ten days of practice time to performing overload practice activities. These activities emphasized wrist strength, hand eye coordination, balance, and footwork. All five groups improved significantly in skill, as manifested by scores from the Miller Wall Volley Test. Analysis of tournaments indicated no significant difference between the five groups on general playing ability of subjects of different skill levels. Experiment II repeated the best aspects of Experiment I. Forty-two subjects were placed into either an experimental group which practiced balance, wrist isometrics, and footwork, or a control group. Miller Wall Volley Test scores disclosed significant differences between these two groups. Deliberate applications of overload practice exercises which are closely related to the badminton skill to be developed seemed to result in steady improvement of skill.

### Coeducational Classes

Evaul (22) compared the badminton skill achievements of a coeducational class, an all female class, and an all male class. Post-test wrist volley, long serve, and short serve scores enabled the author to conclude that no significant differences in mean achievement of badminton skill were found between men taught alone, and those taught in classes with women. The same conclusion applied to women taught alone and women taught in classes with men. The author did observe that women in the coeducational class seemed to have greater motivation than those in the all female class. Little differences between the men's group were observed in this respect.

Bracken's (7) study on "The Values of College Coeducational Badminton" was not available to this writer for review. Information on this study was elicited from an available abstract and is included in order that this section on badminton research will be more complete. Bracken randomly assigned eighty students to one all male, one all female, and two coeducational classes for a seven week unit in badminton. Test scores administered during the first three classes and the thirteenth and fourteenth classes revealed no significant change in attitude toward physical education, significant increases in badminton knowledge and in acquaintances made, and significant skill gains for women in separate as well as in coeducational classes, and for men in separate classes.

### Distribution of Practice

O. G. Young (16) compared the rate of learning in two-days-a-week versus four-days-a-week of practice in college archery and badminton classes. A subproblem also studied was the effect of sex and motor ability on the rate of learning. Whereas the classes which met two-days-a-week completed the semester at the end of twelve weeks, classes which met four-days-a-week completed the course in six weeks. All classes were tested seven times on the Scott and French thirty second wall volley test, five times on the short serve test, and three times on the high clear test. On the wall volley test, the two-days-a-week group made greater and more rapid gain in learning than did the four-days-a-week group. Composite T-scores of the three criterion measures also supported this finding. Why the two-days-a-week pattern was favored was not within the scope of the study to determine. Scores from the Scott Motor Ability Battery led to the finding that the level of motor ability and sex did not seem to affect the rate of learning badminton.

V. P. Young (33) studied the effect of reminiscence on learning badminton skills in a six week unit as compared to a nine week unit. Reminiscence, as defined by Hilgard (3), is

. . . a psychological term for the occasional rise in the curve of retention before it falls, that is when under some circumstances more may be retained after an interval than immediately upon completion of learning. (3:592)

Criterion tests which measured skill were the Scott and French badminton wall volley and short serve tests. The six week unit group

was tested at the beginning and end of the unit of instruction, at the end of six weeks of no practice, and at the end of twelve weeks of no practice. The nine week unit group was tested at the beginning of the unit, at the end of six weeks, at the end of the unit, at the end of the ensuing six weeks of no practice, and at the end of twelve weeks of no practice. Young found that reminiscence did affect the learning of the wall volley skill. Significant gains were made by the nine week unit group after six weeks of no practice, whereas the six week unit group made significant gains after eighteen weeks of no practice. However, no significant differences were found between the wall volley means and the short serve means at the end of the no practice period. Young concluded that there seemed to be no advantage to the longer instructional unit.

Miller (31), using sixty high school sophomore girls, hypothesized that a six week badminton unit would bring a higher degree of skill and knowledge than would two three-week units separated by fourteen weeks. Prior to instruction, the Olympic Motor Ability Test, the Lorge-Thorndike Intelligence Test, and a Modified Miller Wall Volley Test were administered in order that the two groups be equated. Modification in the Miller Wall Volley Test consisted of moving the restraining line from ten to eight feet. A reliability coefficient of  $r = .97$  was determined for three trials and validity was assumed not to have changed. (31:47) At the end of three weeks, all subjects were retested on the Modified Miller Wall Volley Test and a written knowledge examination.



At this point in the study, the two three-week unit group was significantly better. Final results, measured by the Modified Miller Wall Volley Test, a short serve test, and Fox's Beginning Badminton Written Examination, revealed no significant differences between the two groups. However, a continuously rising rate of learning and overall improvement was seen in the six week unit group over the two three-week unit group. The author suggested that longer units were better for efficiency in learning.

#### Other General Factors

According to Greene (24), static balance is not a distinguishing factor in badminton playing ability. In comparing thirty men and women belonging to the Southern California Badminton Association to twenty-eight beginning badminton players on the college and university level, she found no significant correlation between the Miller Wall Volley Test and the Bass Static Balance Test within the two groups.

Bell (19) studied the effects of knowledge of results on skill acquisition and retention. Seventy-eight subjects were randomly assigned to one of four groups: (a) variable group where each individual was asked to correct errors on the preceding trial when performing the next trial; (b) quantitative group where each subject was asked to correct on the next day the most common error of the preceding day's twenty trials; (c) qualitative group where each student was asked to correct on the next day the most common error of twenty trials recorded on a court diagram score card from the preceding day; (d) control group

where each subject had no augmented knowledge of results. Involved with the high serve, the four groups were pretested, practiced eight days over a four and a half week period, post-tested, and retested five weeks after the post-test. Bell found improvement in performance in all four groups. As the control group improved without knowledge of results, information inherent in the task was implied to be of value to the learner. There was no significant differences between the groups in terms of post-test scores or retention scores.

#### Summary

In summarizing the research on devices, aids, and various instructional methods, some general conclusions can be drawn. Although the traditional method of badminton instruction has been supplemented by devices and other forms of "aid," few have been found to be more effective than the traditional method itself. Questionnaires distributed to subjects at the completion of some studies (23, 27, 31, 32) revealed the motivational value of many of the "aids."

The writer was unable to find in the literature any studies that utilized a badminton device which projected badminton birds to specific areas on the court.

#### THE TENNIS BALL-BOY AS AN INSTRUCTIONAL AID

The Ball-Boy is an automatic hydraulically operated ball throwing machine. A mechanical device developed by Judy Barta, physical educator and tennis consultant, the Ball-Boy supplies

the player with a steady stream of balls so that he may extract maximum practice time.

A research study to determine the effectiveness of the Ball-Boy was published by Solley and Borders in 1965. (14) Groups A and B were taught the forehand drive under the traditional method of demonstration, explanation, practice, and individual correction. Group B had added practice with the Ball-Boy, stroking a minimum of twenty balls which were projected by the machine each class meeting.

In each of the three beginning tennis classes studied, subjects were matched according to initial status in the forehand drive and were placed in either Group A or B. Halfway through the fourteen periods of instruction in Class I, the subjects switched groups. After five periods of instruction, subjects in Classes II and III changed groups. On the basis of scores of a revised Broer-Miller Tennis Test, those who switched from Group A to B improved significantly over those who switched from B to A. Gains in forehand skill were achieved by both groups when utilizing the Ball-Boy, although gains of Group B were not as large as those of Group A. When comparing the mean gain of all students under the traditional method to under the Ball-Boy method, the latter emerged statistically better. The authors concluded that it was more effective to utilize traditional technique first and then supplement practice with the Ball-Boy.

Again, in order to make this review section more complete, the information on the following unavailable studies

were elicited from available abstracts: McDonald (10) compared the ball dropped by hand to the ball delivered by the Ball-Boy in the Broer-Miller Forehand Drive Test. In using 150 beginners and seventy-nine intermediate tennis players, the author found the two tests to be equally reliable, but not sufficiently correlated for the test scores to be interchangeable.

Riccio (12) divided forty-one college women into two groups. In eight class meetings, one group hit against a backboard while the other group hit balls projected by the Ball-Boy. No significant differences were found between the scores of the two groups on the Broer-Miller Forehand and Backhand Tests.

It is hoped that this brief review of the research on the Ball-Boy has pointed out the need for further research in this area. The discrepancies as to its value must be analyzed and resolved.

## CHAPTER IV

## PROCEDURE

The purpose of this study was to determine the effectiveness of a badminton shuttlecock projecting device upon the skill achieved by a group of beginning badminton players. Three groups of subjects were used: an experimental group which received badminton instruction supplemented with the badminton device, a control group which received badminton instruction, and a comparison group which received no badminton instruction for the length of the study.

## BADMINTON SHUTTLECOCK PROJECTING DEVICE

The badminton shuttlecock projecting device was borrowed from the Department of Physical Education at the University of California, Berkeley. The machine, illustrated in Figure 1, page 21, originally projected plastic balls, but was adapted for this study to project shuttlecocks. The apparatus is fastened to a wooden board which guarantees stability. The shuttlecock rests at the end of the projection arm which is attached to a spring that tightens as the arm lowers. This action is initiated by activating the start button. After the spring is tightly wound, it releases, projecting the shuttlecock into the air. Energy for operating the device is supplied by three size "D" batteries.

