THE EFFECT OF A SELF-INSTRUCTIONAL PROGRAM OF BADMINTON RULES ON THE KNOWLEDGE AND PLAYING ABILITY OF BEGINNING BADMINTON PLAYERS

by

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The purpose of this study was to determine the effect of a self-instructional program of badminton rules upon the knowledge and skill achieved by a group of beginning badminton players.

Thirty-six women enrolled in two beginning badminton sections at the University of North Carolina at Greensboro were subjects in this study. The subjects participated in two groups that were considered equated on the basis of initial badminton playing ability and previous badminton experience. The experimental group of nineteen subjects was taught the rules of badminton through programmed instruction; the comparison group of seventeen subjects was taught the rules through a class presentation method, the instructor presenting all material.

The two groups were instructed by the author. Classes met for thirty-five minutes twice each week for a total of thirty-one classes. The two classes followed an identical course procedure with the exception of rules presentation. All instruction in rules was presented to the experimental group by programmed instruction. During the semester these subjects completed the eight sections of a badminton rules program prepared by Dr. Gail M. Hennis, professor of physical education at the University of North Carolina at Greensboro.

The Miller Wall Volley Test was used as the measure of badminton playing ability. The skill test was first administered during the third and fourth class periods and readministered during the thirtieth class period to determine badminton playing ability following one semester of instruction.

Badminton knowledge following one semester of instruction was measured by a forty-three item knowledge examination. Knowledge of badminton rules was assessed by the eighteen questions on this examination that pertained to rules. Student opinion of programmed instruction as used in this study was determined by a questionnaire completed by the experimental subjects following the final knowledge test.

Fisher's "t" tests of the significance of difference between means were used to compare initial and final playing ability of both groups, the change in playing ability within each group, and the mean number of rules questions and the mean number of total questions missed by each group on the final knowledge examination. Percentages were used to evaluate the questionnaire.

A significant difference was found on the forty-three question knowledge examination indicating superior over-all badminton knowledge by the comparison group. Both the comparison and experimental groups evidenced significant improvement in playing ability.

The following conclusions were drawn regarding the use of programmed instruction:

1. Programmed instruction was as effective as the class presentation method of instruction with respect to knowledge of badminton rules.

2. Badminton playing ability was not affected by the method of rules instruction.

3. Programmed instruction was not as effective as the class presentation method of instruction with respect to total badminton knowledge.

4. Students in the experimental group reacted favorably to the use of programmed instruction.

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CHAPTER I

INTRODUCTION

Educators are constantly searching for new and more effective methods of instruction - methods providing efficiency and economy of learning time. Programmed instruction, developed in an attempt to meet such standards, has proven successful. In regard to programmed instruction, Schramm has stated:

> Many kinds of students learn - college, high school, secondary, primary, preschool, adult, professional, skilled labor, clerical employees, military, deaf, retarded, imprisoned - every kind of student that programs have been tried on. Using programs, these students are able to learn mathematics and science at different levels, foreign languages, English language correctness, the details of the U. S. Constitution, spelling, electronics, computer science, psychology, statistics, business skills, reading skills, instrument flying rules, and many other topics. The limits of the topics which can be studied efficiently by means of programs are not yet known. (27:4)

Programmed instruction offers an exciting challenge to physical educators. Although it has been used successfully in a wide variety of learning situations, little has been done to apply this medium to activity instruction in physical education. If found successful, the implications for physical education would be broad. Programmed instruction would provide an additional means for teaching knowledges and understandings, allow more time to be devoted to skill development, encourage students to learn on their own, and assist in the instruction of large classes. An activity like badminton would no longer be stymied by inadequate court space or a large number of students; more time could be devoted to actual participation in both singles and doubles.

This study used programmed instruction to teach students the rules of badminton in an attempt to evaluate the effect of this method of instruction upon badminton knowledge and playing ability.

CHAPTER II

STATEMENT OF PROBLEM

The purpose of this study was to determine the effect of a self-instructional program of badminton rules upon the knowledge and skill achieved by a group of beginning badminton players. Instruction using programmed instruction was compared with instruction using a class presentation method. Of the thirty-six subjects completing the experiment, seventeen were in the comparison group and nineteen in the experimental group. The skill and knowledge achieved following thirty-one periods of instruction were measured by the Miller Wall Volley Test and a forty-three question, objective knowledge examination.

For the purpose of this study, programmed instruction has been identified as instruction in rules in which

> . . . a "program" takes the place of a tutor for the student, and leads him through a set of specified behaviors designed and sequenced to make it more probable that he will behave in a given desired way in the future - in other words, that he will learn what the program is designed to teach him. (24:1)

The class presentation method refers to instruction following an identical progression with all rules introduced during class time by verbal presentation of the instructor.

Additional terminology has been defined to assist the reader in an

understanding of this study.

1. The program - ". . . the completed route to mastery of the subject for which it has been prepared - ordered and ready for the student to follow" (17:2).
2. A frame - a unit of information presented in the program.
3. A beginning badminton player - an individual scoring below thirty-four on the Miller Wall Volley Test and having received limited or no badminton instruction.

Limitations

A limiting factor within this study was the procedure used for selection of subjects. Due to scheduling difficulties the subjects were selected by enrollment in the two badminton sections instructed by the author rather than by random selection. Although the subjects were not randomly selected, there is little reason to believe that there was anything unusual about either group.

An additional limitation was the method used to classify the subjects as beginners in regard to badminton knowledge. Subjects were assumed to be beginners on the basis of their enrollment in a beginning badminton class and the information they related on a card completed during the first class period. In the opinion of this author, it may have been erroneous to assume that all the subjects were beginners on the basis of these criterions. It is recommended that future studies base beginning knowledge status upon a pre-instruction knowledge test.

CHAPTER III

REVIEW OF LITERATURE

Several basic characteristics underlie programmed instruction. In following a logical series of steps the student is able to move toward the desired goal without the assistance of a teacher. The program itself leads from the known to the unknown. Each frame has an element in common with a previous frame. As the student moves from frame to frame, the probability is high that he will be able to respond to the next frame as it shares elements with material learned in a previous frame. The student, being required to respond to each unit of information, actively participates in the learning process. Immediately following his response he receives knowledge of its correctness or incorrectness. The next unit of information is then presented, and the cycle is repeated. The material is self-paced; the student proceeds at his own speed. Coulson stated:

> Although any one of the features listed may be represented in other educational methods or devices only programmed instruction combines these features in a systematic fashion toward the solution of practical and objectively stated educational goals. (30:373)

Programmed instruction has been divided into two categories characterized by the nature of the response elicited. In the multiple-choice program the subject selects an answer to a question from a number of alternatives. An ability to recognize data is exercised. This system is often identified with the

work of Norman Crowder.

The constructed-response program requires recall of material. The student is required to complete a sentence or compose the response to a question.

The constructed-response program is associated with the work of B. F. Skinner and others, that was conducted at Harvard University in the 1950's. Skinner attempted to apply to human learning principles found successful in experimental studies with animals. The constructed-response program is often labeled the small-step or Skinnerian program. It can be identified by:

1. Small frames
2. Small, easily-grasped steps
3. Overt student responses
4. Linear arrangements

The frames are small in terms of the number of words and ideas presented. Generally, the frame is only a few sentences in length and introduces only one concept at a time. Deterline (7) theorized that simultaneous presentation of too many ideas would be likely to impair comprehension and later application. For similar reasons the information is presented in small steps. The initial questions are usually easily answered and not dependent upon previous knowledge. The questions increase in difficulty as the student proceeds through the program. As the program steps are very small, the student is able to progress without making excessive errors. Advocates (7, 13) of the small-step program credit it with reduction in student errors and more efficient

learning. Knowledge of frequent correct responses, they have claimed, provides a reward situation for the student. Such knowledge provides additional stimulation and motivation for the learner and prevents the repetition of incorrect concepts. According to Fry (9), Holland and others are willing to accept a 10 per cent error rate for the total program or a 10 per cent rate for responses of all subjects to any one question. The followers of Crowder or intrinsic programming do not feel that incorrect responses are detrimental to the student or program.

The constructed-response program requires continuous active responding by the subject. Overt or short written answers are required in each frame. The program provides for a wide range of student ability, each student being able to proceed at his own pace.

Of the two major techniques for programming sequences, the constructed-response program is generally linear in arrangement. Fry has defined linear programming as arrangement of material in a single ordered sequence requiring every student to ". . . proceed from the first through the last item" (9:4). In the branching or intrinsic arrangement, the sequence of materials is determined by the student's answers. The technique used or variations of the two basic techniques depends upon the material to be programmed and the nature of the learner.

Programs now appear in text as well as machine form. The programmed text as opposed to the scrambled text utilizes two major formats. Fry has described them both.

> In a book with a horizontal format each item is printed on a page separate from the correct answer, which is usually given on the back of the page or at the beginning of the next page. The student reads the program item or frame, responds to the question posed for him, then turns the page to learn the correct answer. (9:7)
>
> Recently the vertical format has become popular in programmed books. In this design, the correct answer is presented either beside or below the frame. (9:7)

In the scrambled book the frames are not presented in sequence, instead, they are scattered throughout the book.

Fry (9) has stated that most present programs use the linear arrangement and the small-step, constructed-response. This writer shall be primarily concerned with the constructed-response, linear program utilizing the textbook approach.

The writer in reviewing the material pertaining to programmed instruction has subdivided it into three main areas: programmed instruction and theories of learning; programmed instruction as related to physical education; programmed instruction as utilized in areas other than physical education.

I. PROGRAMMED INSTRUCTION AND THEORIES OF LEARNING

Rigney and Fry (39) have stated that there are a multitude of factors that could be related to both the educational task and programmed learning. Attempts to appraise programmed instruction require the comparison of the factors known essential to education in general and those correlated with programmed instruction in particular.

The theory of reinforcement is foremost among the learning theories

associated with programmed instruction. Beginning with commonly accepted views in education and Thorndike's early law of effect, Skinner's theory of reinforcement evolved. According to Blyth, the law of effect indicated that " . . . an action which leads to a satisfactory result tends to be repeated" (28:117). Deterline stated that experimentation by Thorndike led to the statement that " . . . repetition or practice has, by itself, little effect unless the practiced response is reinforced" (7:25-26). Skinner's theory reiterated the importance of immediate reinforcement or reward in learning.

Operation of the reinforcement theory in programmed instruction has been simplified by Evaul.

> When certain behavior (in the case of programed instruction, the correct response) is rewarded, (by knowledge that the response is correct) the probability of repeating the response is increased (learning). (32:27)

It is claimed that for reinforcement to be effective it needs to occur immediately after the response. Delayed reinforcement may retard motivation and information needed for learning. Porter has stated that " . . . knowledge of the correctness of one's own responses improves performance at a task" (22:125). According to Gagné and Bolles (10), the immediate reinforcement which accompanies programmed instruction has two functions: it provides feedback as to the correctness or incorrectness of each response, and it sustains motivation. Programmed instruction increases student activity and heightens interest; the student is made aware of progress at all times. If he becomes bored or stops making progress, he can escape by moving on to new material.

The student is also motivated to read carefully and pay attention as the results of such behavior are reinforced (7).

There seems to be some disagreement as to the real nature of reinforcement. Notice the discrepancies in the three theories given below. Lysaught and Williams (17) have stated that an individual learns or changes the way he acts by observing the consequences of his actions, not from the response itself. Deterline's discussion of Guthrie's learning theory suggested:

> . . . learning the association of stimuli and responses occurs as soon as a response is made, not when reinforcement occurs. According to this view both right and wrong answers are strengthened when they occur, and even correction after an error cannot completely eliminate the tendency for the error to recur later. (7:30)

For programmed instruction this theory emphasized the need for the student to respond correctly to every frame. However, Klaus stated: ". . . the student learns from making a response and not from hearing or seeing it. Only by practicing a response will a student learn and retain it" (35:136).

Chambers and Schulte, in quoting Arnstine, injected skepticism into the belief that reinforcement need be immediate by stating that there is " . . . no way of justifying the claim that immediate reinforcement is rewarding to all students in a school learning situation" (29:174).

Responses that are left unreinforced tend to weaken the bond between stimulus and response. This process, known as extinction, is utilized with teaching machines. A programmed text does not withhold a response or keep the student on a specific frame until his response is correct. Instead, observation of an incorrect response should assist the student in elimination of that

response.

Other learning variables are dependent upon reinforcement. Generalization accompanies reinforcement. According to Deterline,

> Generalization is the broadening or far-reaching tendency for a response to occur, not only in the presence of those stimuli actually present during the first occurence of the response, but in the presence of other, similar stimuli. (7:31)

Much in education is dependent upon ". . . generalization from classroom examples to real life situations" (7:31).

