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A STUDY OF THE PROBLEM-SOLVING  
METHOD OF TEACHING BOWLING

by

Marilyn La Plante

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The purpose of this study was to determine the effect of the problem-solving method on skill development in bowling. It was the dual purpose to determine the effect of this method on attitude toward physical education.

Subjects were selected from three bowling service classes at the University of North Carolina at Greensboro on the basis of their past experience in bowling and totals of their first five games in bowling. Twenty-one subjects from two classes were used as the experimental group and twelve subjects from a third class served as the control group. The first five game totals were used as initial scores in bowling and scores from the Drinkwater Attitude Inventory were used as initial scores of attitude. The experimental group received thirty-one class periods of bowling instruction under the problem-solving method. The control group was taught for the same length of time by the control method which was based on the generally accepted methods of instruction in bowling. Final bowling scores were the totals of games nine to thirteen and final attitude scores were the scores on the attitude inventory which was readministered on the last day of class.

The data were treated statistically to determine if changes in bowling and attitude occurred within the groups from the beginning of the study to the end, to determine if there was a difference between the groups at the end of the study, and to determine the relationship between attitude and skill. Fisher's "t" formulae for correlated and uncorrelated small groups were used to test the differences between and within groups. The following results were obtained:

1. There was no significant difference between the groups in bowling or attitude at the conclusion of the study.

2. There was a significant difference between the initial and final bowling scores for both groups.

3. There was no significant difference in the change from the initial to the final bowling scores between the two groups.

4. There was no significant difference between the initial and final attitude scores for both groups.

5. There was a low positive relationship between attitude and skill at the beginning of the study.

6. There was no statistically significant relationship between attitude and skill at the completion of the study.

On the basis of these results, the following conclusions were made within the limitations of the study.

1. Both the problem-solving method and the control method result in favorable skill development in bowling as determined by game scores.

2. Neither method of instruction appears to be superior to the other in skill development in bowling.

3. Favorable attitude toward physical education is maintained under the problem-solving method of instruction.

4. The effectiveness of the problem-solving method appears to be in the students' interest and response to this method rather than in skill development.

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## CHAPTER I

### INTRODUCTION

In the early period of the American educational system, children were taught the knowledges necessary to get along in a rural society. This included a minimum of reading, writing, and arithmetic. This knowledge, plus what a man learned while managing his farm, was sufficient to master the problems that he met throughout life. His world was small, his problems limited, and his education adequate.

With the advances in science and technology, the world became larger, the problems more varied, and the education inadequate. It was inadequate only in the sense that within the twelve year program, it was impossible to teach all of the knowledges essential for getting along in the more complex society. The educational philosophy began to change. Instead of concentrating on the instruction of all knowledges, the emphasis was placed on teaching children basic knowledges and how to use them to solve problems they would encounter. In this way, even though a child did not learn all of the specific solutions, he still had a way of seeking satisfactory solutions.

As part of the educational system, physical education should also seek ways of implementing this philosophy. Too often physical educators attempt to teach everything ignoring the fact that it is impossible to teach all skills of all sports to all students. Physical educators should also educate children to solve future problems. They should

teach in a manner which encourages learning how to understand movement problems and how to find satisfactory movement solutions.

There is another element of this philosophy of "teaching for the future". Much of the academic subject matter is automatically practiced and used throughout normal living situations. However, physical education has within its area of knowledge a type of activity which requires voluntary participation. Participation in sports and recreation activities, although healthful, is easily avoided. One does not usually find that he must perform in a sport to live effectively in our society. He must, however, read and write to live effectively. Therefore, besides educating the students in a manner that will help them develop new skills after graduation, physical educators must also develop an interest in continuing participation in sports and recreation.