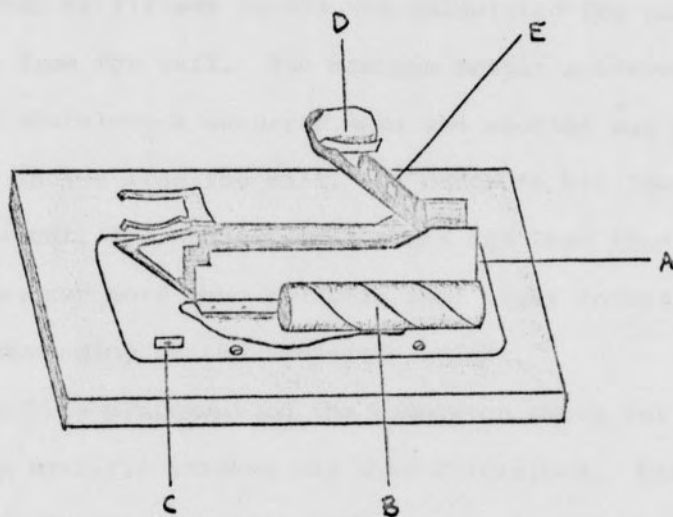


FIGURE 1

THE BADMINTON SHUTTLECOCK  
PROJECTING DEVICE

- A = spring which gives shuttlecock its forceful delivery  
 B = batteries  
 C = starter button  
 D = position for shuttlecock placement  
 E = projection arm

In a preliminary study, the badminton shuttlecock projecting device was tested for consistency. At measured distances from a wall, the device was placed on the floor and later on a table two feet three inches above the floor. Shuttlecocks were projected toward the wall. The place of contact between the shuttlecock and the wall was recorded. As shown in Table I, page 23, the mean of fifteen trials was calculated for each of six distances from the wall. The maximum height achieved by the projected shuttlecock occurred when the machine was placed seven feet four inches from the wall. In order to hit the shuttlecock on its descent, the subject must stand not less than seven feet four inches nor more than fourteen feet eight inches from the machine, depending on the subject's height.

Machine placement on the badminton court for purposes of practicing specific strokes was then determined. Diagrams of where subjects should position themselves in relation to the machine in practicing a particular stroke appear in Figure 2, page 24.

The length of time from the moment of dropping the shuttlecock into the machine to the moment of projection of the shuttlecock was determined at 9.6 seconds. From the moment of projection to the moment of impact with a badminton racket varied from 1.0 to 1.4 seconds, again depending on the height of the subject. The waiting period between shots was subsequently approximated at 10.8 seconds. In a two minute practice period with the machine, each subject would hit approximately eleven projected shuttlecocks.

TABLE I  
MEANS OF MACHINE PROJECTED SHUTTLECOCK  
HEIGHTS ON WALL FOR FIFTEEN TRIALS  
AT EACH OF SIX DISTANCES

Machine Distance From Wall	Height on Wall	
	Machine on Ground	Machine on Table 2'4" Above Floor
5'	6'5"	8'8"
6'	6'9"	9'
6'6"	6'10"	9'1"
7'	6'10"	9'1"
7'4"	6'11"	9'2"
8'	6'10"	9'1"



Projected shuttlecock height appropriate for:	Machine on table 2'3" above floor	Machine on floor
Practice of net shots and underhand flicks	<p>19" ——— 11'8" ———  x lands machine  net</p>	<p>19" ——— 6'6" ——— 3'6" ———  x lands machine  net</p>
Practice of short returns, underhand flicks, underhand clears	<p>short service line  x lands machine  net</p>	<p>short service line  x lands machine  net</p>
Practice of clears and drops	<p>net short service line 2' ——— 13'6" ——— alley  x machine lands</p>	
Practice of clears, drops, smashes, and underhand clears	<p>net 1'4" ——— short service line 8'6" ——— alley  x machine lands</p>	

FIGURE 2

MACHINE PLACEMENT ON BADMINTON COURT FOR PRACTICE OF SPECIFIC STROKES

Another finding of the preliminary study included the lack of efficiency of the machine after eighty minutes of use. After that time, batteries needed to be replaced for the following period of use.

#### SELECTION OF SUBJECTS

The subjects used in this study were students enrolled during the spring semester of 1971 at The University of North Carolina at Greensboro. The sample consisted of fifty students, thirty-eight enrolled in two regularly scheduled eight o'clock badminton classes and twelve enrolled in an eight o'clock regularly scheduled recreational sports class. Because members of the classes were enrolled according to university registration procedures, random selection of subjects was impossible. However, there was little reason to believe that the classes differed in any way from the usual general college class.

On the basis of a toss of a coin, the group that met Monday-Wednesday at eight o'clock was designated as the experimental group. The Tuesday-Thursday eight o'clock class was subsequently designated as the control group.

During the semester, three subjects dropped from the experimental group and one from the control group for various personal reasons. A total of forty-six subjects completed the study - sixteen, eighteen, and twelve in the experimental, control, and comparison groups, respectively.

## SELECTION OF MEASUREMENT TOOLS

Skill

The selected criterion measure of total badminton playing ability was the Miller Wall Volley Test. The test description and directions are included in the Appendix. Miller (11) reported a reliability coefficient of  $.94 \pm .008$  obtained by correlating test-retest scores of one hundred college women. Twenty players who took the test were then involved in a round robin tournament. By correlating the Wall Volley results of these twenty players with the tournament results, Miller reported a validity coefficient of  $.83 \pm .047$ .

On the basis of the established high reliability and validity, this writer chose to utilize the Miller Wall Volley Test to ascertain initial and final playing ability of beginning badminton players.

Knowledge

A preinstruction knowledge quiz was administered to all groups prior to instruction. The fifteen-item quiz covered very basic badminton terminology and rules. Included in the Appendix, this quiz was written by the author for purposes of supplementing the Miller Wall Volley Test scores in estimating the subjects' previous experience in badminton. Since the test was so short and was used only as an indication of knowledge prior to instruction, its reliability and validity were not determined.

### Questionnaire

A questionnaire was constructed by the author to solicit student opinion concerning the value of the badminton machine. Subjects in the experimental group completed the five-item questionnaire by placing a check after the statement which best represented their evaluation of the machine. Space was provided for clarification of responses. A copy of the questionnaire appears in the Appendix.

### ADMINISTRATION OF MEASUREMENT TOOLS

The Miller Wall Volley Test was administered during the second class meeting of the experimental and control groups. The comparison group was tested during the same week. Two graduate students assisted the writer in the test administration. The investigator gave all instructions and was also the official timer. Each class was divided alphabetically into four groups: Groups I and II consisted of five students each; Groups III and IV consisted of four students each. The entire class was first taught the grip. Instructions were then given following the test procedure included in the Appendix.

Groups I and II practiced one minute volleying against the wall while Groups III and IV practiced scoring. The procedure was reversed during the next minute as the groups exchanged positions. New nylon Carleton International shuttlecocks were used.

Following the practice period, Groups I and II were assigned to separate stations. At each station was a graduate scorer, two

student scorers, a student that recorded the results, a student that watched the restraining line, and a student performer. Each subject's score was the average of the scores obtained by the two student scorers and the graduate scorer. As soon as a subject had completed three thirty-second trials interspersed with thirty-second rest intervals, the next subject approached the restraining line. Duties were rotated within each station, with the exception of the graduate scorer, until all subjects in the group had completed the test. While Groups I and II were tested, Groups III and IV took the pre-instruction written knowledge quiz. Upon completion of their respective tests, Groups I and II exchanged positions with Groups III and IV. At all stations, the test procedure was the same as previously described.

Because the testing had gone overtime for the experimental group, the test procedure was slightly revised the next day for the control group. Organization and administration remained the same with the exception of the thirty-second wait between trials. Every student in the group completed trial one before proceeding to trial two. After trial two was performed by all members of the group, trial three commenced. In essence, every control subject had at least thirty seconds rest between trials whereas the experimental subjects had exactly thirty seconds rest between trials. The expediency of the procedure resulted in completing the test on time within the class period. This same procedure was utilized for the comparison group and the readministration of the Miller Wall Volley Test during the twenty-sixth class

meeting. The same graduate students assisted with the scoring during the readministration.

Immediately following the readministration of the Miller Wall Volley Test, the experimental group subjects completed the questionnaire.

#### CLASS PROCEDURE

Classes met for forty minutes at eight o'clock on Monday-Wednesday or Tuesday-Thursday each week for a total of twenty-nine meetings. The writer instructed both groups. The same equipment, facilities (four badminton courts), and lesson plans were used. A summary of material covered in each lesson may be found in the Appendix.

In an attempt to ascertain whether lessons were identically taught to the two groups, a report form was constructed which was distributed to graduate students who observed the classes. The same graduate student attended every fifth lesson of both groups, filling out a report form each time. Two additional graduate observers filled out report forms after viewing the tenth lesson which was videotaped. A copy of the report form and comparisons of summaries of the observed lessons appear in the Appendix.