The opposite of generalization is discrimination or the ability to differentiate between stimuli and then respond appropriately. Concept formation involves both generalization and discrimination. It develops as responses are reinforced, and one common characteristic becomes the stimulus for that concept. Fine discriminations are required to define the concept.

According to Porter (22), the real effectiveness of programmed instruction is determined by the amount of transfer that occurs from the program to other situations. One needs to know the effects on the learner or the degree of transfer following programmed instruction. Measures of achievement and transfer of training following programmed instruction are essential to any evaluation of the teaching method.

II. PROGRAMMED INSTRUCTION AS RELATED TO PHYSICAL EDUCATION

Evaul (32) and Redd (38), each discussing the potential of programmed instruction for physical education, have suggested its use to provide more time for skill development. Programmed instruction would make possible the division of large classes, enabling some students to work on programs while others participated in the activity. The time involved in learning history, rules, strategy, and general information could be reduced by using programmed instruction either inside or outside of class. Evaul felt it conceivable that skill techniques, such as stance and grip, could be learned through programmed instruction. Both felt that such instruction held great potential for increasing the efficiency and effectiveness of the physical education program.

Information, studies, and actual programs available in physical education are very limited. Geared for the general public, programs have been published in scoring bowling and watching a football game (26). In 1964, Penman's Physical Education for College Students (20) was published. This scrambled text is designed for use in introductory physical education courses at the college level. The various units direct the reader to the "why" of physical education. Barnes', Program in Self-Instruction for Officiating DGWS Volleyball Rules (2), published in 1965, is designed to help prospective DGWS rated volleyball officials learn the rules and techniques of officiating. Completion of the linear program is aimed at preparing the individual to pass the DGWS-OSA Volleyball

Examination. Barnes has stated the results of three field trials of the program:

1. . . . students who used the program obtained a higher mean and median score on Form A of the Officiating Services Area Volleyball Exam than did students who did not use the program.

2. There is evidence that the students who used the program obtained higher scores on the directions to timers, scorers, and linesmen than those who did not use the program.

3. The error rate was well within the recommended range (under 10%). (2:ii-iii)

Although programs are currently available in physiology, health, and first aid, little has been done with activity instruction. The results of specific studies involving motor performance but not directly pertaining to physical education activities have implications for physical education. Woelflin (45) found that programmed instruction was as effective as classroom instruction. A teaching machine program using the branching technique and the multiple-choice response was developed to teach students to play the clarinet. Woelflin used a control group of seven, an experimental group of six using the teaching machine and having a clarinet but not allowed to play it, and an experimental group of five using the teaching machine and able to practice with a clarinet. The results indicated that the machine instruction was as effective as classroom instruction in regard to both knowledge and performance. She concluded that one half of the classroom time was saved without an accompanying decrease in knowledge or performance.

Schramm (27) reported a study in 1955 by Dowell which compared practice on verbal programmed material and practice on equipment in learning a task requiring equipment. Although the exact number is not known, twenty-six

thousand sets of programmed materials on troubleshooting were used with United States airmen. The subjects were divided into four groups. The treatment effects varied for the subjects who:

1. Studied the programed material and practiced on actual equipment only.
2. Studied and practiced on both programed material and equipment.
3. Studied and practiced on the programed material only.
4. Received general instructions on troubleshooting, and did not practice. (27:38)

It was found that the group (2) studying and practicing on programmed materials and equipment learned the most. The group (1) that studied programmed material and practiced on actual equipment did better than the group (4) receiving general instructions and not practicing. There was no difference between this group (4) and the group (3) studying and practicing on programmed materials only.

Mizenko and Blanchard (43) compared the effectiveness of programmed and conventional instruction in teaching the theory of direct current fundamentals and the operation of the multimeter in an electronics course at the United States Army Signal Center and School. Eighty-nine control subjects were instructed through conferences, demonstrations, practical exercises, and closed circuit television. Eighty-nine experimental subjects used a linear programmed textbook. There was no significant difference in achievement of the verbal material for the two groups, but achievement of performance skills for the control group was significantly higher than for the programmed group.

The results of these experiments indicate that Evaul's (32) suggestion of teaching physical education skills through programmed instruction may present certain difficulties. However, a greater amount of research is needed before drawing conclusions regarding programmed instruction and motor performance.

III. PROGRAMMED INSTRUCTION AS UTILIZED IN AREAS OTHER THAN PHYSICAL EDUCATION

The absence of any quantity of material regarding programmed instruction and physical education necessitates the investigation of work completed in other fields for information as to its characteristics and effectiveness. Such an investigation shows that the idea of programmed instruction is not new. Rigney and Fry have stated that " . . . organizing subject matter into a sequence of easily understood, interdependent steps probably is as old as man's attempt to educate himself" (39:8). Lysaught and Williams (17) have claimed Socrates as one of the earliest programmers. Through a series of questions, he guided his students' learning. The idea of teaching machines, also, is not new. The first machine, although not as elaborate as present devices, was patented in 1866 (7). Several investigators (17, 41) have considered S. L. Pressey as the pioneer in automated teaching. In 1924, he introduced a device about the size of a portable typewriter that administered and scored tests (23). In 1934, Little (15) did further experimentation with a similar device. In 1931, Peterson (21) reported using sheets of multiple-choice questions that would

change to predetermined colors for correct and incorrect responses. Later developments in programmed instruction owe much to the work of B. F. Skinner. Glazer, Homme, and Evans developed the programmed textbook in 1959. However, according to Green, "The programmed textbook, in a way, has been around for a long time in the form of workbooks" (11:33). Indicative of the great increase in attention focused on programmed instruction, Lumsdaine (16) in 1959, reported that interest in programmed instruction had suddenly become widespread, and developments were occurring at such an accelerated rate that published information was far behind the work accomplished.

Schramm (24) has reported that since Skinner's article, "The Science of Learning and the Art of Teaching" (42), in 1954, approximately 190 pieces of research on programmed instruction have been reported, 165 of these since 1959. He further stated:

> Programed instruction has been tried, and has accomplished learning, at every level from preschool to graduate professional school. It has been used successfully with slow learners, and on mature, superior students. It has been used to contribute to the training of pilots, package and billing clerks, electronics technicians and computer operators. (24:45-46)

He also stated that programmed instruction has been used successfully on a variety of subject matter and behavior; to teach or supplement a course; and as teaching machines, flash cards, and programmed texts. However, he added that the success credited to programmed instruction may only be due to the way the research was conducted.

Both Coulson and Silberman have not been quite as optimistic. Coulson stated: "The popular literature [on programmed instruction] is optimistic, the

experiments on programming are pessimistic, and the field studies hover between these poles" (5:13).

In 1962, Silberman (40) found that the most popular findings showed no significant difference among treatment conditions. He questioned whether this indicated that the variables had little effect on learning or that they were inadequately tested. He theorized that research utilizing short programs of under one hundred frames, small samples of highly motivated students, and short improvised quizzes immediately following programs may be invalid. Coulson felt that conflicting findings could be due to the differences in the extent that training tasks were similar to criterion tasks. He summarized:

> It is becoming increasingly difficult to distinguish between published statements that are based on experimental data and those that are based on faith, enthusiasm and overgeneralization from anecdotal observation. (5:13)

Of the studies available, only those pertaining to programmed texts will be mentioned. The writer has no way of knowing the actual validity of the studies as indicated by the quality of the program itself and the other variables mentioned above. It is to be remembered that improvement in techniques has been continuous, therefore, results found insignificant according to earlier procedures may by today's methods prove more effective.

Major emphasis has been placed on comparison of the programmed text with the conventional classroom situation. In industrial situations,

programmed instruction has produced positive results. Hughes and McNamara (34) report a study involving the IBM 7070 Data Processing System. Seventy experimental subjects were instructed entirely by programmed text while forty-two control subjects received the conventional lecture-discussion type of instruction. The results indicated significant gains in achievement and reduction in training time for the experimental group. Holt (12) reported that the mean score of thirty-four technicians on two criterion tests following completion of the Bell Telephone Laboratories' program on basic electricity was significantly higher than the mean score for those trained by a lecture-discussion method. Furthermore, the significant difference remained on a retention test six months later.

Schramm (27) has cited studies by Reed and Hayman, and Austwick that have compared programmed and conventional instruction. Reed and Hayman found no significant difference in a study involving 250 tenth grade students. They used a linear program of English grammar and usage. Results indicated that there was no significant difference between experimental and control groups, but that the high ability students did significantly better with the program than with conventional instruction, whereas, the opposite was true of the low ability students. Austwick found immediate post-test scores better for the subjects receiving conventional instruction than for the subjects using an algebra program. He felt that these results might be attributed to this being his first program. Retention of information after several weeks was relatively better for the experimental group.

He noted that the experimental group scored well and retained more on questions that had been covered in the program rather than on questions requiring the application of learning to material not covered in the program.

Investigations by Brown, Goldbeck and others, and Lewis, as reported by Schramm (27), have compared a combined program-conventional approach with conventional instruction. Generally, they have found the combined approach superior. Brown, using a linear program in math, compared eighth and ninth graders following conventional instruction and a combined conventional and programmed approach. The experimental group was found to be significantly superior to the control group in a test of general ability. This same superiority was evidenced in eight out of nine achievement tests administered during the school term. In a similar experiment Goldbeck and others used a linear program of three units of a United States government course given to high school students. The final field tests indicated that conventional instruction with a few minutes a day devoted to programmed instruction could raise student performance on two of the three units significantly higher than the conventional instruction alone. Lewis investigated the effectiveness of a programmed text integrated with a language laboratory. The control group of college students received conventional instruction. The experimental group spent a larger proportion of time on the program. No significant difference was found between groups.

Retention of programmed information was studied by Goldberg, Dawson, and Barrett (33) and Bruce (4). Goldberg, Dawson, and Barrett compared the effectiveness of a programmed text, teaching machine, and conventional instruction in a descriptive statistics course. They stated that the programmed material appeared to help the slower learners gain a familarity with the material, whereas, the conventional approach appeared superior in teaching for understanding and application of material. In recall, the programmed group had the greater loss.

Bruce has reported a study at the Eastman Kodak Company investigating recall of sixty key words of the Maslow theory by one group learning with programmed instruction and another learning by lectures. Six weeks after presentation of the material the control group was able to recall 13.5 per cent; the programmed group, 26.8 per cent. The study by Holt (12), cited earlier, also found greater retention by the programmed group.

After reviewing thirty-six reports comparing programmed with conventional classroom instruction, Schramm (27) summarized that eighteen showed no significant difference when experimental and conventional groups were measured on an identical criterion test, seventeen showed a significant superiority for the programmed group, and only one showed a superiority for the conventional group.

Studies comparing the two methods of instruction have shown programmed instruction at least as good if not better than conventional

instruction. Cronbach has said that research indicated that programmed instruction ". . . teaches facts and verbally mediated responses as effectively as conventional procedures . . ." (31:46). However, several investigators (5, 36, 40) look with great skepticism upon any generalizations from such studies. Comparison of the two procedures is complicated by unintended variables. First of all, the situations may not be comparable. The subjects receiving conventional instruction may not receive the same material, may cover a wider range of topics, or may not be using their time as efficiently as possible. The fact that several studies have indicated that programmed groups took less time may only indicate that work in such groups was limited to test-related material. Although the characteristics of programmed instruction can be described, what are the common characteristics of conventional instruction? What is to prevent, as Schramm (24) says, comparing apples with oranges? Krumboltz (36) has reminded investigators that classroom teachers vary in their "conventional instruction", and programs vary in their scope and quality.

Some investigators (5, 27) have felt that the Hawthorne Effect, the student in a new situation and in the spotlight being challenged to do well, may have been present. A report by Calvin, as cited by Cronbach (31), has mentioned the influence of the teacher's attitude toward programmed instruction. When favorable, performance was at least equal and sometimes superior to that of the conventional group. When unfavorable, performance was inferior.

In summarizing the research on programmed instruction several general conclusions can be reached. Programmed instruction has proven effective for all levels of ability. It has produced favorable results with the gifted, average, and below average. Lysaught and Williams (17) felt that the gain in learning is most obvious with those of low ability. The learning time accompanying a program varies widely as the student is able to work at his own speed. Fry (9) indicated that programmed instruction can reduce both training and teaching time. It also can reduce student error, the immediate knowledge of success possibly increasing the subject's motivation to learn. It has been emphasized that programmed instruction can carry the bulk of instruction, supplement or enrich instruction, but does not purport to replace effective teachers. Programmed instruction should be looked upon as an aid for the teacher, freeing him for other tasks, not as a threat to his position.