The swiftly moving social and economic developments of today constantly bring the American public face to face with the problems of health, successful group relationships, and the constructive use of leisure time. It is current educational philosophy that the schools must be concerned with educating the youth of America to more intelligently meet these problems. It is believed that this purpose will be accomplished more successfully if student objectives are satisfied and their needs and interests met in a way that is both pleasant and stimulating to the student. (32:387)

The problem facing physical educators is three-fold. First, they must teach enough skills to give students a background from which to draw. Second, they must teach students how to use this background in the solution of various movement problems. Third, they must develop the students' interest in using movement. To be most effective, a teacher must select a method that would accomplish all three purposes equally. One method which might satisfy these purposes is the problem-solving method. This concept dates back to Aristotle, but is generally credited to John Dewey. (24:362) The emphasis is on self-reliance,

initiative, and independent thinking. (24:363)

The first of the purposes could be met under any method because it is dependent on content more than on the method of teaching. Bruner (33) stated two benefits of the problem-solving method that would show the success of this method in accomplishing the second purpose. He felt that problem-solving would increase the intellectual potency of a student because he would learn to search out and find regularities and relationships in the environment rather than seek solutions in a haphazard fashion. (33:23) Secondly, Bruner felt that practice in problem-solving evolved into a style of solving problems that could be applied to most any problem. (33:31) The third purpose is harder to accomplish. There is no way for a teacher to be sure that the student will continue active participation in sports. About all that can be done is to attempt to create favorable attitudes toward physical education. With favorable attitudes toward, or an interest in physical activity, the tendency would be toward participation. Interest would increase participation; participation would increase proficiency; proficiency might increase interest; and so the circle goes. The problem-solving method could meet this third purpose through the stress on individual development. The student can progress as far as he can as fast as he can. It would seem that this approach would eliminate frustration that occurs when a slow student is required to keep up with the better student, or the better student must slow his progress for the poor student. As the student develops his skill at the most favorable rate for himself, it would seem that his interest in the activity might also develop.

Because this method (Problem-solving) takes its impetus from the point of students' needs, engenders and sustains student interests, emphasizing a high level of thinking, encourages student planning of course aims and objectives, emphasizes student participation and student responsibility for learning, and fosters self-development on the part of the student, problem-centered approaches may well become the best method to fulfill the purpose of American education. (31:204)

## CHAPTER II

### STATEMENT OF THE PROBLEM

#### I. THE PROBLEM

It was the purpose of this study to determine the effect of the problem-solving method of instruction on skill development in bowling. It was the dual purpose of this study to determine the effect of this method on attitude toward physical education.

#### II. DEFINITIONS

For the purpose of this study, the following definitions were accepted.

Problem-Solving Method. A method of teaching bowling in which the goals of skill development and knowledge of the game are attained by requiring students to solve specific problems set by the teacher.

Control Method. A method of teaching bowling in which the goals of skill development and knowledge of the game are attained by verbal presentation and demonstration with analysis and correction of errors made by the teacher for the student. This was consistent with the established practice of teaching as determined by the review of literature.

Problem-Solving. A process of devising some action through thinking and movement experimentation to reach an objective as defined by a problem.

Problem. The presentation of an objective requiring the discovery of an individual movement response which will add to the movement vocabulary of the student.

Attitude. "...a relatively constant tendency to act in a certain direction and in accord with certain mental patterns or beliefs. Attitude is the reflection of a mind set toward or against some object and is acquired by experiences." (3:12)

### III. LIMITATIONS

1. The data gained from this study had application limited to the subjects of this study because the sample was not a random sample.
2. The lesson plans for this study were created solely by the writer without the benefit of a jury.
3. The problem-solving lesson plans were never used or evaluated before their use in this study.

## CHAPTER III

### REVIEW OF LITERATURE

The review of related literature was centered on three major areas: problem-solving, attitudes, and bowling methodology. There was very little material on problem-solving as applied to physical education at the secondary or college levels. Therefore, to understand the elements and techniques of this method, literature about problem-solving as well as how it was related to physical education was reviewed. In an attempt to keep scientific facts and theories separate, the report of the review was divided into two sections: literature offering theories and ideas about the problem-solving method, and research in problem-solving. The study of attitudes was centered on the importance of attitude development within physical education. The review of bowling methodology was undertaken to determine the effect of changes in methods on skill development, and also to establish the control method of teaching.