Despite the advantage of having the tapes as a permanent recording for later viewing, videotaping of further lessons was discontinued. The camera could only focus on the instructor. What the students were doing could only be inferred by listening to what the instructor was saying. Also, at times, it was

difficult to hear the instructor due to distracting noises in the background.

#### Experimental Class Procedure

During the third class meeting, the badminton machine was introduced to the experimental group. Its mechanics and functions were explained, as was an accompanying tally sheet which was to be filled out regarding the amount of time spent by each student, the type and number of shots executed correctly in hitting shuttlecocks projected by the machine. (See Appendix)

Students were informed of the everyday availability of the machine and were encouraged to practice hitting against it at least two minutes for purposes of introduction and familiarization. Thereafter, the students were to use the machine when they felt a need for it or when the instructor felt the consistent projection of shuttlecocks would be advantageous in perfecting strokes. This decision to allow students to determine for themselves when and how long to work with the machine was to approximate normal classroom conditions, rather than a highly structured one in which rigid controls were established with respect to time and number of hits.

The machine was set up on one side of a badminton court through the fourteenth class lesson. When sixteen subjects in the experimental group attended class, the subjects rotated on and off the two out of sixteen available court spaces occupied by the machine. As the instructor felt herself to be the best judge of a "properly executed shot," she tallied all of the shots executed by the students who practiced against the machine. At the same

time, she was able to give immediate verbal feedback on the execution of the strokes.

From the fifteenth lesson to the twenty-ninth lesson, the machine was set up off the courts since all sixteen court spaces were needed for doubles play. The machine was employed only when the students requested it.

#### TREATMENT OF DATA

The sum of the student's three trials constituted the individual's Miller Wall Volley Test score. Group scores on both the initial and final administration of this test were evaluated using a one-way analysis of variance to determine whether or not the experimental, control, and comparison groups were significantly different regarding the variability of these scores. Any statistically significant differences found among the three groups were further evaluated using the Scheffé method. This method, closely linked to the analysis of variance overall test, revealed whether two selected groups differed significantly.

For each member of the experimental group, the percentage of "properly executed" shots and the total time spent hitting against the machine were calculated. Rank difference correlations were done in conjunction with final scores of the Miller Wall Volley Test to determine (a) the relationship of actual percentage of correct execution of strokes practiced with the machine and final playing ability, and (b) the relationship of time spent with the machine and final playing ability.



Percentages were also calculated on data tabulated from the questionnaire.

## CHAPTER V

## ANALYSIS OF DATA

## PRESENTATION OF DATA

Initial and final badminton playing ability of all subjects was assessed by the Miller Wall Volley Test. The sum of the subject's three trials during each administration constituted his test score. A pre-instruction knowledge quiz score supplemented the initial Miller Wall Volley Test score in evaluating each subject's previous experience in badminton. Raw scores for all subjects on both tests appear in the Appendix. The mean, standard deviation, and range of scores for the experimental, control, and comparison groups on the Miller Wall Volley Test and the pre-instruction knowledge quiz appear in Tables II and III, respectively.

All hypotheses in this study were tested at the 5 percent level of significance. This minimum level of significance provides five chances out of a hundred of rejecting a hypothesis which is actually true.

A one-way analysis of variance procedure was applied to the initial Miller Wall Volley Test scores to estimate the differences among the means of the three groups. As shown in Table IV, the obtained "F" ratio of .777 was less than the criterion of  $F_{.95(2,43)} = 19.47$ . (5:509) Failure to reject the

TABLE II  
 MEANS, STANDARD DEVIATIONS, AND RANGES OF  
 THREE GROUPS OF SUBJECTS ON THE  
 MILLER WALL VOLLEY TEST

	Experimental Group N = 16	Control Group N = 18	Comparison Group N = 12
Initial Administration			
Range	13.66-32.32	11.00-24.66	16.00-23.00
Mean	20.120	19.330	21.136
Standard deviation	5.205	3.134	2.657
Final Administration			
Range	20.99-40.99	14.00-26.32	10.32-30.33
Mean	25.725	22.293	21.356
Standard deviation	4.915	3.809	6.316

TABLE III  
 MEANS, STANDARD DEVIATIONS, AND RANGES OF  
 THREE GROUPS OF SUBJECTS ON A PRE-  
 INSTRUCTION KNOWLEDGE QUIZ

	Experimental Group N = 16	Control Group N = 18	Comparison Group N = 12
Range	3.00-6.00	2.00-9.00	4.00-8.00
Mean	5.625	6.056	6.167
Standard deviation	1.360	1.830	1.267

TABLE IV  
 ANALYSIS OF VARIANCE AMONG INITIAL MILLER  
 WALL VOLLEY TEST MEANS OF THREE  
 GROUPS OF SUBJECTS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Between groups	2	23.534	11.767	.777
Within groups	43	651.028	15.140	
Total	45	674.562		

null hypothesis indicated that the experimental, control, and comparison groups did not differ significantly with regard to initial badminton playing ability.

In testing the hypothesis concerning the pre-instruction knowledge quiz means of the three groups, the one way analysis of variance method was utilized. The calculated "F" ratio of .513, appearing in Table V, was less than the criterion of  $F_{.95(2,43)} = 19.47$ . (5:509) The null hypothesis stating no difference between the three groups in badminton knowledge prior to instruction was found tenable.

The same statistical procedure was applied to the final Miller Wall Volley Test scores. Because the computed "F" value of 3.231 (Table VI) fell in the critical region greater than  $F_{.95(2,43)} = 3.215$  (5:511), the null hypothesis was rejected, manifesting significant differences among the final Miller Wall Volley Test means. The analysis of variance procedure, however, did not indicate which pair of means was significantly different. This was determined by employing the Scheffé method. According to the data presented in Table VII, no significant difference between pairs of group means could be found. Winer (6) explained this phenomenon in his statement,

The Scheffé method is clearly the most conservative with respect to type 1 error; this method will lead to the smallest number of significant differences. In making tests on differences between all possible pairs of means, it will yield too few significant results. (6:89)

Initial and final ability were compared within each group using a two factor design of the analysis of variance method.

TABLE V  
ANALYSIS OF VARIANCE AMONG PRE-INSTRUCTION  
KNOWLEDGE QUIZ MEANS OF THREE  
GROUPS OF SUBJECTS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Between groups	2	2.443	1.222	.513
Within groups	43	102.361	2.380	
Total	45	104.804		

TABLE VI  
ANALYSIS OF VARIANCE AMONG FINAL MILLER WALL  
VOLLEY TEST MEANS OF THREE  
GROUPS OF SUBJECTS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Between groups	2	157.479	78.739	3.231*
Within groups	43	1047.975	24.372	
Total	45	1205.454		

\*Significant at the 5 percent level of significance.

TABLE VII  
 DIFFERENCES BETWEEN FINAL MILLER WALL VOLLEY  
 TEST MEANS AND CALCULATED SCHEFFÉ VALUES

Groups	Means	Difference	Scheffé
Experimental (N = 16)	25.725		
vs		3.431	4.238
Control (N = 18)	22.294		
Experimental (N = 16)	25.725		
vs		4.368	4.712
Comparison (N = 12)	21.357		
Control (N = 18)	22.294		
vs		.937	4.600
Comparison (N = 12)	21.357		

The summary of the analysis of variance is presented in Table VIII. The obtained "F" ratio of 9.705 fell in the critical region greater than  $F_{.95(1,86)} = 3.95$  (5:511), disclosing significant differences between initial and final Miller Wall Volley Test means. Subsequent Scheffé tests, according to the data presented in Table IX, revealed significant differences between the initial and final Miller Wall Volley Test means of the experimental and control groups.

The amount of time each subject in the experimental group spent in hitting shuttlecocks projected by the machine and his percentage of properly executed strokes are recorded in Table XII in the Appendix. The Spearman rank difference correlation coefficient was used to determine whether each variable, amount of machine time and percentage of correct strokes, was significantly related to a second variable, the final Miller Wall Volley Test score. The calculated rhos, comparable to the product moment correlation coefficient as a measure of strength of relationship, were tested for significance using a "t" statistic. (5:234) The data of Table X reveal that the obtained correlation coefficients were not statistically significant. The "t"'s were less than the criterion of 2.145 (5:508) for fourteen degrees of freedom.

Percentages of responses to each item in the questionnaire were calculated and are presented in Table XI. Typical comments which accompanied the checked responses appear at the end of the table.

The attendance record of the experimental and control groups appear in the Appendix. It was found that the experimental



TABLE VIII

ANALYSIS OF VARIANCE, TWO FACTOR DESIGN,  
 AMONG MILLER WALL VOLLEY TEST MEANS OF  
 THREE GROUPS OF SUBJECTS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio
Between columns (Miller Test administrations)	1	191.728	191.728	9.705*
Between rows (groups)	2	74.014	37.007	1.873
Interaction	2	107.981	53.991	2.733
Error	86	1699.003	19.756	
Total	91	2072.726		

\*Significant at the 5 percent and 1 percent level of significance.