Schramm summarized the progress in programmed instruction when he wrote:

> Looking back over the first public years of programed instruction . . . we can record a swift growth rate in production and use, some encouraging evidence that programs teach, some research results puzzling as to how programs teach but encouraging as to how they may be made to teach better, and a premature hardening in program form and use. (24:15)

The author has discussed programmed instruction in relation to the theories of learning, physical education, and areas other than physical education in an attempt to acquaint the reader with this medium of instruction. It is

hoped that the discussion has pointed out the definite need that exists in physical education for research involving programmed instruction.

CHAPTER IV

PROCEDURE

This study was undertaken to determine the effect of a self-instructional program of badminton rules upon the knowledge and skill achieved by a group of beginning badminton players. Two groups of subjects were used, one an experimental group learning badminton rules through programmed instruction, the other a comparison group receiving instruction in rules through class presentation.

I. SELECTION OF SUBJECTS

Forty students enrolled in two beginning badminton classes in the general college program at the University of North Carolina at Greensboro during the spring semester of 1965 participated in this study. The students were predominantly freshman and sophomore women. They were arbitrarily selected to the extent that students enrolled in the two badminton sections instructed by the writer were designated as subjects.

To prevent the comparison group from seeing copies of the programmed rules and because more students in the nine o'clock section could remain after class, the eight o'clock section was designated as the comparison group, the nine o'clock section as the experimental group.

During the first class period both groups were informed of the nature

of the study and asked to complete an information card. (Copy included in Appendix.) On the basis of their responses and their enrollment in a beginning badminton class, the subjects' knowledge was considered elementary. One subject was eliminated from the study because the writer considered her experience to be beyond the beginning level. The one male student was also excluded. During the semester two additional subjects were dropped from the comparison group; one withdrew from school, and the other was unable to take the second Miller Wall Volley Test because of illness. A total of thirty-six subjects completed the study--seventeen in the comparison group, and nineteen in the experimental group.

II. PREPARATION OF PROGRAMMED INSTRUCTION

Badminton rules were selected to be programmed because of the quantity of rules existing in this activity and because this activity was of special interest to the author.

An outline of material to be programmed was prepared in question form by the writer in accordance with her course objectives. Using the Laws of Badminton as adopted by the International Badminton Federation and the American Badminton Association and reported in the Tennis-Badminton Guide June 1964-June 1966 (19), material was programmed by Dr. Gail M. Hennis, professor of physical education at the University of North Carolina at Greensboro. A linear format was used. A typical series of frames may be found in the Appendix.

The program was divided into eight individual booklets, each to be administered separately to prevent subjects from reviewing previous material. A total of 218 frames were constructed, requiring 340 responses. The program booklets in the order of their administration were: (1) Rules Governing Service, (2) General Rules Which Apply to Both Singles and Doubles Play, (3) Singles Game, (4) Singles Setting, (5) General Doubles Rules, (6) Doubles Scoring, (7) Doubles Setting, (8) Additional Rules Applying to Both Singles and Doubles.

The individual booklets were each initially completed by five to seven volunteers not participating in the study. On the basis of these trials, problem frames were revised and booklets then prepared for class use.

III. SELECTION OF MEASUREMENT TOOLS

Skill

The Miller Wall Volley Test (37) was selected to measure total badminton playing ability. A description of the test appears in the Appendix. Miller (37) determined the reliability of the test by the test-retest method. One hundred college women of varying abilities were administered the test and retested within a one week period. Correlation of the scores for the two administrations yielded a reliability of $.94 \pm .008$.

The validity of the test was determined by correlating test scores for twenty players with the results of a round robin tournament among these same twenty players. The validity of the Miller Wall Volley Test as a measure of

total playing ability was found to be .83 ± .047.

In summarizing the results of her study, Miller has stated:

> The wall-volley test is a reliable and valid measure of either total playing ability in badminton or specifically a measure of a clear in badminton. The reliability of .94 ± .008 and validity of .83 ± .047 are significant coefficients. (37:212)

Miller has recommended that norms be established according to the situation due to the differing conditions, such as wall surfacing, prevalent during administration.

The Miller Wall Volley Test was selected to measure the initial and final playing ability of the subjects because of its high reliability and validity.

Knowledge

A knowledge test to be administered as a final examination was constructed by the author. The content of the test was based upon a table of specifications of course content to insure curricular validity of the test. The test, consisting of fifty-five questions, was administered as a final examination at the conclusion of the first semester. Forty-eight students, eighteen of whom were in a section instructed by the writer, completed the test. An item analysis was performed using the Flanagan Method. Revisions in items were made on the basis of the item analysis. The revised test consisted of forty-six three or four choice multiple-choice questions. Three of these questions were later deleted.

Eight criterion tests were prepared by the author to be administered to the experimental group as pre- and post-program tests, measuring each sub-

ject's knowledge prior to each section of the program and immediately following completion of each booklet. A copy of each test appears in the Appendix. The tests varied in length from five to ten questions of the alternate-response, multiple-choice, classification, diagram completion, and short answer formats. An attempt was made to limit questions to material specifically discussed within each program section and unaccessible to the student by other means.

Questionnaire

A questionnaire was constructed by the author to obtain the subjects' opinions regarding the use of programmed instruction in physical education. The questionnaire consisted of five questions requiring indication of the appropriate response with a check. Space was provided for additional comments. A copy of the questionnaire can be found in the Appendix.

IV. ADMINISTRATION OF MEASUREMENT TOOLS

Skill

The Miller Wall Volley Test was first administered to the subjects during the third and fourth class periods. Three graduate students assisted the writer in the administration. The author gave all instructions; she and a graduate student served as scorers. Another graduate assistant served as timer and the third helped to organize students and replenish the supply of shuttlecocks. New Pennsylvania 3 Penn Falcon Nylon Shuttlecocks were used. Students were arranged in alphabetical order and participated at one of three stations.

Immediately preceding her three trials each subject was given a one minute practice period. The two scorers rotated from station to station testing one subject as subjects at the other two stations rested. Both scorers scored each subject for each of three trials, the score for each trial becoming the average of the scores reported by the two scorers. In both classes it was necessary to complete the testing at the beginning of the fourth class period. Instructions and administration followed the procedure given in the Appendix. Subjects were not allowed to practice except during the one minute practice period. The subjects were told that the test would require power and that an overhead stroke would provide greatest success.

Scores were totaled for each subject. These scores were used to determine if there was any significant difference in skill level between the comparison and experimental groups.

The Miller Wall Volley Test was readministered during the thirtieth class period to measure playing ability following one semester of instruction. The procedure was revised to allow all subjects to complete the test within the same class period. At the beginning of the testing, groups of five subjects completed one minute of practice until all twenty students had completed the practice. The same graduate students who had helped with the initial testing assisted with the readministration. Students were alphabetically divided into two groups, each group assigned to a separate station. The students were tested in groups of three at each station. One student performed the test while the other two students scored. Students had practiced the scoring technique the

previous period. During this administration the two graduate scorers scored at different stations. The final score for each trial became the average of the scores reported by the one graduate and two student scorers. In instances where a student reported a score that differed by more than four points from the average of the scores reported by the graduate scorer and the other student scorer, that score was disregarded. The instructions were the same for both test administrations with the exception of the revised procedure.

Knowledge

The final knowledge test was administered to all subjects two days following the last class period during the scheduled final examination period. During the grading process three questions were deleted from the test because the writer felt that the material had been inadequately covered in class. Immediately following the test, experimental subjects completed the questionnaire.

V. CLASS PROCEDURE

Classes met for thirty-five minutes at eight and nine o'clock on Tuesday and Thursday each week for a total of thirty-one classes. An attempt was made to instruct both the comparison and experimental groups in an identical manner except for the presentation of rules. The comparison group received a three page information sheet during the fifth class period and was instructed in rules through class presentation. The experimental group received initial information pertaining to rules through programmed instruction. A course outline for both

groups appears in the Appendix. The outline used was formulated following a review of pertinent literature (1, 6, 18). General techniques and strokes were introduced to each class as a whole. For instruction in the singles game, both class periods were divided to allow maximum participation. On the basis of their class schedules, ten comparison subjects met from 7:55 to 8:30, and ten met from 8:20 to 8:55. Eleven experimental subjects met from 9:10 to 9:45, and nine met from 9:35 to 10:10. Classes again met as a whole during doubles instruction. Four badminton courts were available for use.

Experimental Class Procedure

Each program section was completed during class time to prevent review by the experimental subjects and to eliminate the possibility of comparison subjects seeing the program. Each experimental subject received an individual program booklet and answered each frame within the booklet. Subjects were not allowed to see the booklet again following the class period in which it was completed. An announcement that a section of the program was to be given was made the period preceding its administration to encourage full attendance. Prior to the first and second program sections, the procedure was reviewed and students were given an instruction sheet. (See Appendix.)

Students were requested to attend class a few minutes early during the periods of program use. Upon arrival each student received a clipboard and a pre-program test. Subjects did not receive a pre-test prior to the first program section. After completion of the test the student began the program booklet.

Following the program booklet, each took a post-program test identical to the pre-program test. Each student used the gymnasium clock to time herself on (1) the pre-test, (2) the program booklet, and (3) the post-test. Following completion of all three items, the student played badminton utilizing the information learned in the program. After all students had finished the program booklet, the instructor answered any questions and quickly reviewed the content of the booklet by asking the students questions. When time allowed, the class then practiced badminton skills with emphasis on the material covered within the program.

In administering the second, third, and fourth program booklets, the procedure was slightly altered as classes had been split into early and late sections. As the early group was completing the program booklet, the late group practiced badminton skills. The early group practiced skills utilizing program information while the late group worked on the program booklet. Following dismissal of the early group, the late group practiced for the remainder of their class period. In several instances the class periods in which the program was administered were slightly longer than the usual thirty-five minutes. Students absent on a day on which a program booklet was administered, completed the booklet upon their return to class.

VI. TREATMENT OF DATA

Group scores on both the initial and final administrations of the Miller Wall Volley Test were evaluated using Fisher's "t" test of the significance of

difference between means for small uncorrelated groups to determine whether or not the experimental and comparison groups were significantly different. Individual scores on the Miller Wall Volley Test were obtained by adding the scores on each of the three trials.

Fisher's "t" test of the significance of difference between means for small correlated groups was used to determine if a significant difference existed between the initial and final administrations of the Miller Wall Volley Test within each group. A significant difference could possibly be attributed to improvement due to class instruction.

The total number of questions incorrectly answered by each group on the forty-three item final knowledge test was also compared using Fisher's "t" test of the significance of difference between means for small uncorrelated groups. This formula was also used to determine if a significant difference existed on the number of questions specifically pertaining to rules incorrectly answered by each group. Three badminton instructors and the author individually reviewed the test and selected questions they felt pertained to rules. All four agreed on eighteen questions.

Data from the questionnaire were tabulated and presented in percentages.

CHAPTER V

ANALYSIS OF DATA

Presentation of Data

The Miller Wall Volley Test was used to measure the initial and final badminton playing ability of the seventeen comparison and nineteen experimental subjects. Scores on the three trials completed during each test administration were totaled yielding a measure of playing ability. The raw scores for subjects on both test administrations may be found in the Appendix. For all of the tests of significance, the 5% level of significance was selected as the minimum level of significance for rejection of the null hypothesis.

The first administration of the Miller Wall Volley Test was used to determine if a significant difference existed between the initial playing ability of the two groups of subjects. The mean, standard deviation, and range for each group appear in Table I. Fisher's "t" test of the significance of difference between means for small uncorrelated groups was used to determine if a significant difference existed between the means of the two groups. The obtained "t" of .115 was less than the criterion of 2.042 (25) for thirty degrees of freedom at the 5% level of significance. The null hypothesis was thus accepted indicating that the two groups did not differ significantly in regard to initial playing ability.

Fisher's "t" test of the significance of difference between means for small uncorrelated groups was used to determine if a significant difference existed

TABLE I

MEANS, STANDARD DEVIATIONS, RANGES, AND SIGNIFICANCE OF DIFFERENCE BETWEEN MEANS OF TWO GROUPS OF SUBJECTS ON THE MILLER WALL VOLLEY TEST

	Comparison Group N=17	Experimental Group N=19	"t"
Initial Administration			
Range	2.5 - 33.0	0.0 - 33.5	
Mean	18.794	19.105	.115
Standard Deviation	8.052	7.742	
Final Administration			
Range	14.4 - 64.2	18.5 - 59.0	
Mean	34.512	36.263	.449
Standard Deviation	11.067	11.590	

between the means of the two groups on the second administration of the Miller Wall Volley Test. The mean, standard deviation, and range for both groups appear in Table I. The obtained "t" of .449 was not statistically significant. The null hypothesis that there was no difference between the two groups in final badminton playing ability was accepted. It can be noted in Table I that the mean of the experimental group for each test administration was higher than the mean for the comparison group.