#### I. LITERATURE RELATED TO THE PROBLEM-SOLVING METHOD

In the current literature, problem-solving was often defined, explained, or discussed in terms of general characteristics or elements of the method. Problem-solving involves devising some action through thinking to reach a goal which cannot be reached simply by action. (41:1)

The process of analysis of the situation includes understanding the

conflict, knowledge of available materials for solution, and an understanding of what the goal demands. (41:21-23) The individual then seeks solutions that appear to be useful in overcoming the problem. The final solution is found via processes which in themselves are problems and solutions. (41:9) The phases of this process of problem-solving have been named by several authors. Although the terminology is different and some stages more elaborate than others, basically the process is the same. Dewey's analysis was one of the earliest. He said the process took five phases: suggestion, intellectualization, hypothesis, reasoning, and testing the hypothesis. (12:107-113) Burack (34) gave a comprehensive list of the various elements of problem-solving. He included: the formulation of the problem, survey of the aspects of the problem, application of past experience for solution, analysis of major variables, location of the crucial aspect of the problem, trials of solutions, elimination of the solutions causing error, and finally, insight. He went on to say that the "method" chosen was defined by the kind of task presented as a problem. Johnson (50) combined several of the steps enumerated by Burack and divided the problem-solving method into only three processes: orienting, elaborating, and judging. (50:202)

The emphasis in problem-solving should be on the "...ability to find good problems; to make good hypotheses; to gather information expertly by reading, listening, observing, and experimenting; to make generalizations; and to use them to guide living." (14:14-15) The basis of this method is on pupil freedom, and self-reliance. It stresses the development of initiative and independent thinking. (24:363)



The teacher's role in this methodology was analyzed by several writers. First the teacher creates the problem situation and helps the students discuss the requirements of it. The problem must be within the understanding of the student and identifiable to him with a reasonable amount of effort. (17:430) Important learning problems are those in which solutions aid in the modification of behavior. (24:364) Through questioning, the teacher directs the students' attention to unrecognized solutions and errors. Teachers must be careful not to supply answers. An important part of the learning process occurs when weaknesses of certain solutions are shown to students. (6:439) The teacher helps the students analyze alternatives and determine probable consequences created by the solutions. (7, 8, 42, 48) Questioning is the common method of guidance in problem-solving. It can be used to stimulate reflective thinking, to develop understanding, to build new concepts, to develop the powers of evaluation, to focus attention on cause and effect relationships, and to create interest. (7:363-364)

There are difficulties associated with the problem-solving method. One of the more common of these is making a fixed methodology out of problem-solving and thereby destroying the creativity and critical evaluation of the individual. (48) Several limitations have been suggested in the use of the problem-solving approach. A student may not recognize as a problem the area chosen by the teacher to be the problem area. (30:46, 34:135) Therefore, much valuable time can be wasted in the analysis of the problem and the search for solutions. In the search, a student may not recall past experiences to apply toward a solution or perhaps not recognize their application to the present problem. Negative transfer can occur in problem-solving because the

student is unable to use past experiences in new and unusual situations. (63:68) In looking for the crucial aspect of the problem, the student may not recognize it until after a solution has been found. (34:135-137) Many times the trials of the solutions are too vague and the student is not effective in finding the real solution to the problem. (34:135-137, 30:48) The attitude of the student can also affect the success of this method. If the student is confident he is more able to find the solutions. However, those who are less confident in their ability are often less able to find solutions. (30:47) Some of the difficulty occurring in the use of the problem-solving method may be caused by the inexperience of the teacher in the use of this type of teaching. In this case, improvement may be slower. Whereas, under an experienced teacher, improvement in learning may be more apparent. (45)

## II. PHYSICAL EDUCATION LITERATURE RELATED TO THE PROBLEM-SOLVING METHOD

There was little information on the problem-solving method included in physical education literature. Kozman, Cassidy, and Jackson (19) gave a definition of the method and some guidance in its use. This material was general and not specifically related to learning physical activities. They included the following steps in the problem-solving process:

1. A felt difficulty defined
2. Seeking information about alternative solutions
3. Selecting a solution to be tried
4. Deciding what to do to move toward a solution
5. Acting to solve the problem
6. Resolution of the problem or another solution tried (19:70)

Throughout this process the teacher helps the student by directing him to sources of information and helping him apply knowledges and correct errors. (19:71)

Halsey (15) was in agreement with the steps suggested above, but related this method more specifically to teaching in physical education. She suggested elements of program development that are related to problem-solving. While it appears that most problem-solving is done at the elementary level through movement exploration, the method can be incorporated at the secondary and college levels also. She suggested that students can use this method to develop their own strategies and plays in the game situations. They can also discover new ways to perform on apparatus, in gymnastics, and in dance. Broer (4) stressed the same concepts and added that experimentation can enhance learning.

### III. RESEARCH RELATED TO THE PROBLEM-SOLVING METHOD

Most of the research into the use and effectiveness of the problem-solving approach has been done in the areas of psychology and education. Ray (61) tested two groups to determine the relationship between learning and two teaching methods-instruction and discovery. He found no difference in initial learning between the two groups, and no difference in initial retention. The results contradicted his stated hypothesis of no transfer. The group learning under the discovery method showed better transfer ability after six weeks. Although his hypothesis of no difference in initial retention was supported, he did find that the "discovery group" retained more after six weeks than did the "instructed group". A similar study was conducted by Craig, (37) to test the relationship of learning to directed or undirected learning

experiences. The undirected group searched for the principles involved in the solution of the problem. They were told the right answers only, and were instructed to continue working until the solution was reached. The directed group was first told the relationships and principles of the problem, and then were to find the answer. Craig found that the directed group was more effective than the undirected group.

Separate studies by Weaver and Madden (69) and Burack and Moos (35) were conducted to study whether existing relevant past experience would be quickly drawn upon to solve problems and if not, whether hints referring to such experience would lead to the solution. The conclusions showed that relevant past experience did not necessarily lead to the solution. Burack and Moos went on to state that neither verbal nor demonstrated hints necessarily helped. They also concluded that awareness of a principle does not necessarily lead to the solution of a problem. Weaver and Madden said that past experience plus direction during the problem-solving was most effective.

Harootunian and Tate (47) did research to discover the effect of certain variables on problem-solving. They tested the variables: problem recognition, word fluency, ideational fluency, closure, judgment, intelligence, and reading ability. They found the most important variables in problem-solving to be: reading, test intelligence, judgment, and problem recognition. The others contributed very little independently. When the variables were controlled statistically, a negative correlation between ideational fluency (ability to call up ideas when quantity not quality is required) and problem-solving was found.

Gagne and Smith (43) sought to determine the effect of verbalization on problem-solving. They found that the individuals who had to verbalize their formulated principles for solution of a puzzle were also the superior performers in problem-solving.

Corman (36) studied the effect on problem-solving when the amounts and kinds of guidance were varied. He found that the information used in guidance must be appropriate to the task set by the individual. The amount of information given does not necessarily improve problem-solving ability. The most helpful kind of information was explicit instruction.

Klugman (55) and Hudgins (49) worked independently on the effects of group solution on problem-solving. They both determined that the groups solved more problems correctly than did the individuals. Klugman found that it took longer due to the greater number of possible responses. Hudgins went further into the study to determine if group communication on the process of solution affected problem-solving. He found that the group in which the individuals worked independently on the steps toward solution, but had to agree on the final solution was more successful than the group in which the individuals had to agree on each step as well as on the solution. Thus, he concluded that group work increases achievement but not necessarily problem-solving ability.