TABLE IX  
 DIFFERENCES BETWEEN INITIAL AND FINAL MILLER  
 WALL VOLLEY TEST MEANS AND  
 CALCULATED SCHEFFÉ VALUES

Groups	Means	Difference	Scheffé'
Experimental (N = 16)			
Initial	20.120	5.605*	3.123
Final	25.725		
Control (N = 18)			
Initial	19.330	2.963*	2.944
Final	22.293		
Comparison (N = 12)			
Initial	21.136	.220	3.606
Final	21.356		

\*Significant at the 5 percent level of significance.

TABLE X

RELATIONSHIP BETWEEN FINAL MILLER WALL VOLLEY TEST  
 SCORES AND AMOUNT OF TIME SPENT ON SHUTTLECOCK  
 PROJECTING MACHINE, AND PERCENTAGE OF  
 CORRECT STROKES EXECUTED FOR SUBJECTS  
 IN THE EXPERIMENTAL GROUP

(X, Y)	$\rho(X, Y)$	"t"
X = Final Miller Wall Volley test score		
Y = Amount of time spent on shuttlecock projecting machine	.30	1.176
X = Final Miller Wall Volley test score		
Y = Percentage of correct strokes executed	.09	.330

TABLE XI  
 QUESTIONNAIRE RESULTS  
 N = 16

Questions and Responses	N	Per-centage
In hitting shuttles projected from the badminton machine, I found the machine to be		
Very helpful	3	19
Helpful	8	50
Indifferent	4	25
Useless	1	6
Very useless	0	0
If the instructor had not used the badminton machine in teaching the strokes,		
I would have learned more	0	0
I would have learned the same amount	13	81
I would have learned less	3	19
The time I spent hitting off the machine was		
Time well spent	9	56
Time that just passed during the period	6	38
Time wasted	1	6
If I were enrolled in an intermediate badminton class next semester, I would		
Make it a point to ask to use the machine even if machine not set up	3	19
Use the machine only if set up	10	62
Not use the machine even if set up	3	19

TABLE XI (continued)

Questions and Responses	N	Per-centage
I would recommend that the UNC-G Department of Physical Education		
Purchase another such machine for use in future badminton classes (i.e., two machines for class use)	8	50
Continue to employ this one machine for all future badminton classes	6	38
Not employ this machine for any future badminton class	2	12

Typical Comments

I liked the machine because it was consistent.

It helps on isolated types of shots because you have more time to think about form and placement than you do with the less regular birds hit to you by other students.

More class time should be devoted to its use early in the semester.

I would suggest purchasing one that threw the birdies higher for tall kids and let the short ones use the one we now have.

It was helpful at first when were beginning to learn different strokes, but don't think it would be necessary later on in the course.

I think I would have benefited more if I had used the machine much more than I did.

You can count on the machine for a good setup at approximately the same point so you can repeat a good stroke or correct a bad one.

group averaged 4.69 absences per student for the fourteen week period, while the control group averaged 3.11 absences per student for the same period of time.

#### INTERPRETATION OF DATA

Past studies reviewed in Chapter III have shown that time devoted to the experimental factor, for example, learning mechanical principles (30), performing physical fitness exercises (20, 21), and performing agility activities (25), may not have significantly enhanced the learning of basic badminton skills, but neither did it negatively affect learning. As inferred from the data revealed in Table VII, page 38, the time devoted to the badminton machine did not detract from or enhance the experimental group's mean achievement on the Miller Wall Volley Test over the control and comparison groups.

However, the analysis of variance did show a significant difference among the final Miller Wall Volley Test means. Although subsequent Scheffé tests failed to indicate which pair of means was significant, the data of Table VII, page 38, suggests that the contrast between the experimental and comparison means is the greatest and is probably the one that is significantly different.

The Scheffé tests indicated that skill achieved by the experimental group was not significantly superior to skill achieved by the control group. As use of the badminton machine was the differentiating factor between these two groups, perhaps more time

devoted to practicing with the machine might have yielded statistically significant differences if in reality the device provides more effective practice than an opponent. The mean amount of machine time for the sixteen subjects in the experimental group was 5.09 minutes; the standard deviation was 1.50 minutes (see Appendix). Out of twenty-eight lessons, each of forty minute length, this average amount of machine time is comparatively small and may have been an important limiting factor.

Past studies have also revealed, with the different criterion measures held constant, that experimental groups utilizing instructional media (9, 15, 23, 26, 27, 28, 32), when compared to control groups, disclosed no significant differences in badminton playing ability at the end of instruction. In reference to Table VII, page 38, this study supports these conclusions.

The two factor design of the analysis of variance and the subsequent Scheffé tests revealed significant differences between the initial and final mean scores on the Miller Wall Volley Test for the experimental and control groups. This difference in improvement of means, as contrasted with the lack of improvement for the comparison group, could be attributed to class instruction.

Every fifth lesson in both the experimental and control classes was observed and recorded by a graduate student. An examination of the submitted reports, which appear in the Appendix,

reveal that lessons were identically taught to the two groups by the instructor.

Amount of time spent hitting against machine projected shuttlecocks and percentage of correct strokes executed each correlated low with final Miller Wall Volley Test scores for the subjects in the experimental group. These correlations would appear to suggest that there was little relationship between time spent hitting against machine projected shuttlecocks and correct stroke execution during that practice and the achievement of final playing ability. However, as previously mentioned, relatively little time was spent by students in practice with the machine.

Questionnaires distributed in some of the studies reviewed in Chapter III (23, 27, 31, 32) exhibited enthusiastic responses in support of the experimental factor under investigation. The questionnaire results of this study also disclosed a favorable reaction to the badminton machine. Sixty-nine percent of the respondents found the machine to be at least helpful. Eighty-eight percent of the experimental subjects recommended employing the machine in future badminton classes.



## CHAPTER VI

## SUMMARY, CONCLUSIONS, RECOMMENDATIONS

## SUMMARY

The purpose of this study was to determine the effectiveness of a badminton shuttlecock projecting device upon the skill achieved by a group of beginning badminton players.

Two beginning badminton classes and one recreational sports class at The University of North Carolina at Greensboro were involved in this study. The two badminton classes were designated as the experimental (N = 16) and control (N = 18) groups; the recreational sports class was designated as the comparison group (N = 12).

Badminton skill of each student was assessed before and after the instructional unit. The pretest involved administration of the Miller Wall Volley Test and a pre-instruction knowledge test. In comparing these scores by the one way analysis of variance procedure, the three groups were considered equated on initial badminton playing ability.

Following the pretest period, instruction commenced. Both experimental and control groups, taught by the author, followed as nearly as possible an identical course procedure for the twenty-eight forty-minute periods of instruction. The comparison group received no badminton instruction. The experimental group, in

addition, practiced badminton strokes by hitting shuttlecocks projected by a machine. An accurate record of the time spent working against the machine and the percentage of properly executed strokes was kept for each subject in the experimental group.

At the end of the instruction unit, the Miller Wall Volley Test was readministered to assess final badminton playing ability.

Using the data collected, a one-way analysis of variance procedure was applied to estimate the differences among the final Miller Wall Volley Test means of the three groups. Within each group, initial and final badminton ability were compared using a two factor design of the analysis of variance method with subsequent Scheffé tests to further assess differences. The Spearman rank difference correlation coefficient was used to test whether time spent working against the machine and percentage of correct strokes executed was significantly related to the final Miller Wall Volley Test scores of the experimental subjects. Questionnaire responses, given by the experimental subjects, were converted to percentages and evaluated.

Results revealed significant differences between the three groups on final badminton playing ability, although the conservative Scheffé tests failed to pinpoint the exact nature of the differences. A significant improvement in playing ability was found for both the experimental and control groups. Percentage of properly executed strokes and the amount of time spent

utilizing the badminton machine correlated rather low with final Miller Wall Volley Test scores.

Sixty-nine percent of the experimental subjects expressed that they found the machine to be helpful while 88 percent recommended employing the machine for future badminton classes.

#### CONCLUSIONS

Within the limitations of the study, the following conclusions seem justified:

1. Badminton instruction supplemented with the aid of a badminton shuttlecock projecting machine was as effective as badminton instruction alone.
2. Students in the experimental group responded favorably to the use of the badminton machine.

#### RECOMMENDATIONS

The author recommends, for further research, a repeat of this study using Timpé shuttlecocks in the Miller Wall Volley Test administrations in combination with one or all of the following modifications:

1. use of all female subjects;
2. use of intermediate or advanced badminton classes;
3. use of more than one badminton machine in class to increase the amount of machine time per experimental subject.