Initial and final playing ability were compared within each group using Fisher's "t" test of the significance of difference between means for small correlated groups. The data in Table II show that the "t" of 7.282 obtained for the comparison group and the "t" of 7.704 obtained for the experimental group were both significant at better than the 1% level of significance. In both instances, the null hypothesis that there was no difference between initial and final badminton playing ability was rejected.

The forty-three question knowledge examination was used to measure final badminton knowledge following thirty-one class periods of instruction. Data pertaining to the total number of questions missed and the number of rules questions missed appear in the Appendix.

The total number of questions answered incorrectly by the comparison and experimental groups was compared using Fisher's "t" test of the significance of difference between means for small uncorrelated groups. The obtained "t" of 2.231 was found significant at the 5% level of significance indicating superior performance by the comparison group, the group having the lower mean. The null hypothesis that

TABLE II

MEAN DIFFERENCE AND SIGNIFICANCE OF DIFFERENCE BETWEEN INITIAL AND FINAL ADMINISTRATIONS OF THE MILLER WALL VOLLEY TEST FOR COMPARISON AND EXPERIMENTAL GROUPS

	N	Mean Difference	"t"
Comparison Group	17	15.718	7.282*
Experimental Group	19	17.158	7.704*

* Significant at the 1% level of significance.

there was no significant difference in final knowledge between the two groups of subjects was rejected. Pertinent data appear in Table III.

The eighteen test questions pertaining to rules were rescored. The mean number missed by each group was then compared using Fisher's "t" test of the significance of difference between means for small uncorrelated groups. The mean, standard deviation, and range for each group appear in Table III. Although the mean number missed and the range of incorrect answers were larger for the experimental group than for the comparison group, the obtained "t" of 1.783 was not significant. The null hypothesis that no significant difference existed in the number of rules questions answered incorrectly by each group was accepted.

Scores on the pre- and post-program tests, indicating knowledge preceding and following completion of the programmed instruction, were compared graphically in Figures 1-8. In all cases, performance on the post-test was superior to performance on the pre-test. The mean time required for the experimental subjects to complete each program section, the pre-program test, and the post-program test was represented graphically in Figure 9. A mean time of 145.239 minutes was required to complete the eight sections of the program and the program tests.

Questionnaire responses were tabulated and presented in percentages. Results and typical comments appear in Table IV. The percentages obtained were based upon the responses of twenty students--the nineteen experimental subjects and the one male student also enrolled in the class.

Attendance data for both groups appear in the Appendix.

TABLE III

MEANS, STANDARD DEVIATIONS, RANGES, AND SIGNIFICANCE OF DIFFERENCE BETWEEN MEANS OF TWO GROUPS OF SUBJECTS ON THE KNOWLEDGE EXAMINATION

	Comparison Group N=17	Experimental Group N=19	"t"
Total Questions Missed			
Range	5 - 14	5 - 23	
Mean	9.412	12.474	2.231*
Standard Deviation	2.952	4.739	
Rules Questions Missed			
Range	1 - 6	1 - 10	
Mean	3.118	4.474	1.783
Standard Deviation	1.451	2.722	

* Significant at the 5% level of significance.

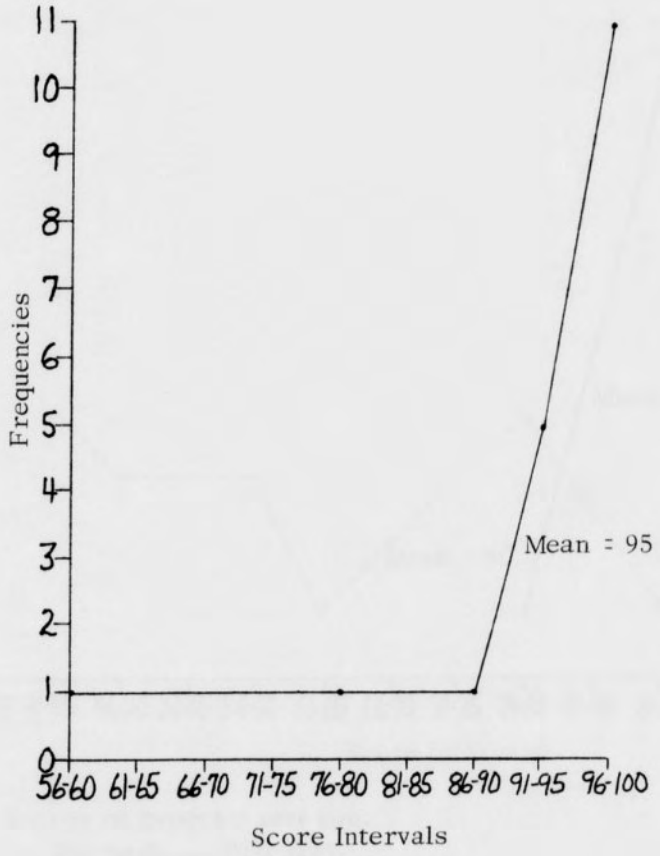


Figure 1. Scores on program test one.

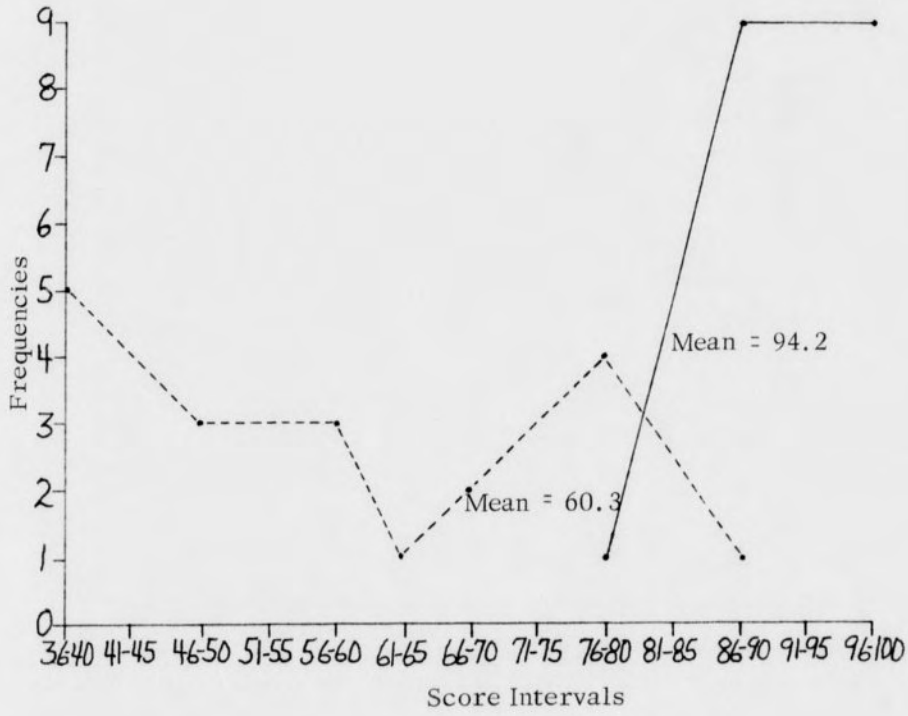


Figure 2. Scores on program test two.
--- Pre-test; —— Post-test.

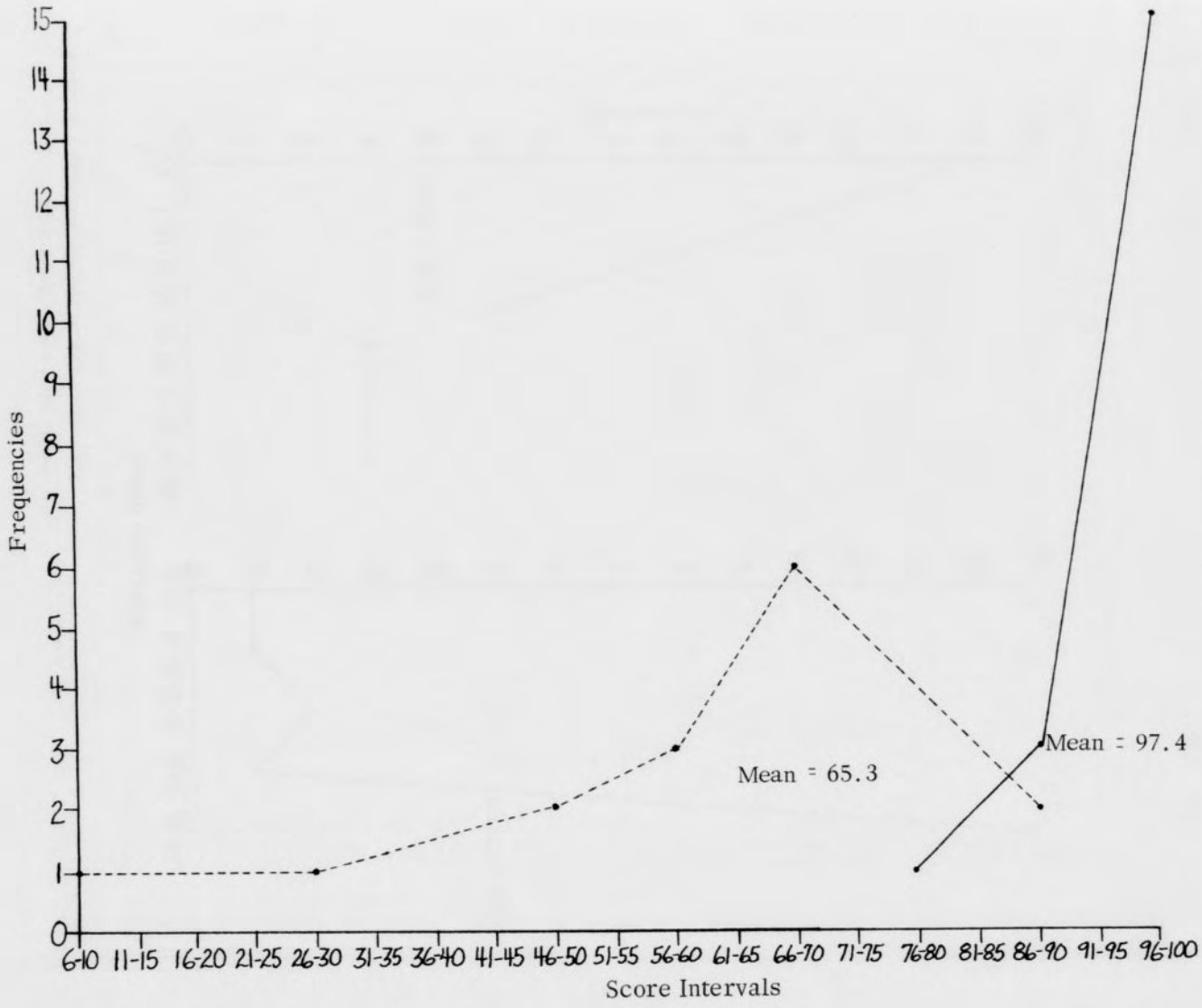


Figure 3. Scores on program test three. --- Pre-test; —— Post-test.

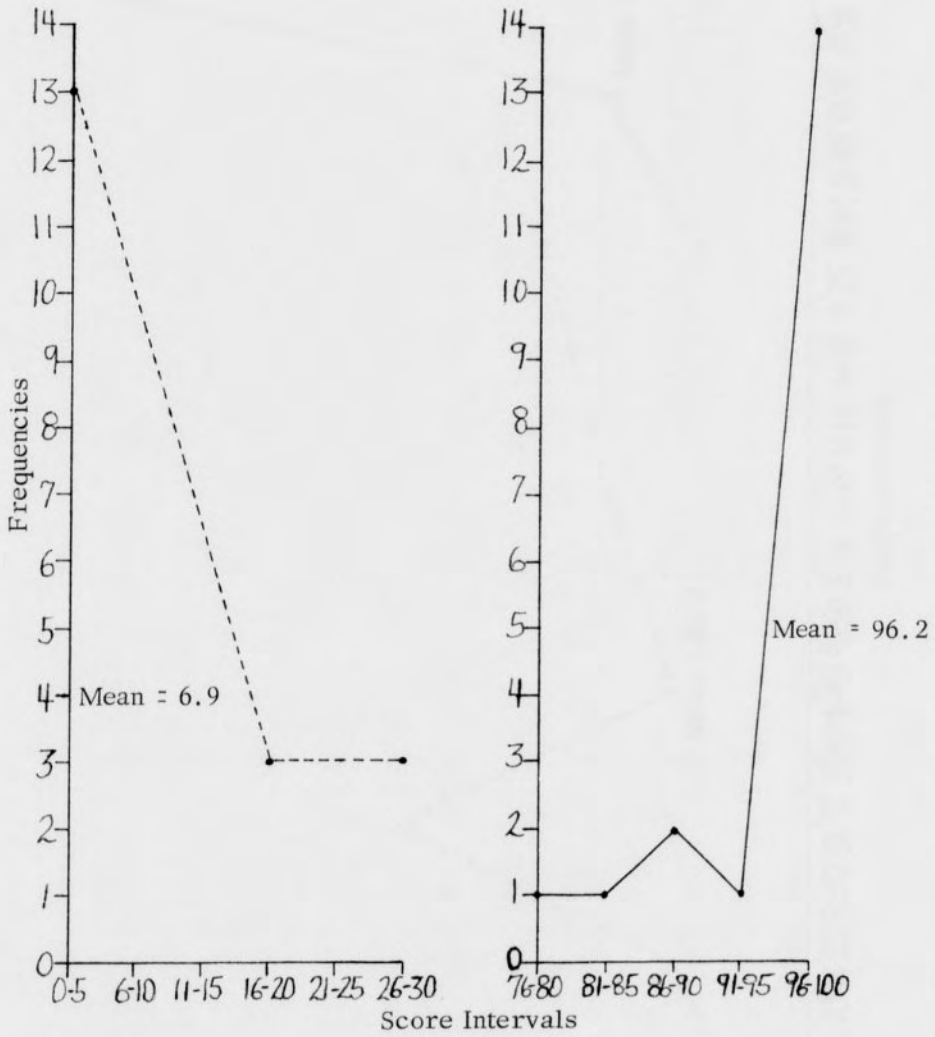


Figure 4. Scores on program test four.
--- Pre-test; —— Post-test.