#### IV. PHYSICAL EDUCATION RESEARCH RELATED TO THE PROBLEM-SOLVING METHOD

Only one study in physical education was found which was directly related to the use of the problem-solving method at the college level. This was a study by Garland (72) in which she tried to determine the effectiveness of the problem-solving method in learning swimming. She

used the problem-solving approach with one group and the traditional approach with the control group. In the experimental group, the investigator emphasized learning with three methods:

1. exploration--selecting the movement that "felt" efficient
2. observation--selecting the movement that "looked" efficient
3. reasoning--selecting the movement that "should be" efficient

The results of the experiment showed no significant difference in the two groups after the first skills test. The experimental group was slightly slower than the control group at the beginning, but was learning faster at the end of the study. The experimental group exhibited more relaxation and rhythm than the control group. The investigator learned through a student opinion poll that the problem-solving approach was enjoyable. The investigator concluded that; a) transfer in swimming occurred more easily when principles were generalized and discovered; b) critical thinking should include discriminations resulting from exploration; and c) problem-solving was more successful in motivation and self-direction.

#### V. RESEARCH RELATED TO ATTITUDE DEVELOPMENT IN PHYSICAL EDUCATION

Attitudes are an integral part of readiness thereby exerting a directive or inhibitory effect on learning. (5:371) As favorable attitudes toward learning develop, students work harder and learning behavior changes. (65) Therefore, the success of education varies with the feelings connected with thoughts. (23:217) Because of this influence, attitude development should be considered in the realm of educational concern.

In the introduction to research concerning attitude analysis, Keogh stated:

A primary goal of educational programs is to develop self-motivated and self-directed graduates. Thus, one of our most important concerns in school physical education programs is that students develop positive attitudes toward active participation in physical activity, which will lead them to seek further physical activity after leaving the organized school program. (52:239)

In another study, Keogh (53) determined that groups scoring high on an attitude inventory were physically active but that groups scoring low on the inventory were not particularly active and also felt that physical activity was not important. It seems important from this research that physical educators be concerned about attitude development along with skill development.

Kappes (51) developed an attitude inventory and administered it to 739 women at Baylor University. Examination of the data revealed a high correlation between enjoyment and estimated skill level. The study also indicated that attitude may be a more important factor in the desire for instruction than an individual's estimate of her skill level.

In a study by Bell and Walters (29), the significant positive relationship between attitude and enjoyment was upheld. They also found a positive relationship between an individual's attitude and his concept of the importance of physical activity as recreation. This supports Keogh's findings. However, contradictory evidence was revealed in a study by Baker (27). She concluded that psycho-physical factors exert very slight influence on participation. In other words, attitudes and feelings about participation do not regulate it as much as they reflect

the influence of other causes.

## VI. RESEARCH RELATED TO BOWLING METHODOLOGY

There have been several studies in methodology in teaching bowling. Some investigators concentrated on the effect of a total method of teaching on the skill development. Others studied the affect of changes in one phase of the teaching method, such as would be found in a study of various types of aim. Most of the investigators concluded that there was no significant difference in methods of presentation.

Barsanti (28) recommended a rhythmical approach to learning the bowling approach. In this method, comfort and rhythm were stressed, practiced, and refined. The approach and the swing were practiced first without the ball, then later with the ball. The investigator concluded that this approach was more natural and easier for the students to learn.

Walters (67) studied a perceptual approach which emphasized seeing the total picture of bowling in relation to a focal point. She used several teaching devices such as a repetitive action film, bowling in the dark at phosphorescent painted pins, use of softballs in the bowling pattern, diagonal directional lines on the alleys, mirrors and charts. The results showed no statistically significant difference, but the experimental group had fewer plateaus and higher mean scores.

Waterland (68) tried the kinesthetic approach as a method of teaching bowling. Her emphasis was on developing the feel for the correct range of movement, force, and direction. To do this, she had the subjects do some practicing with eyes closed trying to tell the



time of the ball, the score, and the direction of the ball before looking. The instructor checked each of these and informed subjects of their success or lack of success. This knowledge was then utilized in "feeling" the next practice. Some of the subjects then did mental practice which the investigator felt would improve kinesthetic awareness. The results of the study showed that the subjects who had the added emphasis on kinesthetic awareness by the use of mental practice had a greater improvement in the time it took for the ball to reach the pins, than did the subjects not engaged in mental practice. A second conclusion was that accuracy as determined by first ball averages was not significantly different between the two groups. However, the investigator felt that this was not a good measure of accuracy in bowling.