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## APPENDIXES

MILLER WALL VOLLEY TEST

- A. Substrate paper or board
- B. Ink
- C. Roller
- D. Ink tray
- E. Ink brush
- F. Ink container
- G. Ink tray
- H. Ink brush
- I. Ink container
- J. Ink tray
- K. Ink brush
- L. Ink container

APPENDIX A

Miller Wall Volley Test



- 1. Test Direction
- A. Test Direction
- B. Test Direction
- C. Test Direction
- D. Test Direction
- E. Test Direction
- F. Test Direction
- G. Test Direction
- H. Test Direction
- I. Test Direction
- J. Test Direction
- K. Test Direction
- L. Test Direction

## MILLER WALL VOLLEY TEST (11:210-211)

## I. Equipment

- A. Badminton racket in good condition
- B. New Timpé outdoor shuttlecock (sponge-end)\*
- C. Accurate stop watch
- D. Score cards and pencils

## II. Markings

- A. Wall—a one inch line extended across the wall 7 feet, 6 inches from the floor and parallel to the floor. The width of the wall space should be at least 10 feet and the height preferably 15 feet or higher.
- B. Floor—a straight line 10 feet from the wall extended the length of the wall distance and parallel to the wall.

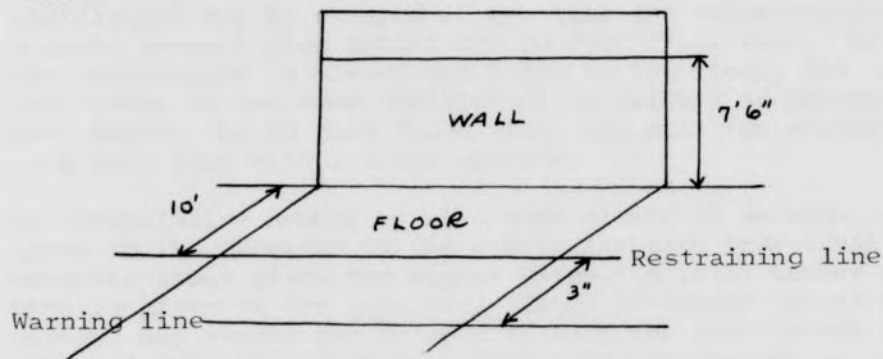


FIGURE 3

## FLOOR MARKINGS FOR MILLER WALL VOLLEY TEST

## III. Test Directions

- A. The subject should be given opportunity to practice for one minute before the first trial is given. If there is ample wall space, several players can practice at the same time and also can be tested at the same

\*Carleton International nylon shuttlecocks were used in this study.

time as long as there is a 10 foot distance between players. A short rest period of at least 30 seconds should be allowed between trials. Practice should not be allowed between trials.

- B. On the signal, "Ready, Go," the subject serves the shuttlecock in a legal manner against the wall from behind the 10 foot floor line. The serve puts the shuttlecock in a position to be rallied with a clear on each rebound. If the serve hits on or above the 7 foot, 6 inch wall line, that hit counts as one point and each following rebound hit made on or above the 7 foot, 6 inch wall line when the subject is behind the 10 foot floor line counts as one point. The hit is not counted if any part of a foot goes over the 10 foot restraining line. (Due to the fact that a subject encounters difficulty when trying to look at the line on the floor along with watching the shuttlecock, it is suggested that a chalk line three inches back from the 10 foot line be added, and the subject told to stay behind that line if possible. This allows the foot to slide as much as three inches without penalizing the person being tested. Also the scorer should say "Back" whenever the subject consistently goes over the line.) The hit is not counted if the shuttlecock goes below the 7 foot, 6 inch line. The shuttlecock may be stopped at any time and restarted with a legal service from behind the 10 foot floor line. If the shuttlecock is missed and falls to the floor, the subject picks up the same shuttlecock as quickly as possible, gets behind the 10 foot floor line, and puts the shuttlecock into play with a legal service.
- C. An accumulative number of hits made within 30 seconds is given to the recorder by the scorer for each individual. When the timer gives the signal "Stop," a total number of hits is given to the recorder. Three 30 second trials are given. Any stroke may be used to keep the shuttlecock in play. A "carried bird" or a double hit is counted as good if the hit eventually goes on or above the 7 foot, 6 inch wall line. The subject may step in front of the 10 foot line in order to keep the shuttlecock in play, but hits failing to follow the specifications given above do not count. The sponge end shuttlecock will bounce if the shuttlecock falls to the floor. The subject does not have to pick up the shuttlecock if he can keep the shuttlecock in play in any other manner. The score consists of the sum of three trials.

APPENDIX A

Pre-Instruction Knowledge Assessment

- Part 1. Indicate which of the following are correct (C) and which are incorrect (I).
1. The shuttlecock hits the ceiling.
  2. When playing in pairs, a player's racket must always cross the net.
  3. The first serve of a singles game is delivered from the server's left side of the court.
  4. A player must not hit a shuttlecock with a racket.
  5. In doubles, the server serves the net and falls into the court of the receiver.

APPENDIX B

Badminton Pre-Instruction Knowledge Test

1. The width of the court is \_\_\_\_\_ meters.
2. The width of the net is \_\_\_\_\_ meters.
3. A player must not hit a shuttlecock with a racket.
4. In a singles game, the server serves the net and falls into the court of the receiver.
5. In a doubles game, the server serves the net and falls into the court of the receiver.

## BADMINTON

---

Name

## Pre-Instruction Knowledge Examination

PART I. Indicate which of the following are faults (F) and which are legal (L).

1. \_\_\_ The shuttlecock hits the ceiling.
2. \_\_\_ While playing at net, a player's racket accidentally grazes the net.
3. \_\_\_ The first serve of a singles game is delivered from the server's left side of the court.
4. \_\_\_ A player stands out of bounds while returning a shot.
5. \_\_\_ In doubles, the serve touches the net and falls into the court of the receiver's partner.

PART II. Fill in the blanks with the appropriate word.

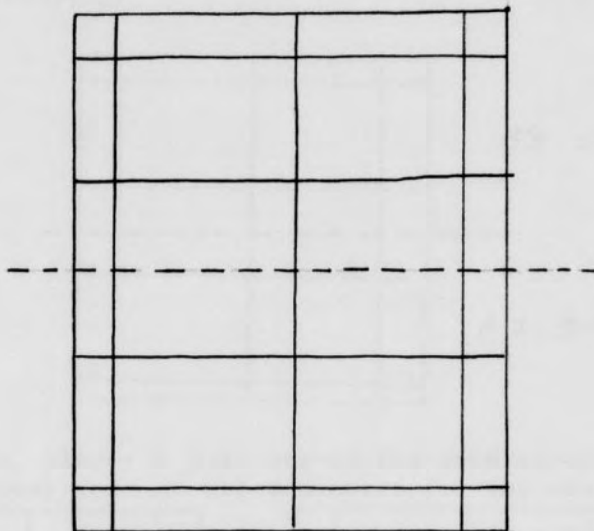
6. The score is 7-9. You are the receiver. How many points, according to the score, do you have? \_\_\_\_\_
7. A ladies' singles game consists of \_\_\_\_\_ points.
8. A ladies' doubles game consists of \_\_\_\_\_ points.
9. If a player desires to gain time to recover her court position, she should return the opponent's shot with a \_\_\_\_\_.
10. A powerful overhead stroke that sends the shuttle sharply downward over the net describes the \_\_\_\_\_.

## BADMINTON - Pre-Instruction Knowledge Examination (con't)

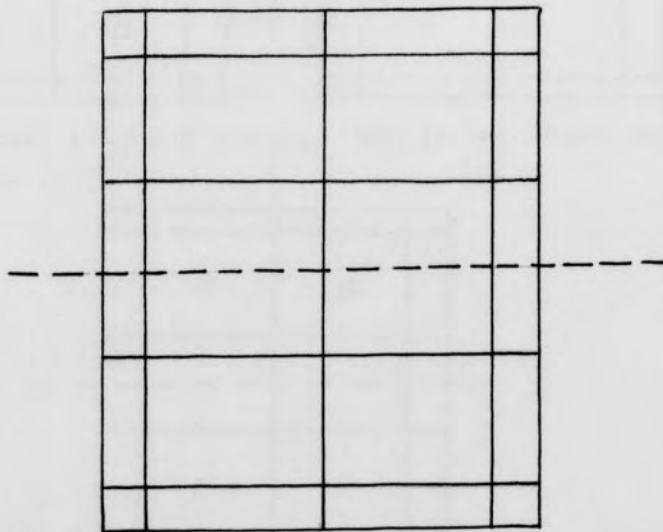
Name \_\_\_\_\_

## PART III.

11. Indicate the singles playing court by shading in the correct area.



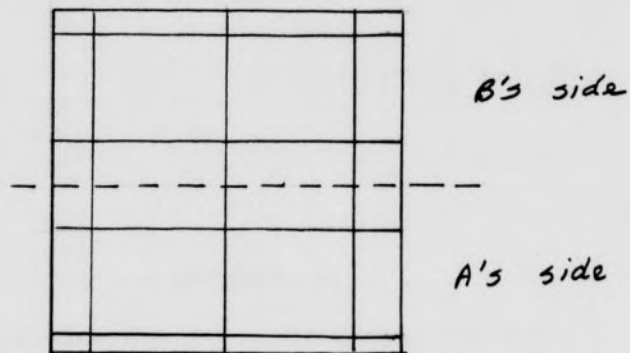
12. Indicate the doubles service court by shading in the correct area.