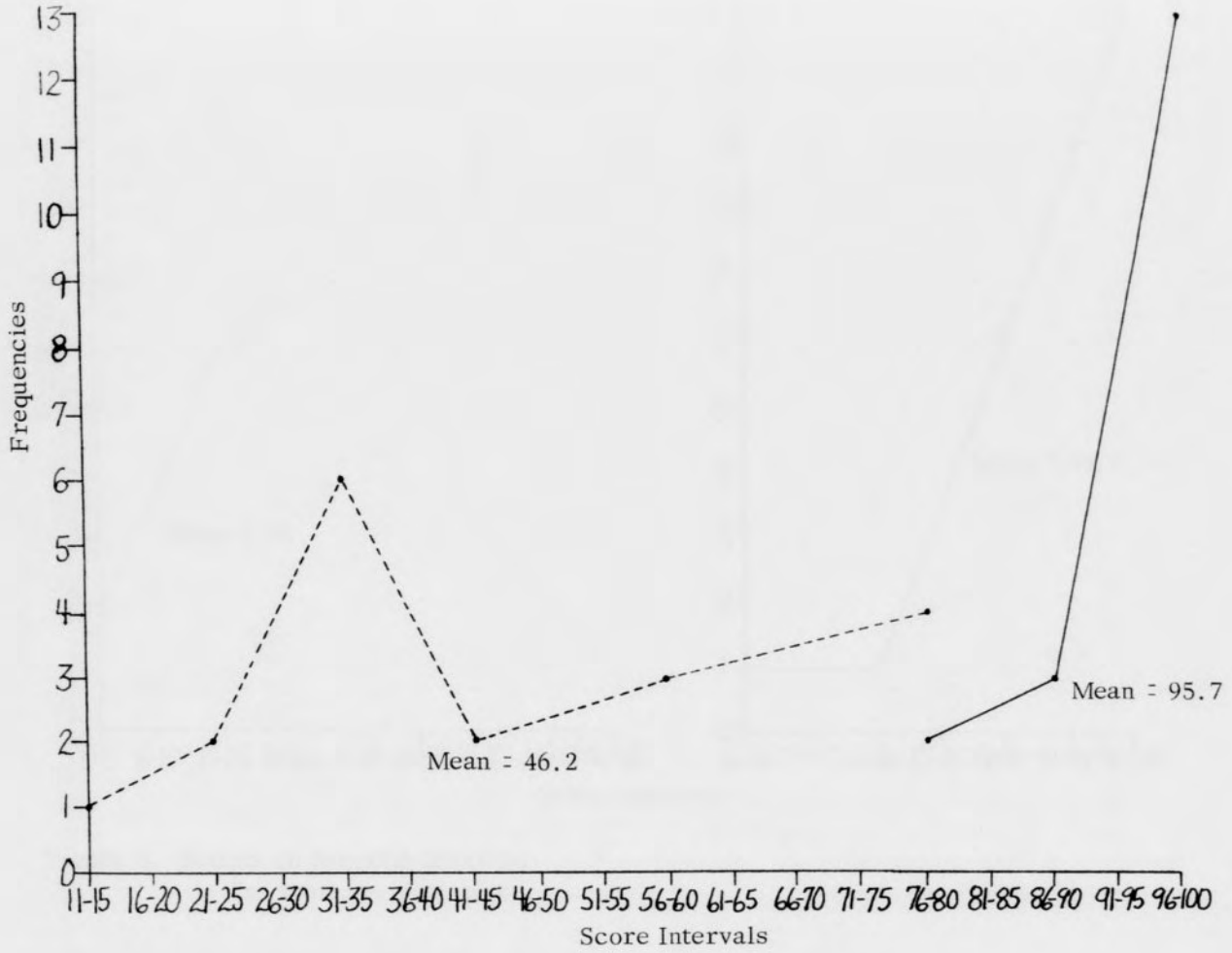


Figure 5. Scores on program test five.
--- Pre-test; —— Post-test.

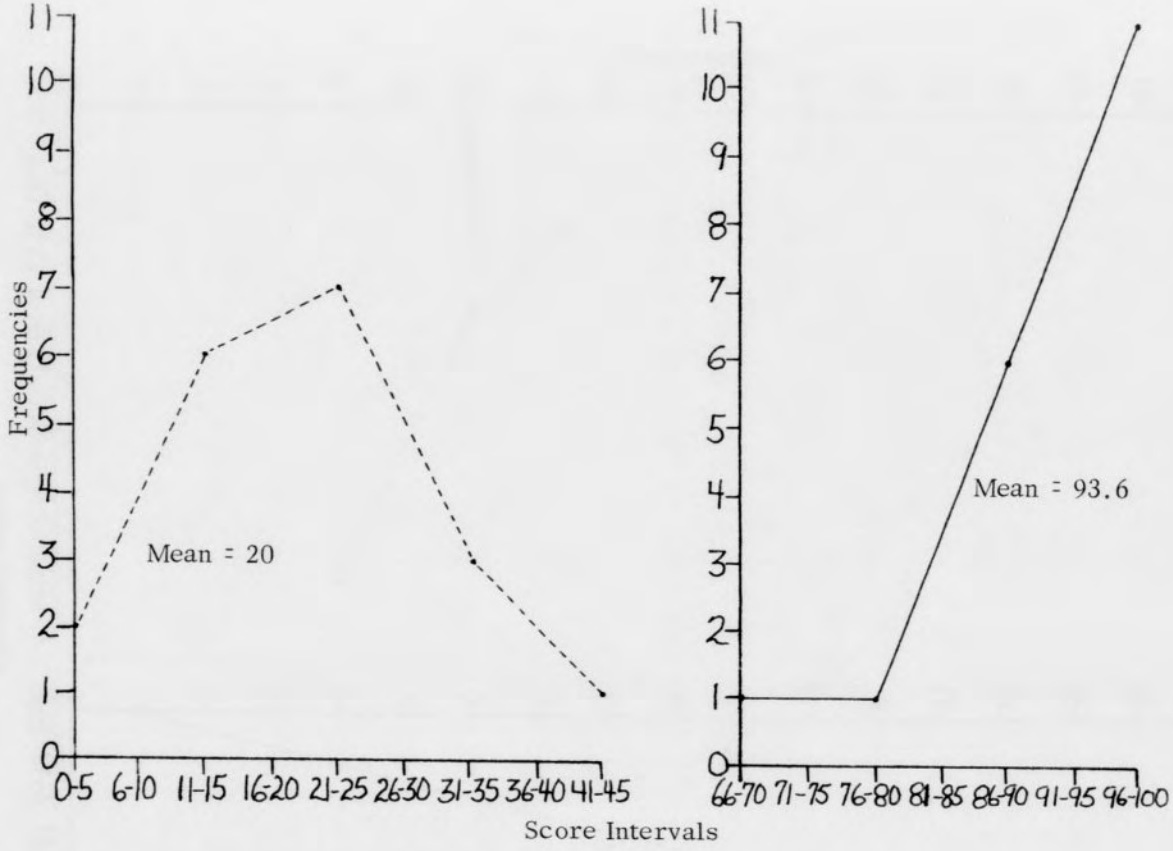


Figure 6. Scores on program test six.
--- Pre-test; —— Post-test.

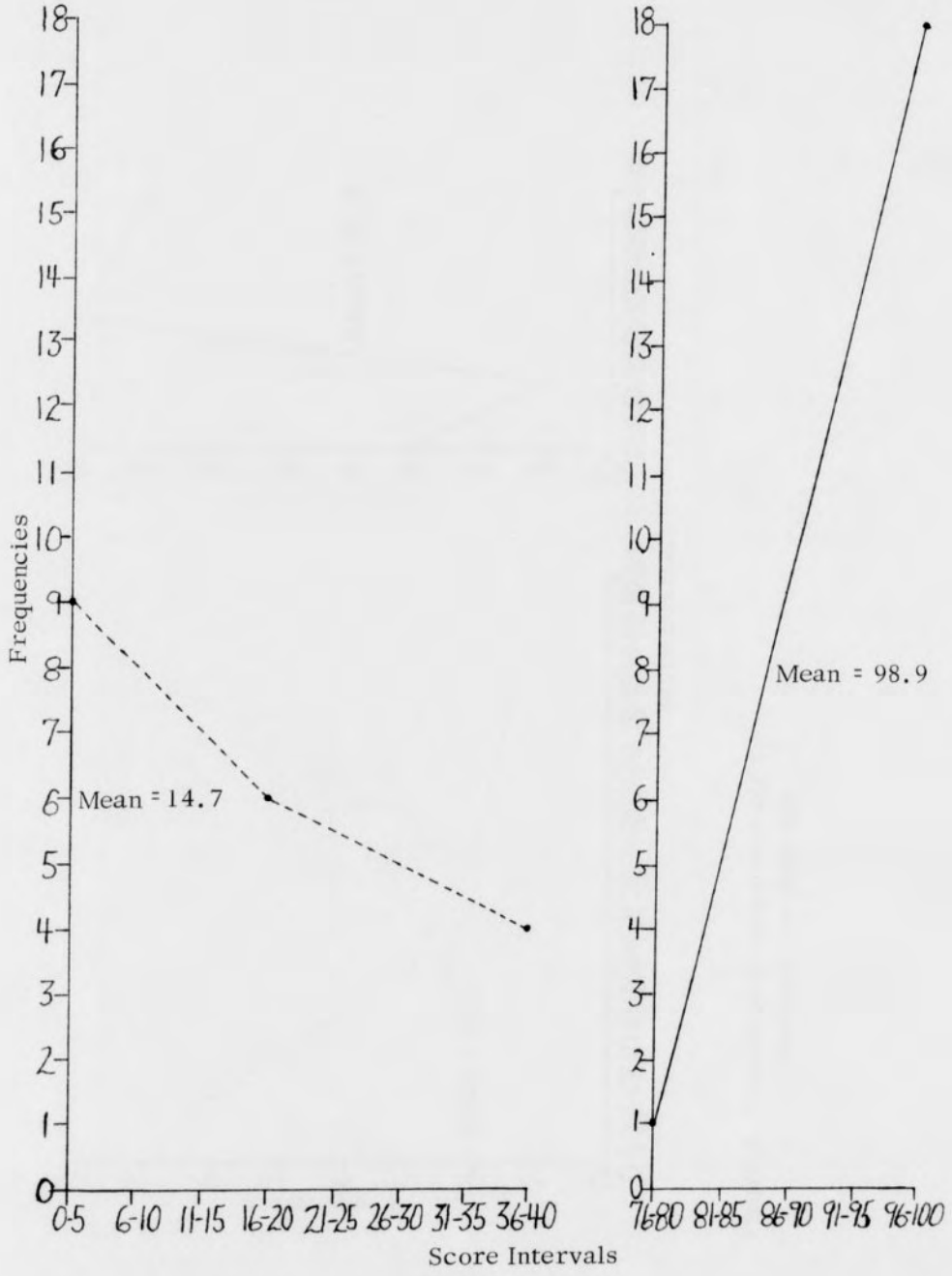


Figure 7. Scores on program test seven.
--- Pre-test; —— Post-test.