The effectiveness of mental practice was tested by Tufts (77). With a group of intermediate bowlers, she had one half of the group practice physically and the other half practice mentally. The mental practice group imagined themselves bowling and scoring a game on nine different occasions. Verbal cues, a filmstrip, and written cues were used to aid them in concentration on the skills. The results showed no significant difference in performance and accuracy between the two groups. The conclusion was that mental practice was as effective as physical practice.

Quite different from the other studies was one which concentrated on the analytical approach. The researcher analyzed the mechanics of the bowling techniques, then determined the mechanical principles that applied to these activities. The experimental group was then taught with the principles as a major portion of the learning experience.

The results showed no statistical difference and the conclusion was that the inclusion of the mechanical principles neither helped nor hindered the learning process. (75)

Hall (73) studied the effects of the whole method and the part method on learning bowling. In the part method, each skill was analyzed into small units and presented one unit at a time. In the whole method, the whole skill was presented, and practiced immediately with coaching hints given during the practice. She found no significant difference in the cumulative average of beginners taught with these two methods.

Hofland (74) compared learning curves of two classes taught by different methods. Class I started bowling from the center of the alley and then changed to cross alley bowling after the eighth lesson. Class II started with cross alley bowling and used it throughout the whole study. The investigator found a more regularly ascending curve and a higher class average as a result of using one type of bowling throughout the study.

Lockhart (57) tested the effectiveness of the use of a film as part of the teaching method. The control and experimental groups were taught in the same manner. The experimental group, however, was shown a film on techniques in addition to the lessons. The film was used in its entirety and in part on several occasions throughout the unit. She discovered the rate of improvement of the experimental group to be more consistent and the experimental group to be superior in skill. In another study, the use of the film was not found to be as effective. Church (70) combined teacher instruction and a filmstrip introduction with spot aim and a mechanical aid aim and tested the effectiveness of

the four combinations. The results of this study showed no difference in the four combinations of teaching method and aim as they affected skill development.

A mechanical aid was used in another study in which the investigators sought to determine the effectiveness of the Alley Spotting Target, a device designed to improve accuracy in spot bowling. The basic methods of teaching were the same, but the aid was included in the experimental group. As a result of a pilot study and an experimental study, the investigators questioned the use of the device, as they employed it in their study, because they found no significant difference in the final skill level of the control and experimental groups. (38)

Three investigators have studied the effects of varying types of delivery and aim. Summers (64) studied the effectiveness of variations in techniques of delivery and aim. She found spot bowling to be more effective for beginners. She also concluded that there was no real difference in the different combinations of straight or hook delivery with spot and head pin bowling. Hyde (56) made the same conclusion of no difference in her study of the V-hand position (which would cause the delivery of a hook) or the thumb-up hand position (which would cause the delivery of a straight ball) on the delivery. Goellner (44) disagreed with Summers. He concluded that head pin aiming was most effective for beginners, with a combined head pin and spot aim next in effectiveness, and spot aiming least effective.

## VII. LITERATURE RELATED TO TRADITIONAL METHODS OF BOWLING

Several resources were consulted to find the general content and methods generally used in the teaching of bowling. The first step was the introduction to the game which included the history and development of the sport, orientation to the equipment and facilities, safety, and etiquette. (1, 11, 20, 21, 25) The first skill to be taught was the arm swing. This skill was broken down into: grip, stance, and pendular swing. (1, 11, 20, 21, 25) Following this came the coordinated approach and delivery. Ainsworth and others (1) taught this skill in three steps. First they used the 1-step and slide, then the 3-step approach, and finally the 4-step approach. The other authors included only the 4-step approach. (11, 20, 21, 25) All authors used the straight ball delivery at the beginning level.