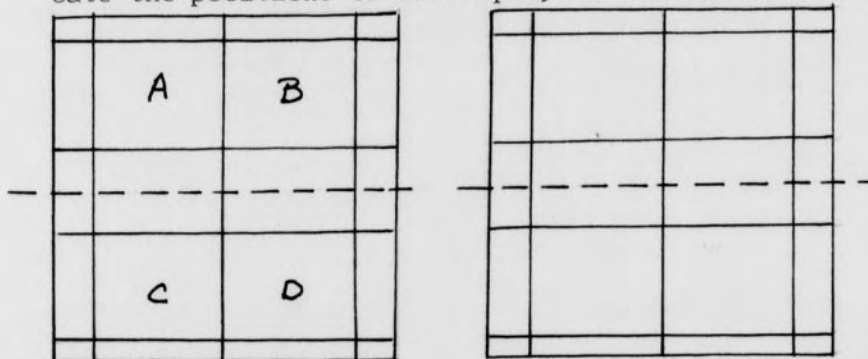
## BADMINTON - Pre-Instruction Knowledge Examination (con't)

\_\_\_\_\_  
Name

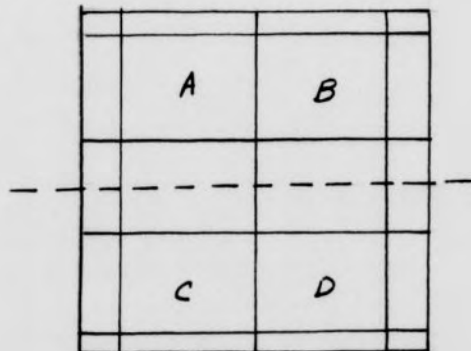
13. In singles, player A is serving and the score is 8-10. Indicate on which side of their respective courts should each be standing.



14. In doubles, player B just served and made a point. Indicate the positions of all 4 players for the next serve.



15. In doubles, player B serves. Who is the legal receiver?  
\_\_\_\_\_





APPENDIX C

It is your responsibility to make sure that the machine is used in a safe and sound manner. Please read the instructions carefully and follow them to the letter. If you have any questions, please contact the manufacturer.

1. I am satisfied with the quality of the machine.  
2. I am satisfied with the service of the machine.  
3. I am satisfied with the price of the machine.  
4. I am satisfied with the appearance of the machine.

APPENDIX C

Opinion Ballot of Badminton Machine

1. I am satisfied with the quality of the machine.

2. I am satisfied with the service of the machine.  
3. I am satisfied with the price of the machine.

4. I am satisfied with the appearance of the machine.

5. I am satisfied with the durability of the machine.

6. I am satisfied with the safety of the machine.  
7. I am satisfied with the ease of use of the machine.

8. I am satisfied with the value of the machine.

9. I am satisfied with the overall performance of the machine.

10. I am satisfied with the customer service of the machine.  
11. I am satisfied with the warranty of the machine.

OPINION BALLOT ON USE OF BADMINTON  
MACHINE AS A SUPPLEMENTARY AID

In order to prepare for future badminton classes, an effort is being made to solicit your opinion concerning the value of the badminton machine. Please place a check after the statement that best represents your evaluation of the badminton machine. Feel free to clarify any of your choices under "additional comments." Do not sign your name. Your response will not influence your badminton grade.

1. In hitting shuttles projected from the badminton machine, I found the machine to be

\_\_\_\_\_ very helpful.            Additional comments:  
 \_\_\_\_\_ helpful.  
 \_\_\_\_\_ indifferent.  
 \_\_\_\_\_ useless.  
 \_\_\_\_\_ very useless.

2. If the instructor had not used the badminton machine in teaching the strokes,

\_\_\_\_\_ I would have learned more.  
 \_\_\_\_\_ I would have learned the same amount.  
 \_\_\_\_\_ I would have learned less.

Additional comments:

3. The time I spent hitting off the machine was

\_\_\_\_\_ time well spent.  
 \_\_\_\_\_ time that just passed during the period.  
 \_\_\_\_\_ time wasted.

Additional comments:

4. If I were enrolled in an intermediate badminton class next semester, I would

\_\_\_\_\_ make it a point to ask to use the machine even if  
                   machine not set up.  
 \_\_\_\_\_ use the machine only if set up.

## 4. (continued)

\_\_\_\_\_ not use the machine even if set up.

Additional comments:

## 5. I would recommend that the UNC-G Department of Physical Education

\_\_\_\_\_ purchase another such machine for use in future badminton classes (i.e., two machines for class use).

\_\_\_\_\_ continue to employ this one machine for all future badminton classes.

\_\_\_\_\_ not employ this machine for any future badminton class.

Additional comments:

BADMINTON COURSE OUTLINE FOR  
EXPERIMENTAL AND CONTROL GROUPS

UNIT 1  
 Course Introduction  
 UNIT 2  
 Shuttlecock and Racket  
 Shuttlecock: weight, shape, construction, use, maintenance  
 Racket: grip, head, shaft, frame, use, maintenance  
 UNIT 3  
 Badminton Court  
 Dimensions, markings, net, net height, net posts  
 UNIT 4  
 Badminton Rules  
 Laws of Badminton, Laws of Doubles, Laws of Singles  
 UNIT 5  
 Badminton Equipment  
 Shuttlecock, Racket, Net, Net Posts, Net Cord, Badminton Shoes

APPENDIX D

Badminton Course Outline

UNIT 1  
 Introduction to Badminton  
 History, Origin, Popularity, Equipment  
 UNIT 2  
 Shuttlecock and Racket  
 Shuttlecock: weight, shape, construction, use, maintenance  
 Racket: grip, head, shaft, frame, use, maintenance  
 UNIT 3  
 Badminton Court  
 Dimensions, markings, net, net height, net posts  
 UNIT 4  
 Badminton Rules  
 Laws of Badminton, Laws of Doubles, Laws of Singles  
 UNIT 5  
 Badminton Equipment  
 Shuttlecock, Racket, Net, Net Posts, Net Cord, Badminton Shoes

BADMINTON COURSE OUTLINE FOR  
EXPERIMENTAL AND CONTROL GROUPS

Lesson 1

Course introduction

Lesson 2

Grip, wrist action; Miller Wall Volley Test; Pre-instruction Knowledge Quiz.

Lesson 3

Reviewed grip, ready position; short serve practice without net; long high serve practice; clear practice.  
\*Experimental group - introduced to machine, informed of its mechanics and availability.

Lesson 4

Reviewed long high serve; clear practice; introduced singles, boundaries, scoring.

Lesson 5

Reviewed long high serve; reviewed clear; introduced backhand clear and drive; played short singles game.

Lesson 6

Long high serve test; introduced drop shot, practiced drop shot; short singles game; setting in singles.  
\*Observer present in class.

Lesson 7

Reviewed clear, drop, backhand; introduced smash; smash practice.

Lesson 8

Clear, drop, backhand, smash practice; short singles game.

Lesson 9

Introduced hairpin (net) shot and flick shot; pattern: clear, drop, net, underhand set up; short singles game.

Lesson 10

Practiced smash; introduced double elimination tournament; introduced modified "ping pong" scoring system for singles game; tournament.

Lesson 11

Double elimination singles tournament.  
\*Lesson videotaped and later observed by three judges to determine whether lesson was identical for both groups.

Lesson 12

Double elimination singles tournament; losers into an eight-minute round robin tournament.

Lesson 13

Double elimination singles tournament; losers into an eight-minute round robin tournament.

Lesson 14

Reviewed tournament results; introduced doubles' serving court; introduced scoring; short serve practice; scoring practice.

Lesson 15

Short serve practice; smash practice; introduction of doubles' strategy-side by side, up and back team play; strategy practice.

Lesson 16

Short serve practice; return of short serve practice; reviewed "carry" (sling) shot-a fault; review of doubles' strategy; assigned partners; practice strategy with tournament partners.  
\*Observer in class.

Lesson 17

Short serve practice; return of short serve practice; smash practice; practiced strategy with partners.

Lesson 18

Doubles games.

Lesson 19

Clear, drop, smash, net practice; doubles games.

Lesson 20

Rules session: serving from wrong court, net fouls, receiving serve when not ready, playing two out of three games, setting;  
Doubles games - practiced setting starting games at 12-12.

Lesson 21

Written stroke errors test.  
\*Observer present in class.

Lesson 22

Clear, drop, smash, net practice; doubles games.

Lesson 23

Round robin doubles tournament.

Lesson 24

Smash and drop test.

Lesson 25

Round robin doubles tournament.

Lesson 26

Miller Wall Volley Test

\*Experimental group - filled out questionnaires.

Lesson 27

Round robin doubles tournament.

Lesson 28

Consolation tournament; question and answer period regarding rules and strategy for singles.

Lesson 29

Consolation Tournament; question and answer period regarding rules and strategy for doubles; distribution of prizes.