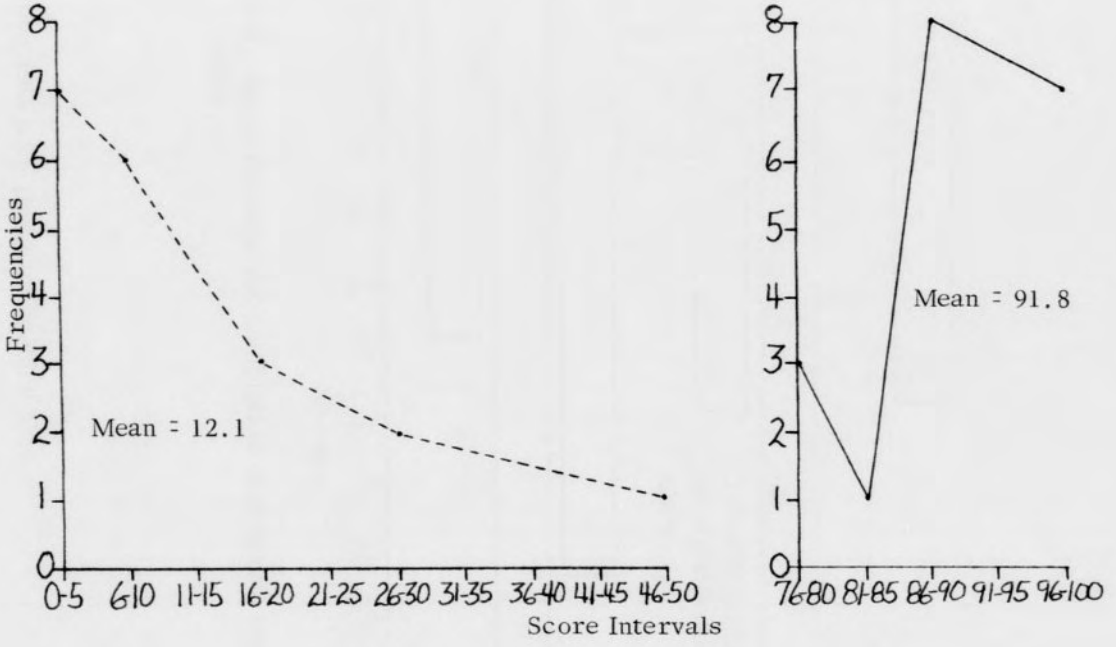


Figure 8. Scores on program test eight.
--- Pre-test; —— Post-test.

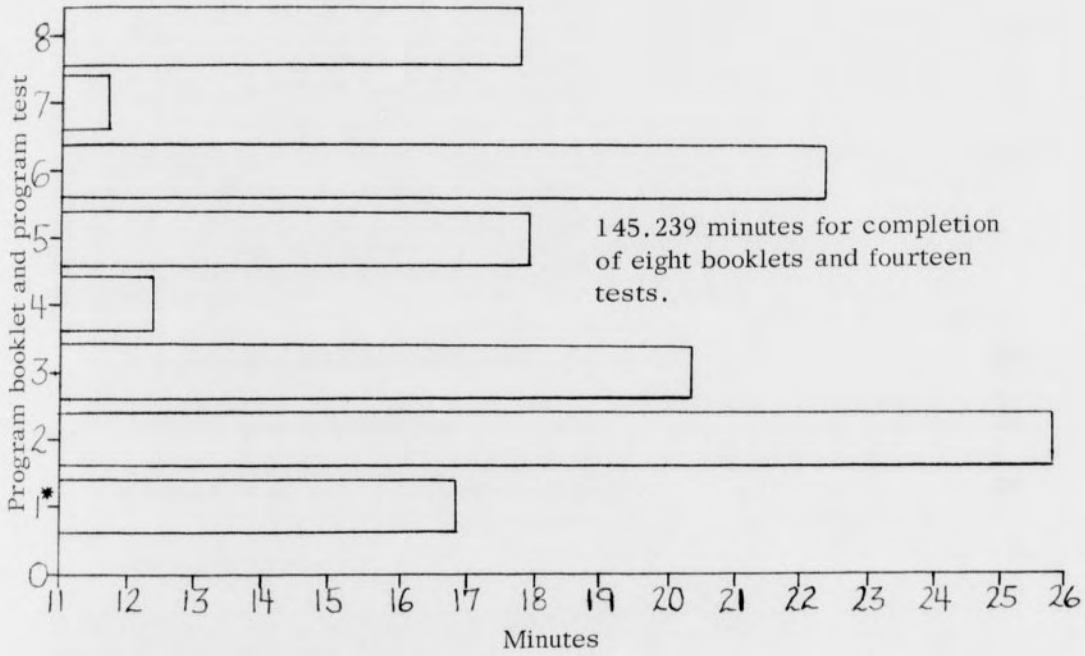


Figure 9. Mean minutes for completion of program booklets and program tests.

*One includes only program booklet time.

TABLE IV

QUESTIONNAIRE RESULTS*

Questions and Responses	Percentage
Did you like using programmed instruction?	
Yes	70
No	5
Undecided	25
If the instructor had taught the badminton rules without the use of programmed instruction, how would your knowledge have been affected?	
I would have learned more	25
I would have learned less	45
I would have learned the same amount	25
No response	5
Would you like to use programmed instruction in another physical education class?	
Yes	65
No	10
Undecided	20
No response	5

*Based upon the completion of twenty questionnaires.

TABLE IV (continued)

Questions and Responses	Percentage
If yes, when would you prefer to use it?	
During class time	60
Outside of class time	10
No response	30
What did you particularly like about programmed instruction?	
Important points repeated	85
Interest maintained	25
Able to proceed at own speed	60
Immediately informed of correctness or incorrectness of answers	75
Did not like anything	5
What did you particularly dislike about programmed instruction?	
Required to turn pages constantly	15
Boring, questions too easy	15
Too many written responses required	10
Did not dislike anything	40
No response	25

TABLE IV (continued)

Questions and Responses	Percentage
Typical Comments	
I like to be able to read about things, for I remember them better.	
I did not have to memorize consciously; I remembered more by repetition.	
Programmed instruction is good for the class since it practically forces the student to concentrate on the material at hand. Too often students don't listen attentively to all information in class.	
I would have profited more from programmed instruction if a review sheet had been given to me after the class studied singles and after the class studied badminton. It was easy to forget what the instructions had included, and I think that I would have learned more had the information been repeated more.	
Sometimes points were overemphasized.	
There was a little too much drill all at once.	
I always blundered through to hurry up and get through and absorbed only those questions where I had to repeatedly write long answers.	
My main dislike about the programmed instruction is the fact that it took up too much of the class playing time.	

Interpretation of Data

The Fisher's "t" test of the significance of difference between means on the forty-three question knowledge examination yielded a "t" that was significant at the 5% level of significance. The significant difference was in favor of the comparison group, the group having the lower mean. These data appear in Table III. The superior performance by the comparison group might be attributed to several factors:

1. It is possible that the two groups could have differed in knowledge prior to the study. The initial knowledge of subjects in both groups was considered equated on the basis of their previous badminton experience and enrollment in a beginning badminton class.
2. In using class time for the programmed instruction, it is possible that the experimental group received less activity time than the comparison group. As the programmed instruction pertained only to rules but the knowledge test covered history, equipment, strokes, strategy, and tactics as well as rules, it is logical to assume that the group with more practice time and application of knowledge would score better on the knowledge test.
3. Although every attempt was made to keep the instruction of the two groups identical except in regard to the presentation of rules, there is the possibility that an unintended difference emerged.

The significant difference in favor of the comparison group in regard to total knowledge conflicted with the findings reported by Barnes (2) following her

construction and experimentation with a volleyball program. Barnes found that on the Officiating Services Area Volleyball Examination, the students using the program evidenced performance superior to the students not using the program. However, it is to be remembered that Barnes' results were based upon a criterion test, and that both her program and the criterion test applied solely to DGWS Volleyball Rules. In this study, the results were based upon a retention test, and although the program pertained entirely to badminton rules, only eighteen of the forty-three questions on the retention test involved rules.

Although the mean number of rules questions missed by the experimental group was higher than the mean for the comparison group, the difference was not significant. This possibly indicates that the use of programmed instruction in presenting badminton rules was as effective in regard to final knowledge of rules as the use of the class presentation method.

The "t" tests of the significance of difference between means failed to show a significant difference between groups on either the initial or final administration of the Miller Wall Volley Test. This would appear to indicate that neither method of instruction was superior to the other in affecting final playing ability.

The "t" tests of the significance of difference between means conducted within each group to compare initial and final performances on the Miller Wall Volley Test were both significant at greater than the 1% level of significance. This difference could indicate improvement in badminton playing ability due to class instruction.

This investigation did support Evaul's (32) and Redd's (38) predictions that programmed instruction would allow effective division of classes with some students completing programs while others participated in activity. Three programs were administered after the experimental group had been divided into early and late sections. Each of these sections practiced badminton techniques while the other worked on the program. Knowledge and skill did not appear to be adversely affected. In the opinion of the author, this division of the class into two sections allowed greater time to be devoted to the individual student as well as to the singles game.

The results of this study tend to question Evaul's (32) and Redd's (38) predictions that a reduction in learning time would accompany the use of programmed instruction. The significant difference obtained on the forty-three question knowledge examination could possibly be attributed to the length of time--a total of approximately four class periods--taken from class instruction to complete the programmed work. It is also possible that learning time was not reduced because of the author's inexperience in working with programmed instruction. Additional studies, especially investigations utilizing programmed instruction outside of class time, may find a reduction in learning time as well as other advantages that may be associated with this method of instruction.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The purpose of this study was to determine the effect of a self-instructional program of badminton rules upon the knowledge and skill achieved by a group of beginning badminton players.

Thirty-six women enrolled in two beginning badminton sections at the University of North Carolina at Greensboro were subjects in this study. The subjects participated in two groups that were considered equated on the basis of initial badminton playing ability and previous badminton experience. The experimental group of nineteen subjects was taught the rules of badminton through programmed instruction; the comparison group of seventeen subjects was taught the rules through a class presentation method, the instructor presenting all material.

The two groups were instructed by the author. Classes met for thirty-five minutes twice each week for a total of thirty-one classes. The two classes followed an identical course procedure with the exception of rules presentation. All instruction in rules was presented to the experimental group by programmed instruction. During the semester these subjects completed the eight sections of a badminton rules program prepared by Dr. Gail M. Hennis, professor of physical education at the University of North Carolina at Greensboro.

The administration of the eight program booklets was characterized by (1) a pre-program test, (2) the program booklet, (3) a post-program test, and (4) a brief discussion of the program information. The administration of the first program booklet did not include a pre-program test, but the above procedure was followed for the remaining seven booklets. The program booklets in the order of their administration were: (1) Rules Governing Service, (2) General Rules Which Apply to Both Singles and Doubles Play, (3) Singles Game, (4) Singles Setting, (5) General Doubles Rules, (6) Doubles Scoring, (7) Doubles Setting, (8) Additional Rules Applying to Both Singles and Doubles.

The Miller Wall Volley Test was used as the measure of badminton playing ability. All subjects took the skill test during the third and fourth class periods. To the extent that the mean scores for the two groups did not differ significantly, the two groups were considered equated in skill. The final administration of the Miller Wall Volley Test, during the thirtieth class period, was used to determine badminton playing ability following one semester of instruction.

Initial badminton knowledge of the subjects was considered equated on the basis of enrollment in a beginning badminton class and previous badminton experience as indicated on an information card completed by the subjects. Final badminton knowledge was measured by a forty-three question knowledge examination completed during the scheduled final examination period. Knowledge of badminton rules was assessed by the eighteen questions on this examination that pertained to rules. Student opinion of programmed instruction as used in this

study was determined by a questionnaire completed by the experimental subjects following the final knowledge examination.

Fisher's "t" tests of the significance of difference between means were used to compare both initial and final playing ability of the two groups as measured by the Miller Wall Volley Test and to compare the change in playing ability within each group as indicated by the difference between the initial and final performances on the Miller Wall Volley Test.

Fisher's "t" test of the significance of difference between means was also used to compare the mean number of rules questions and the mean number of total questions missed on the final knowledge examination. Percentages were used to evaluate the questionnaire completed by the experimental subjects.

Statistical treatment of the data revealed no significant difference between groups in final playing ability and in final knowledge of rules. A significant difference was found on the final forty-three question knowledge examination indicating superior over-all badminton knowledge by the comparison group. Both the comparison and experimental groups evidenced significant improvement in playing ability. Seventy per cent of the experimental subjects indicated that they liked using programmed instruction while 65 per cent related that they would like to use it in another physical education class.

Within the limitations of this study, the following conclusions were drawn regarding the use of programmed instruction:

1. Programmed instruction was as effective as the class presentation method of instruction with respect to knowledge of badminton rules.

2. Badminton playing ability was not affected by the method of rules instruction.

3. Programmed instruction was not as effective as the class presentation method of instruction with respect to total badminton knowledge.