Scoring was taught before aim was introduced. Vannier and Poin-dexter (25) included only spot aiming at the beginner level. Other authors (11, 20) included both spot aiming and head pin aiming. Spare bowling was introduced as the last skill. (1, 20, 25) The authors varied from the general program only on minor areas. Ainsworth and others (1) included a discussion of deflection and angles before completing the presentation of the 4-step approach. Miller and Ley (20) included a discussion of the hook and back-up balls and special types of spares and splits toward the end of the unit.

The method of skill introduction followed by most authors was that of explanation, demonstration and mimetic practice. (1, 11, 20, 21, 25) This was followed by individual help. Ainsworth (1) emphasized a slow progression with much time for review. Raymer (21) stressed mass

practice with the instructor as the leader and all students following his rhythm and pattern of movement. The generally accepted method seemed to be characterized by teacher dominated lessons in which specific skills were introduced with emphasis on mastering correct form.

## CHAPTER IV

### PROCEDURES

#### I. PURPOSE OF THE STUDY

It was the purpose of this study to determine the effect of the problem-solving method of teaching on skill development in bowling. Secondly, it was the purpose to determine the effect of this method on attitudes toward physical education.

#### II. SELECTION OF SUBJECTS

The subjects for this study were selected from three bowling classes at the University of North Carolina at Greensboro. A questionnaire to determine experience in bowling was administered to the students enrolled in the three classes. Those students who had no previous instruction and had bowled five or fewer games in the past three years were classified as beginners and served as subjects for this study. The subjects were freshman and sophomore girls.

An attempt to randomly assign the subjects to the control and experimental groups was unsuccessful because too many of the subjects could not change into different sections. A second attempt at randomization was made by assigning students within one class to both conditions. With this plan, the experimental condition would have been applied for half the period and the control condition for the other half. Again, the attempt was unsuccessful because of lack of flexi-

bility in the subjects' schedules. Therefore, in an attempt to equalize the groups, the two classes with the smaller number of subjects served as the experimental classes. Combining these two groups of subjects gave nineteen subjects in the experimental group. The third class, which included fourteen subjects, was used as the control group. The experimental classes met from 8:00-9:00 A. M. on Tuesday and Thursday, and from 12:00-1:00 P. M. on Monday and Wednesday. The control class met from 9:00-10:00 A. M. on Tuesday and Thursday.

Initially, there were nineteen subjects in the experimental group and fourteen in the control group. One subject was dropped from the study because of more than three absences. Five subjects were dropped because they had bowled less than the thirteen games on which the groups were compared. It was noted in comparing the initial bowling scores, which were totals of the first five games, of the experimental and control groups that some of the students who stated on the questionnaire that they had had experience, and therefore were eliminated from the study, had scores that were lower than some subjects included in the study. A "t" test of the significance of difference showed that no difference would exist if the students with lower scores were added as subjects. Therefore, a "t" test of the significance of difference was calculated between groups composed of subjects with no experience plus all students with five game totals of less than five-hundred. Again, no difference existed between the control and the experimental groups at the time of the initial test. Therefore, the group of students offering the larger number of subjects was used. Students were not treated differently because they were subjects. All students were taught bowling by the experimental or the control method by virtue of

enrollment in the classes. Adding the additional subjects then did not destroy the validity of the study. The final number of subjects included in the study was: twenty-one in the experimental group and twelve in the control group.

### III. METHOD OF INSTRUCTION

#### General Method

The study was conducted during the second semester of the academic year, 1964-1965. Classes met twice a week for a total of thirty-one classes. The odd number was due to the semester beginning and ending in the middle of the week. The study was interrupted by spring vacation, but this did not reduce the number of class periods. The first, second and thirty-first classes were thirty-five minutes in length. All others were thirty minutes in length. All classes were taught by the investigator.