Lesson 30

Written final examination.



## INSTRUCTIONS FOR OBSERVERS

Before the start of a 15-minute flight, the observer should be instructed in the following manner. Report on this report that you are not in the field of vision. The following points should be observed:

1. Location of the bird.
2. Nature of the bird.
3. Number of birds seen.
4. Number of birds seen in the field of vision.
5. Number of birds seen in the field of vision.

## APPENDIX E

## Instructions for Observers

## Summary of Observations

## INSTRUCTIONS FOR OBSERVERS

Assume the role of a newspaper reporter when you enter Coleman Gym at 8:00 a.m. Report on this sheet what you see and hear in the next 50 minutes. The following points should be included:

1. Lesson objective.
2. Class organization.
3. Content of lesson (what was said, what was emphasized).
4. Order of happenings (what was done) and approximate time of each happening.
5. Instructor - appearance, attitude and behavior.

## SUMMARY OF 1st CLASS OBSERVATIONS

Monday 8:00 AM (2-22-71)

Lesson Objective

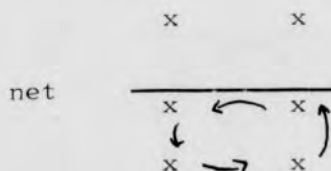
To test long serve; to teach and develop drop.

Class Organization

4 units set up; birds out; students played on own as waited on class, did this without being told; demonstration: focus on second court; instructor: showed lines, 1, 3, 5, for points (shown twice); 5 trials at a time; demonstrated "drop and hit;" 4 students scoring, 4 students being tested, each hit 5 birds at time and count where falls in; extra student hitting against wall, other 2 courts practicing drop shot; students changed with testers as finished; about 4-6 minutes each group.

Content of Lesson

Demonstration backhand grip, back to students so see grip, backhand drop and push; drop serve-just over the net; shown so that opponent has to run for it from way back; demonstration-pat (top) swing not slash; asked for questions; demonstration 3-4 times clear, drop, backhand (4-5 minutes); divided class into half (2 courts for test and 2 courts for drop); setting: score 9-9, set to 3, score back to zero or don't set go to 11; score 10-10 (missed hearing this clearly); clear, backhand, drop-3 shots knew, use them (2 $\frac{1}{2}$ -3 minutes); game of deception-shown poor fake drop; some can smash-use it; students went into game on first court.



Hit and rotate counterclockwise drill; teacher one of 4, once hit shot, called "move" (10 min.)

Instructor

Appearance: neat, tidy, sharp; greeted students as came in, friendly, individual help given; encouragement "good girl" frequently heard when in final game situation.

## SUMMARY OF 1st CLASS OBSERVATIONS

Tuesday 8:00 AM (2-23-71)Lesson Objective

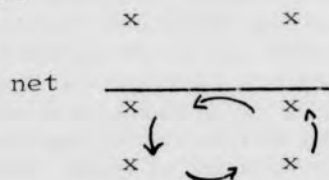
To teach drop; to test the serve.

Class Organization

Worked with partners on own for warm-up (10 minutes); focus on center court, where to stand to serve; lines to score points 0, 1, 3, 5, 0 shown twice; 4 people tested at time; answered questions about sidelines; drop demonstration; put 5 birds in court, hit 15 altogether; score where hits, not where birdends up; 1st group tested (8 minutes); 2nd group tested (10 minutes); 2nd test-stayed to see if needed help, reminded them of a few things; in fours on courts, worked on drop shots and rallying.

Content of Lesson

Drop looks like clear-except at top, tap it and drop right over net; make opponent run-if she hits up, you can smash back; just right over net, pat it; can't tell whether drop or clear; asked for questions (4 minutes); scoring 9-9 option to set to 3 so serve goes back to zero; 1st person to get 3; 10 tie set game to 2; option to set or not to, goes to one who is leading; game-play and use set if want, reviewed what strokes to use (2½ minutes); game rotation-end court, whoever hits says "move," other 2 play regular:



(12 minutes)

Instructor

Appearance: neat, tidy, lively; individual help; gave encouragement, stayed long enough with testing group to make sure they understood directions; friendly and relaxed.

## SUMMARY OF 2nd CLASS OBSERVATIONS

Wednesday 8:00 AM (3-10-71)

Lesson Objective

Machine work on clear and drop shot; class in tournament;  
(Note: portion of video missed strategy and use of shots).

Class Organization

Class in tournament, selected people on machine; assigned courts to play games; winners play winners; took scores of people who were playing, checked who player's next opponent was throughout period; with machine off, more noise and enthusiasm in background.

Content of Lesson

Machine: instructions hard to hear; clear and drop involved; with machine, 1st student told to take it out 2 inches more out in front, shown where to check oneself on drop; demonstrated without racket; see if could glide it over net; told to get closer to net (8 minutes); 2nd student on machine: talked with him, asked him how shot felt, teacher appears more relaxed with this student; drop shot-emphasized why shot was good; suggested another effective method; demonstration followed question from student (8 minutes); took 2 minutes off to check students off in tournament and organized courts; 3rd student on machine-moved her forward and gave racket reminder; demonstrated clear with machine stopped (approximately 3 minutes); period of observation of players, called instructions, i.e., "don't jump off floor," encouraged and demonstrated; told students to rally until next opponent arrived; checked scores, retold 2 students what to do with 20-20 tie situation; observation of class in tournament (20 minutes); told student sharply to keep feet on floor, smiled afterwards; girl approached teacher for help on smash, teacher made suggestions, demonstrated, and stayed 5 minutes; "that's it for today," reminder that people already "doubly eliminated" will be in another tournament next week so encouraged to show up, reminder to sign up for ping pong intramurals.

Instructor

Neat, tidy, serious during instruction; encouragement, pleasant attitude, enthusiastic, lots of praise when shot done correctly; criticism after every shot or some comment.

## SUMMARY OF 2nd CLASS OBSERVATIONS

Thursday 8:00 AM (3-11-71)

Lesson Objective

Use strategy in tournament situation and shots previously taught.

Class Organization

Called class in from rally, told class camera was being tested for departmental use; was told to pay no attention to it; announced intramural ping pong tournament; strategy, position of placing shots; told people where to play; told those waiting for opponents to go to last court; players who were eliminated went off to rally as they were defeated.

Content of Lesson

One girl left after organization, (5-6 minutes), teacher rallied with her, did not see the student; tried to get student to hit at highest point; served several times to her; footwork reviewed; gave student rest and watched rest of class; gave encouragement and instructions; at end of approximately 9 minutes made change in players; went on for 10 minutes with continual reassignment of students to new opponents as they came off courts (20 minutes); checked student's grip; background noise suggested enjoyment; relaxed interchange between 2 students and teacher; teacher watched class, called encouragement and suggestions; checked a couple who sat after they had finished; firmly told to get back on courts; told another individual what to work on; set up court rotation game involving 2 on one side of net and 4 on other; teacher was 4th member, called out when to move counterclockwise after hit; team moved fairly well (5-6 minutes); did not hear last instructions; announced tournament for losers for Tuesday and finish present tournament; reminder of ping pong sign-up.

Instructor

Neat, tidy, seemed relaxed, enjoyed the class; relaxed and obviously enjoys helping students; teacher showed enthusiasm when good score reported by student; enthusiastic student told teacher she lost another bird on basketball supports, accepted by teacher; criticism after each shot; praised when deserved; energetic, good sense of humor, seemed concerned.

SUMMARY OF COMMENTS ABOUT VIEWING  
VIDEOED LESSONS

Wednesday 8:00 AM (3-10-71)

1. Machine running, hard to hear anything said.
2. Camera focused on teacher frequently, could not see student's reaction or what rest of class was doing.
3. No observation of student possible, difficult to say anything about them, half the view of class.

Thursday 8:00 AM (3-11-71)

1. Difficulties: do not see students or any interplay of teacher and student because of filming, so left in dark as to what is going on in class.
2. Observation of teacher means seeing student reaction too!
3. Easier to hear because no machine rattling away in background.

## SUMMARY OF 3rd CLASS OBSERVATIONS

Monday 8:00 AM (3-29-71)Lesson Objective

Review short serve, dink shot, up and back, side by side strategy in game.

Class Organization

Easy to organize as only 12 people; 3 courts of four.

Content

Warm up friendly game or rally when they entered; practiced short serves 3 feet behind "T," staying with birdie as long as can (4 minutes); served diagonally, practiced short return, demonstration: aim for corners, keep racket up; teacher visited each court to help, encouraged, and made suggestions; easy to get around to 12 people (4 minutes); demonstration of strategy: side by side, up and back review, explained what a "carry" shot was (4 minutes); demonstrated difference if racket kept low; talked about next Monday's class; class practiced strategy in game, teacher watched courts, moved up and down 3 courts, helped them with rules or placement when confused; would incidentally comment on shots which were good; "no serve, no points;" students asked questions like on scoring "let;" they seemed to take game seriously and worked to implement techniques which had been taught; as class progressed, more verbalizing from students as got techniques to work-seemed interested and enthusiasm grew; switched sides after 1st game, teacher reminded them winners always serve first in 2nd game; girl tapped net, checked and told fault, was also told best flick shot she'd ever seen from her (correction tempered with encouragement, takes sting out of disappointment); times teacher cracked up when funny things happened, a lot of interest (35 minutes); time called, told on parting, class developing good strategy; machine out but not used.