4. Students in the experimental group reacted favorably to the use of programmed instruction.

BIBLIOGRAPHY

BIBLIOGRAPHY

A. BOOKS

1. Ainsworth, Dorothy, and others. Individual Sports for Women. Third edition. Philadelphia: W. B. Saunders Company, 1955.

2. Barnes, Mildred J. Program in Self-Instruction for Officiating DGWS Volleyball Rules. Minneapolis: Burgess Publishing Company, 1965.

3. Barrow, Harold M., and Rosemary McGee. A Practical Approach to Measurement in Physical Education. Philadelphia: Lea & Febiger, 1964.

4. Bruce, J. S. "Applied Research on Programed Instruction at the Eastman Kodak Company," Programed Learning: A Critical Evaluation, J. L. Hughes, editor. Chicago: Educational Methods, Inc., 1963. Pp. 59-81.

5. Coulson, John E. (ed.). Programmed Learning and Computer-Based Instruction. New York: John Wiley and Sons, Inc., 1962.

6. Davidson, Kenneth R., and Lealand R. Gustavson. Winning Badminton. New York: The Ronald Press Company, 1964.

7. Deterline, William A. An Introduction to Programed Instruction. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1962.

8. Filep, Robert T. (ed.). Prospectives in Programing. New York: The Macmillan Company, 1963.

9. Fry, Edward B. Teaching Machines and Programmed Instruction An Introduction. New York: McGraw-Hill Book Company, Inc., 1963.

10. Gagné, Robert M., and Robert C. Bolles. "A Review of Factors in Learning Efficiency," Automatic Teaching: the State of the Art, Eugene Galanter, editor. New York: John Wiley and Sons, Inc., 1959. Pp. 13-53.

11. Green, Edward J. The Learning Process and Programmed Instruction. New York: Holt, Rinehart and Winston, Inc., 1962.

12. Holt, H. O. "An Exploratory Study of the Use of a Self-Instruction Program in Basic Electricity," Programed Learning: A Critical Evaluation, J. L. Hughes, editor. Chicago: Educational Methods, Inc., 1963. Pp. 15-39.

13. Hughes, John L. Programed Instruction for Schools and Industry. Chicago: Science Research Associates, Inc., 1962.

14. Johnson, Joan (ed.). Selected Tennis and Badminton Articles. Washington: American Association for Health, Physical Education, and Recreation, 1958.

15. Little, James Kenneth. "Results of Use of Machines for Testing and for Drill upon Learning in Educational Psychology," Teaching Machines and Programmed Learning a source book, A. A. Lumsdaine and Robert Glaser, editors. Washington: National Education Association, 1960. Pp. 59-65.

16. Lumsdaine, A. A. "Teaching Machines: An Introductory Overview," Teaching Machines and Programmed Learning a source book, A. A. Lumsdaine and Robert Glaser, editors. Washington: National Education Association, 1960. Pp. 5-22.

17. Lysaught, Jerome P., and Clarence M. Williams. A Guide to Programmed Instruction. New York: John Wiley and Sons, Inc., 1963.

18. Miller, Donna Mae, and Katherine L. Ley. Individual and Team Sports for Women. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1955.

19. Nicholson, Mary P., and Virginia R. Crafts. (editors). Tennis-Badminton Guide June 1964-June 1966. Washington: American Association for Health, Physical Education, and Recreation, 1964.

20. Penman, Kenneth A. Physical Education for College Students. St. Louis: The C. V. Mosby Company, 1964.

21. Peterson, J. C. "The Value of Guidance in Reading for Information," Teaching Machines and Programmed Learning a source book, A. A. Lumsdaine and Robert Glaser, editors. Washington: National Education Association, 1960. Pp. 52-58.

22. Porter, Douglas. "A Critical Review of a Portion of the Literature on Teaching Devices," Teaching Machines and Programmed Learning a source book, A. A. Lumsdaine and Robert Glaser, editors. Washington: National Education Association, 1960. Pp. 114-132.

23. Pressey, S. L. "A Simple Apparatus Which Gives Tests and Scores--and Teaches," Teaching Machines and Programmed Learning a source book, A. A. Lumsdaine and Robert Glaser, editors. Washington: National Education Association, 1960. Pp. 35-41.

24. Schramm, Wilbur. Programed Instruction, Today and Tomorrow. New York: Fund for the Advancement of Education, 1962.

25. Van Dalen, Deobold B. Understanding Educational Research: An Introduction. New York: McGraw-Hill Book Company, 1962.

B. PUBLICATIONS OF THE GOVERNMENT

26. Hanson, Lincoln F. (ed.). Programs, '63 A Guide to Programed Instructional Materials Available to Educators by September 1963. Office of Education, United States Department of Health, Education, and Welfare. Washington: Government Printing Office, 1963.

27. Schramm, Wilbur. The Research On Programed Instruction An Annotated Bibliography. Office of Education, United States Department of Health, Education, and Welfare. Washington: Government Printing Office, 1964.

C. PERIODICALS

28. Blyth, John W. "Teaching Machines and Human Beings," The Educational Record, 41:116-125, April, 1960.

29. Chambers, Barbara, and John M. Schulte. "An Evaluation of Programed Instruction," Education, 85:172-176, November, 1964.

30. Coulson, John E. "Programmed Instruction: Perspective," The Journal of Teacher Education, 24:372-378, December, 1963.

31. Cronbach, Lee J. "What Research Says About Programed Instruction," National Education Association Journal, 51:45-47, December, 1962.

32. Evaul, Thomas W. "The Automated Tutor," Journal of Health, Physical Education, and Recreation, 35:27, March, 1964.

33. Goldberg, Myles H., Robert I. Dawson, and Richard S. Barrett. "Comparison of Programed and Conventional Instruction Methods," Journal of Applied Psychology, 48:110-114, April, 1964.

34. Hughes, J. L., and W. J. McNamara. "A Comparative Study of Programed and Conventional Instruction in Industry," Journal of Applied Psychology, 45:225-231, August, 1961.

35. Klaus, David J. "The Art of Auto-Instructional Programming," Audio Visual Communication Review, 9:130-142, March-April, 1961.

36. Krumboltz, John D. "Needed Research in Programed Instruction," Educational Leadership, 21:30-33, October, 1963.

37. Miller, Frances A. "A Badminton Wall Volley Test," The Research Quarterly, 22:208-213, May, 1951.

38. Redd, John G. "Programmed Learning in Health and Physical Education," The Physical Educator, 20:174-175, December, 1963.

39. Rigney, Joseph W., and Edward B. Fry. "Current Teaching-Machine Programs and Programming Techniques," Audio Visual Communication Review, 9:7-33, May-June, 1961.

40. Silberman, Harry F. "Self-Teaching Devices and Programmed Materials," Review of Educational Research, 32:179-193, April, 1962.

41. Skinner, B. F. "Teaching Machines," Science, 128:969-977, October, 1958.

42. Skinner, B. F. "The Science of Learning and the Art of Teaching," Harvard Educational Review, 24:86-97, Spring, 1954.

D. UNPUBLISHED MATERIALS

43. Mizenko, Albert J., and Carroll M. Blanchard. "Comparison of Self-Tutor and Conventional Instruction in Direct Current Fundamentals." Fort Monmouth, New Jersey: United States Army Signal Center and School, [n.d.]. (Mimeographed).

44. Shields, Dorothy Ann. "Badminton Tests for College Women." Unpublished Master's thesis, The Woman's College of the University of North Carolina, Greensboro, North Carolina, 1952.

45. Woelfilin, Leslie E. "An Experimental Study on the Teaching of Clarinet Fingerings With Teaching Machines." Paper presented to the American Educational Research Association, Chicago, Illinois, February 13, 1963.

APPENDIX

SAMPLE INFORMATION CARD

Name

Classification Major

1. Previous badminton experience; estimate number of times.
   (Examples: backyard, recreation program)

2. Previous badminton instruction.
   (Examples: high school, college, camp)

3. Names of badminton strokes.

4. Estimation of present badminton ability.
   (Examples: beginner, intermediate)

INSTRUCTIONS FOR BADMINTON PROGRAMS

The self-instructional program which you will be using in this class should enable you to learn the rules governing badminton play with limited assistance from your instructor.

You will be working on your own and can, therefore, proceed as rapidly as you like. The program will not make sense unless you respond to each page before proceding to the next.

The concept, basic to programming, is that learning proceeds in small steps. Each step is called a frame. In each of the frames in the badminton program you will be asked to write a word or phrase. To determine whether your response is correct you merely turn a page and compare your answer to the one given there. If you should find that the response you have written is incorrect, reread the frame and find the correct response. You should not proceed until you have done this.

There will be several frames which present the same material in different ways. The purpose of this repetition is to be certain that you know the material when you have finished the program.

The program is NOT a test - it IS a learning situation!!

SAMPLE PROGRAM FRAMES***

Program cues:

* use more than one word in your answer

** express answer in your own words

\# the answer is a number

*** Singles Game, Frames 1-3.

---

1. We have learned that the singles service court is long and narrow. The same description applies to the singles playing court. It too is 1)_____ and 2)_____.

---

1) long (narrow)

2) narrow (long)

---

2. The boundaries of the singles court which is described as 1)_____ and 2)_____ are the side boundary and back boundary lines. The singles court is bounded by the 3)_____ and 4)_____ lines.

---

1) or 2) long (narrow)

1) or 2) narrow (long)

3) or 4) side boundary (back boundary)

3) or 4) back boundary (side boundary)

---

3. In singles a shuttlecock is out-of-bounds if it goes beyond the

*1)_____ or outside the

*2)_____.

---

1) back boundary line

2) side line

MILLER WALL VOLLEY TEST (37:210-211)

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.

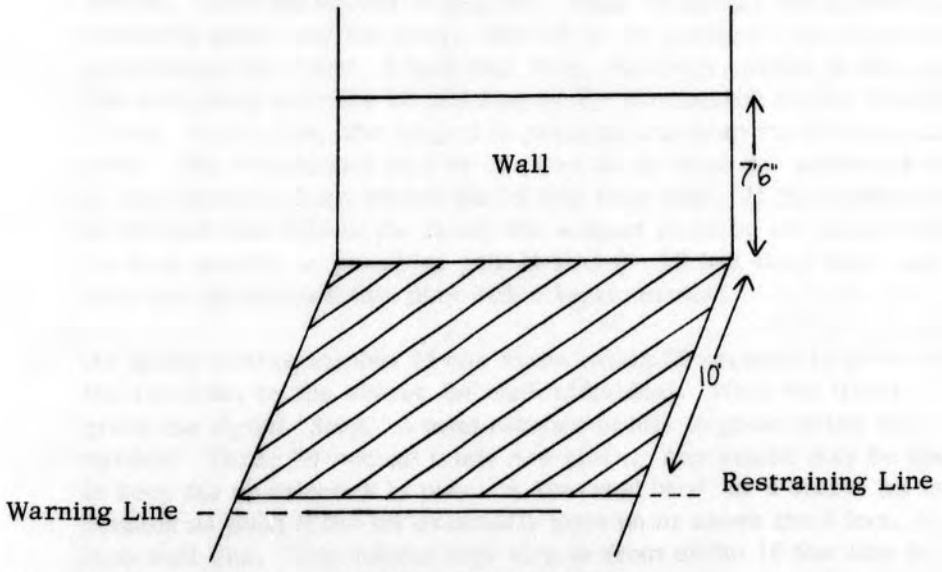


Figure 10. Floor markings for Miller Wall Volley Test.

* Pennsylvania 3 Penn Falcon Nylon Shuttlecocks were used in this study.

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 time 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 wall line. However, either in the case of the foot going over the 10 foot line or the shuttlecock hitting below the 7 foot, 6 inch line, the subject is permitted to keep the shuttlecock in play. 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.

PROGRAM TESTS

PROGRAM TEST ONE

RULES GOVERNING THE SERVICE

1. The server is standing in her left-hand court. Into which of the opponents' service courts will she serve?

2. What are the boundary lines of the service court in singles? (Name the lines or draw a court and shade in the correct area.)

3. Name three criteria for a legal serve.
   1.

   2.

   3.

4. If the server in attempting to serve completely misses the shuttlecock, is a service counted?

5. How may a server determine if his opponent was ready to receive his serve?

PROGRAM TEST TWO

GENERAL RULES WHICH APPLY TO BOTH SINGLES AND DOUBLES PLAY

1. What is a fault?

2. Is a shuttlecock landing on a boundary line considered in-bounds or out-of-bounds?

3. On a service, the shuttlecock touches the top of the net and lands in the correct service court. Has the server committed a fault?

4. Indicate which of the following are faults and which are legal. Use F for fault and L for legal.

   _____A. A player returns a shuttlecock that has gone out of bounds.

_____B. A player reaches over the net to strike the shuttlecock.

_____C. The shuttlecock hits the ceiling.

_____D. In executing a stroke, a player's hand continues over the net on the follow-through.

_____E. During a rally, the shuttlecock touches the top of the net.

_____F. A player attempts to return a shuttlecock that is going out-of-bounds. He misses the shuttlecock and it lands beyond the back boundary line. (Indicate whether this player has committed a fault or the play was legal.)

_____G. In executing a stroke, a player accidentally touches the net.

PROGRAM TEST THREE

SINGLES GAME

1. How many points are there in a game of ladies singles?

2. Who may earn points?

3. From which court is the first serve of a game delivered?

4. Whose score is given first when announcing the score?

5. In the following situations indicate: 1) Who will serve next, 2) From which court she will serve.

   A. Player D is serving from the right-hand court. Player E commits a fault.
      1)
      2)

   B. Player D has just won a point from player E. The score is now 9-8.
      1)
      2)

C. Player D served to player E. The score is 9-8. In the rally following the service, player D fails to return the shuttlecock over the net.
1)
2)

PROGRAM TEST FOUR

SINGLES SETTING

1. Name two instances in which a ladies singles game may be set.

2. Indicate the number of points the game may be set to in each instance.

3. How many total points must the winner earn in each instance?

4. After the game is set, what does the score become?

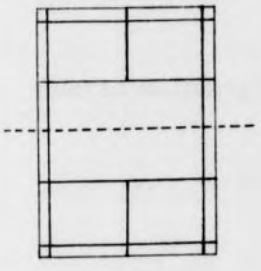
5. Who has the option of setting?

6. If a player does not choose to set at the first opportunity, may he at the second?

PROGRAM TEST FIVE

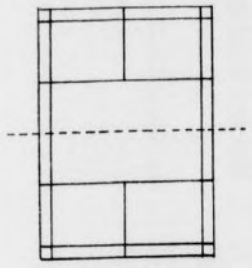
GENERAL DOUBLES RULES

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



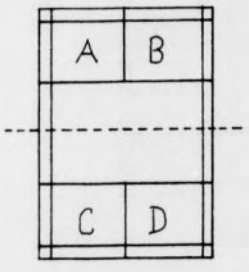
2. Name the boundary lines of the doubles service court.

3. Indicate the doubles playing court by shading in the correct area.



4. Name the boundary lines of the doubles playing court.

5. Player A is serving. Which player may attempt to return the serve?
   1. C
   2. D
   3. C or D



PROGRAM TEST SIX

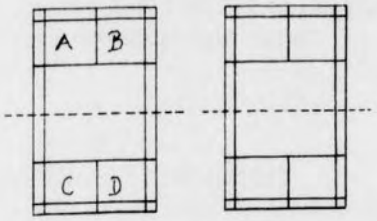
DOUBLES SCORING

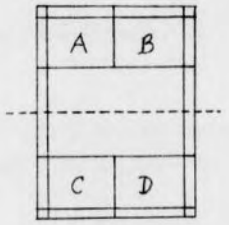
1. How many points are there in a game of ladies doubles?

2. What is a down?

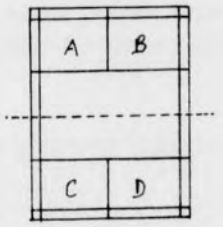
3. What is an inning?

4. Player A serves and earns a point. Indicate the positions of all four players on the next serve.



5. 

Player A serves first to start a doubles game. Which player will serve after A loses the serve?

6. 

The serve has just gone over the net to side CD. D serves and commits a fault. Which player will serve next?

7. What does a score of 6, 3, 1 mean?

8. How does one determine which side will serve first in the second game of a match?

9. With knowledge of the game score and the court in which one started the game, how can one determine from which court one should serve?

PROGRAM TEST SEVEN

DOUBLES SETTING

1. Name two instances in which a ladies doubles game may be set.

2. Indicate the number of points the game may be set to in each instance.

3. If the game is set at the first opportunity, how many additional points must the winning side earn?

PROGRAM TEST EIGHT

ADDITIONAL RULES APPLYING TO BOTH SINGLES AND DOUBLES

1. What is a match?

2. How many points must the leading scorer have when sides of the net are changed in a game of ladies singles?

3. How many points must the leading scorer have when sides of the net are changed in a game of ladies doubles?

4. What happens if players forget to change sides of the net?

5. If players forget to change sides of the net, is the score affected?

6. What provisions must be met for a let to be declared when a player has served from the wrong court?
   1.

   2.

7. What happens if these provisions are not met?
   1.

   2.

8. Name another situation in which a let may be called.

PROGRAMMED INSTRUCTION QUESTIONNAIRE

Directions: Complete the following questionnaire as carefully and honestly as possible. Check the statement that you feel applies to each question. Feel free to write your own statement if none of the others apply or if you care to clarify any statement. Do not sign your name. Your responses will not influence your badminton grade.

1. Did you like using programmed instruction?
   _____A. Yes
   _____B. No
   _____C. Undecided
   Additional comments:

2. If the instructor had taught the badminton rules without the use of programmed instruction, how would your knowledge have been affected?
   _____A. I would have learned more
   _____B. I would have learned less
   _____C. I would have learned the same amount
   Additional comments:

3. Would you like to use programmed instruction in another physical education class? Yes_____ No (indicate why)_____ Undecided_____

   If yes, when would you prefer to use it?
   _____A. During class time
   _____B. Outside of class time
   Additional comments:

4. What did you particularly like about programmed instruction? Check as many statements as apply.
   _____A. Important points repeated
   _____B. Interest maintained
   _____C. Able to proceed at own speed
   _____D. Immediately informed of correctness or incorrectness of answers
   _____E. Did not like anything
   Additional comments:

5. What did you particularly dislike about programmed instruction? Check as many statements as apply.

_____A. Required to turn pages constantly
_____B. Boring, questions too easy
_____C. Too many written responses required
_____D. Did not dislike anything
Additional comments:

BADMINTON COURSE OUTLINE

Comparison Group	Experimental Group
1*	1
Course Introduction Completion of Information Cards	Course Introduction Completion of Information Cards
2	2
History Equipment Grip Wrist Action	History Equipment Grip Wrist Action
3	3
Miller Wall Volley Test	Miller Wall Volley Test
4	4
Completion of Miller Wall Volley Test Explanation of Thesis Long, High Service	Completion of Miller Wall Volley Test Explanation of Thesis Introduction of Programmed Instruction Procedure Long, High Service
5	5
Distribution of Information Sheet Service Rules Long, High Service Practice Clear	Instruction Sheet for Programmed Instruction Program Booklet One - Rules Governing Service Post-Program Test Program Discussion Long, High Service Practice
6	6
Clear Practice Forehand Drive	Clear Forehand Drive
7	7
Clear Practice Backhand Drive Forehand and Backhand Drives	Clear Practice Forehand Drive Backhand Drive

* Refers to lesson number.

8	8
Drop	Backhand Drive
Short Service	Forehand and Backhand Drives
	Drop
9	9
Short Service	Drop
Long, High Service	Short Service
General Singles Rules	

Classes Split into Early and Late Sections

7:55-8:30; 8:20-8:55	9:10-9:45; 9:35-10:10
10	10
Stroke Practice Utilizing Patterns	Instruction Sheet for Programmed Instruction
Clear	Pre-Program Test
Drop	Program Booklet Two - General Rules Which Apply to Both Singles and Doubles Play
Short Service	Post-Program Test
Long, High Service	Program Discussion
	Stroke Practice
11	11
Long, High Service Practice	Stroke Practice Utilizing Patterns
Singles Scoring	Short Service
Singles Games	Long, High Service
	Clear
	Drop
12	12
Footwork	Pre-Program Test
Singles Scoring	Program Booklet Three - Singles Game
Clear - Drop Games	Post-Program Test
	Program Discussion
	Clear - Drop Games
13	13
Smash	Footwork
Singles Games	Smash
Assignment - Pattern Using Variety of Strokes and Placements	Singles Games
	Assignment - Pattern Using Variety of strokes and Placements

14
Smash Practice
Singles Games (Emphasizing Strategy Devised)
Assignment - Twenty-Five Consecutive Wall Volleys From Any Distance; To Be Completed Before End of Semester

15
Setting in Singles
Additional Strategy

16
Clear Practice
Clear - Drop Practice
Singles Games
Assignment - What Is a Ladder Tournament?

17
Hairpin
Singles Ladder Tournament

18
Ladder Tournament

19
Ladder Tournament

20
Ladder Tournament
Novelty Game

14
Smash Practice
Singles Games (Emphasizing Strategy Devised)
Assignment - Twenty-Five Consecutive Wall Volleys From Any Distance; To Be Completed Before End of Semester

15
Pre-Program Test
Program Booklet Four - Singles Setting
Post-Program Test
Program Discussion
Setting Practice
Additional Strategy

16
Clear Practice
Clear - Drop Practice
Singles Games
Assignment - What Is a Ladder Tournament?

17
Hairpin
Singles Ladder Tournament

18
Ladder Tournament

19
Ladder Tournament

20
Ladder Tournament
Novelty Game

Classes Again Meet As a Whole

21 Stroke Practice for Doubles Game Clear - Drop Smash Hairpin Short Service Side-by-Side Team Play	21 Stroke Practice for Doubles Game Clear - Drop Smash Hairpin Short Service
22 General Doubles Rules Diagonal Team Play	22 Pre-Program Test Program Booklet Five - General Doubles Rules Post-Program Test Program Discussion Side-by-Side Team Play
23 Systems of Team Play Doubles Strategy Diagonal Team Play Practice	23 Diagonal Team Play
24 Clear Practice Drop Practice Diagonal Team Play Practice	24 Systems of Team Play Doubles Strategy Diagonal Team Play Practice
25 Doubles Scoring Doubles Games	25 Pre-Program Test Program Booklet Six - Doubles Scoring Post-Program Test Program Discussion Scoring Practice
26 Doubles Games	26 Doubles Games
27 Setting in Doubles Doubles Consolation Tournament	27 Pre-Program Test Program Booklet Seven - Doubles Setting Post-Program Test

	Program Discussion Doubles Consolation Tournament
28 Additional Rules Applying To Both Singles and Doubles Consolation Tournament	28 Pre-Program Test Program Booklet Eight - Additional Rules Applying to Both Singles and Doubles Post-Program Test Program Discussion Consolation Tournament
29 Consolation Tournament Miller Wall Volley Test Procedure	29 Consolation Tournament Miller Wall Volley Test Procedure
30 Miller Wall Volley Test	30 Miller Wall Volley Test
31 Discussion of Miller Wall Volley Test Results Consolation Tournament	31 Discussion of Miller Wall Volley Test Results Consolation Tournament
32 Knowledge Examination	32 Knowledge Examination Questionnaire

TABLE V

RAW DATA FOR SKILL TESTS, KNOWLEDGE TESTS, AND ATTENDANCE

Subject Number	Miller Wall Volley Initial	Miller Wall Volley Final	Knowledge Exam Total Rules		Absences
Comparison Group					
1.	27.5	37.0	11	3	2
2.	16.5	37.7	9	3	1
3.	11.5	32.7	14	4	0
4.	19.0	28.8	7	4	3
5.	21.0	34.0	14	6	1
6.	15.5	25.2	5	2	1
7.	14.5	33.6	9	2	0
8.	12.0	20.0	8	1	1
9.	21.0	36.9	5	1	3
10.	28.0	64.2	6	2	0
11.	2.5	14.4	11	3	1
12.	11.0	25.3	11	4	3
13.	28.0	49.6	7	1	1
14.	30.5	30.4	7	3	2
15.	13.0	33.9	10	4	2
16.	33.0	39.0	12	5	3
17.	15.0	44.0	14	5	1
Experimental Group					
1.	17.5	37.6	14	4	1
2.	13.5	23.0	9	1	6
3.	22.0	59.0	15	7	2
4.	11.0	22.7	16	7	2
5.	19.5	18.5	23	9	3
6.	15.0	30.0	12	3	0
7.	18.5	34.0	13	3	0
8.	19.0	32.4	21	8	6
9.	17.5	23.0	9	4	0
10.	18.0	33.3	10	4	4
11.	18.0	53.5	7	1	3
12.	26.0	44.3	6	1	0

TABLE V (continued)

Subject Number	Miller Wall Volley Initial	Final	Knowledge Exam Total	Rules	Absences
13.	31.0	44.6	12	4	0
14.	33.5	41.7	17	10	3
15.	20.0	42.7	16	6	0
16.	0.0	26.7	13	6	4
17.	8.5	25.3	5	2	0
18.	26.5	55.7	7	1	0
19.	28.0	41.0	12	4	1