Instructor

Clean, tidy, alert; on watch to give help, instruction on theme of lesson, or to remind them of part learnings; business-like but relaxed.



## SUMMARY OF 3rd CLASS OBSERVATIONS

Tuesday 8:00 AM (3-30-71)

Lesson Objective

Review short serve and return of short serve, strategy and scoring, application to game.

Class Organization

Warm up by fours on court, each with partner; assigned partners, odd number so teacher had to play.

Content

Reviewed serve-drop, hit, glide; gave individual help; return of short serve, little drop shot which just falls over net, demonstrated two times, demonstrated difference if racket kept up to net, shorter angle easier; teacher paced the courts looking for problems, encouraged them, told if too high, keep racket up (4 minutes); strategy review-demonstration by 4 players, class sitting on sidelines, called out score, told why opponent missed shot "too close to line," explained a "sling" or "carry" - happens when out of position, demonstrated how happens and out of courtesy must call own; sidelines quite quiet (6 minutes); told that teacher would be in class next Tuesday whether they were or not; set up courts in partners, on court that teacher played, she gave help and comments on play; on other courts, strategy positions assumed by most on serve; drops and smashes tried, didn't see too much of up and back, side by side combination, mainly side by side (13 minutes); rotated team to left; teacher played so students on opposite side forced to correct positioning, verbal help given as well (5 minutes); rotated again, fewer verbal comments as class progressed (4 minutes); "thank you ladies, see you next time."

Instructor

Same as yesterday - believes she comes out of a mold each class.

## SUMMARY OF 4th CLASS OBSERVATIONS

Wednesday 8:00 AM (4-21-71)Lesson Objective

To give a test.

Class Organization

Warmed up as they entered; called class to get pencil and paper; gathered in circle and then sat on sidelines of court.

Content of Lesson

Introduced Karen who was setting shots; gave demonstration clear shot and asked what was wrong with shot; students responded and told to write "bad shot-jumped" on their papers; 7 shots to be demonstrated, 4 demonstrations for each shot; asked for questions and told them they could move around; demonstrated long high serve, told class to write "good" or "bad" and if "bad," why; reurged class to move around; demonstrated short serve, clear, backhand clear, drop shot, smash, net shot; gave time between tests for students to write; questions 8 to 12, Karen and instructor played game, 5 things obviously wrong with game, score 8-8 when start; students told to move around and did; score called out by Karen; Karen won quickly so had to play another 8-8 game; students handed in papers, instructor goes over test; gave shot and asked for answers, led students on for more complete answers: "the shot went out. Why did the shot go out?;" long serve was good; short serve-restricted motion when racket held at the belly button position; clear-no body rotation, straight arm; backhand clear-feet wrong, body rotation unrestricted; drop shot-no follow through, elbow down, not hit at highest point; smash-good shot, landed at opponent's feet; net shot-racket too low; game errors: (1) started serving in wrong court, (2) scored wrong, (3) "carry" shot called wrong, (4) set game to wrong number at tied score of 10, (5) rackets not up on serve-took answers from class, got all but last answer from them (45 minutes); blackboard explanation of future dates; papers back by Wednesday; "Okay, you can go, pick up rackets and birds, please."

Instructor

Fresh and tidy; testing-serious and matter of fact.

## SUMMARY OF 4th CLASS OBSERVATIONS

Thursday 8:00 AM (4-22-71)

Lesson Objective

To give a test.

Class Organization

Warmed up after they entered; called class to get pencil and paper, said "You may move around so you can see, sit somewhere on the sidelines."

Content of Lesson

Introduced Karen; "Going to give you 7 shots, some right and wrong, write down good or bad and if bad, why;" reminded to move around; few stood up; each shot demonstrated 4 times; long high serve-regave instructions; short serve-someone questioned if evaluated each of 4 shots or overall, instructor said just one main thing wrong with all 4 shots; clear shot-gave time for writing until heads came up; backhand clear; drop shot; smash, net shot; single game situation, score tied at 8-8, strokes perfect but some things wrong with the game, at end of game have 5 things wrong; Karen and instructor played game; question at end about five things if mechanics or skill errors; some mistakes occurred once, others repeatedly wrong; students asked for a third game and got one (25 minutes); students handed in papers, test reviewed; demonstrated strokes again and asked if good or bad and why; on "bad" got "why" and demonstrated what "good" shot should be; long serve-good; short serve-position crouched; clear-stance bent from waist, arm straight; backhand clear-trouble seeing error, stance different to yesterday, some points made as to why want right foot forward; drop shot-arm all crunched up and no sweep to it; smash-okay, right back to Karen's feet; net shot-racket down, did not get them over the net, 2 foot stiff legged stance; game errors: (1) wrong court to serve, (2) server called score wrong, (3) set game wrong, (4) "carry" shot called wrong, (5) rackets not up on serve; missed last point, class criticized this as skill and not strategy or rules, instructor said would take it into consideration when grading; humorous comments from class as took test; on another sheet, took down blackboard dates, explained what happened on different days; told class of absence and substitute would only give directions (since substitute did not know badminton); students' last chance to practice strokes; gave tournament dates, round robin doubles tournament; no further questions; "Okay, you guys go ahead and go."

Instructor

Neat, serious, businesslike.

"BIRDIE DROPPER" DATA SHEET

APPENDIX F

"Birdie Dropper" Data Sheet

Raw Data

## "BIRDIE DROPPER" DATA SHEET

NAME \_\_\_\_\_ Date \_\_\_\_\_

Type of shot practiced today (Circle one):

clear

net shot (hairpin)

drop

flicking down net shots

smash

return of short serve

Time spent on shot: \_\_\_\_\_ minutes \_\_\_\_\_ seconds

Number of attempts \_\_\_\_\_

Number of properly executed shots \_\_\_\_\_

TABLE XII  
 AMOUNT OF MACHINE TIME AND PERCENTAGE OF  
 CORRECT HITS FOR SUBJECTS IN  
 THE EXPERIMENTAL GROUP

Subject Number	Machine Time	Percentage of Correct Hits
1	6 minutes	.44
2	3 minutes 30 seconds	.57
3	5 minutes	.63
4	2 minutes	.70
5	3 minutes	.67
6	5 minutes	.56
7	5 minutes	.36
8	7 minutes 30 seconds	.55
9	5 minutes	.56
10	6 minutes	.85
11	6 minutes	.68
12	5 minutes	.50
13	8 minutes	.57
14	4 minutes 30 seconds	.70
15	4 minutes	.46
16	6 minutes	.64

Mean = 5.09 minutes

Standard deviation = 1.50 minutes

TABLE XIII  
 RAW DATA FOR SKILL TESTS, PRE-INSTRUCTION  
 KNOWLEDGE TEST, AND ATTENDANCE

Subject Number	Miller Wall Volley Initial	Final	Pre-instruction Knowledge Test	Absences
Experimental Group				
1	32.32	30.99	7	9
2	26.66	25.00	8	3
3	14.66	25.00	6	1
4	20.00	25.00	4	5
5	17.00	25.00	8	2
6	14.00	24.33	6	4
7	20.00	21.33	4	4
8	20.00	21.99	5	9
9	13.66	24.66	6	6
10	28.66	28.66	3	3
11	18.66	23.00	6	6
12	15.99	40.99	6	8
13	19.66	27.00	5	6
14	21.66	20.99	6	2
15	19.00	21.00	5	2
16	20.00	26.66	5	5
Control Group				
1	19.66	16.00	6	6
2	18.66	23.33	6	7
3	23.00	20.00	9	10
4	22.00	25.00	8	1
5	16.00	22.00	6	1
6	20.66	23.00	7	4
7	21.66	23.33	4	1
8	22.00	25.99	7	2
9	18.99	23.00	3	2
10	16.00	24.00	2	2
11	19.33	22.99	7	6
12	17.00	17.00	5	4
13	24.66	30.00	9	3
14	20.00	22.33	6	0
15	11.00	14.00	6	2
16	18.00	22.00	6	2
17	18.33	26.32	5	0
18	21.00	21.00	7	3

TABLE XIII (continued)

Subject Number	Miller Wall Initial	Volley Final	Pre-instruction Knowledge Test	Absences
Comparison Group				
1	21.66	29.00	6	-
2	22.00	19.66	7	-
3	20.66	24.00	8	-
4	27.00	30.33	8	-
5	22.00	25.00	6	-
6	20.33	12.32	7	-
7	20.33	20.33	6	-
8	16.00	14.33	6	-
9	21.00	25.33	4	-
10	18.00	10.32	6	-
11	21.66	21.66	6	-
12	23.00	24.00	4	-