During the first class period, the Drinkwater Attitude Inventory (71) was administered. The questionnaire to determine past experience in bowling was also given to the students. After the second class period, classes were divided so half of the group would come for the first thirty minutes and the other half would come for the last thirty minutes of the hour. This was done to allow more activity time for each subject during the semester. The classes were taught the skills of a beginning bowling unit according to the problem-solving method or the control method. The two groups met together for the last class period and the attitude inventory was readministered. An evaluation questionnaire was given to the experimental group only to determine interest in and reaction to the problem-solving method.



### Problem-Solving Method

In the first class period an orientation to the problem-solving method was given. The subjects were told the possible benefits of learning under this method, their responsibility in this type of learning situation, and the relationship of the teacher to the students in this method.

All skills were presented in the form of problems to be solved by the subjects. (See Appendix) No demonstration or explanation of the skill patterns was used. Instead, the subjects were given time to develop individual patterns. They were encouraged to find patterns that were efficient and effective. It was efficient if there was no unnecessary strain in the performance of the skill and if balance could be maintained throughout the performance. It was effective if the goal established by the problem was accomplished. Any pattern that developed that satisfied the criteria of the particular problem and was efficient was acceptable. For example, when the aiming process was introduced, the students observed the action of the pins as the teacher rolled several balls with different points of contact. The class then discussed the effect of the point of contact on downing the pins and the relationship of aim to the point of contact. The students were then given the problem to develop a point of aim for a strike that utilized most effectively what they had discovered about pin and ball action. When the students began to work toward their solutions to the problem, they were allowed to develop individual patterns. With this particular problem, the points of aim varied from the 1-2 pocket to the 1-3 pocket, regardless of handedness. Even though the point of aim varied

from the generally accepted pocket aim, if the student found success with it she was encouraged to perfect it. If, however, the student did not find success with her aim, the teacher through questioning helped her re-evaluate the relationship of contact, action, and aim and develop a more effective movement pattern.

After a problem had been introduced and the class had worked on the solution to it, the students discussed the problem and possible solutions. This time was used to establish reasons for the success of some movement patterns and the relationships of the various skills. The rest of the available class time was devoted to practicing the individual patterns. During this time, individual help was given in the form of questions. The instructor allowed a student to make errors several times before she offered any direction through questioning. This was done to allow the student time to detect the error and begin to analyze her movement pattern in order to correct it. It was found that if the teacher intervened too quickly, even though it was in the form of questioning and not direct help, the error was pinpointed and the student had not had to solve any problems. However, if the same error occurred several times and there was no sign of change, the teacher directed some questions to the student to help her discover the cause of the error and develop a solution which would be more successful.

Smaller problems or redefinitions of problems were given to students having more difficulty with skill patterns. For example, one student had much difficulty developing a smooth approach and quiet delivery as defined by the problem in the third lesson. The smaller problem given to the student was to make a quiet delivery. The approach

was eliminated in order to give the student an opportunity to direct her concentration to only one aspect of the total approach and delivery.

#### Control Method

The order of skill presentation was the result of a compilation of several sources of bowling lesson plans. The subjects were taught the four-step approach with a straight ball delivery and spot aiming. Following the practice of these skills, spare bowling was introduced. Spot aiming and cross-alley bowling were taught with this skill. The skills and progression followed were those generally recommended by sources reviewed. All skills were verbally introduced and demonstrated by the instructor. After the introduction, the students were required to conform to the generally accepted skill patterns. During the practice period, the instructor gave individual help by analyzing errors and explaining the correction to the student. The student then attempted to incorporate the correction into her skill pattern. Lesson plans can be found in the Appendix.

#### IV. METHOD OF EVALUATION

##### Initial Evaluation

To determine the attitude of the students toward physical education before the application of the conditions of the experiment, Form A of the Drinkwater Attitude Inventory (See Appendix) was administered. This Inventory was used because it was designed to measure the attitude of college women toward physical education. Secondly, it was readily available to the investigator. The inventory consisted of fifty-eight statements about the value of physical education. The subject was asked

to react to each statement in one of the following ways: strongly agree, agree, undecided, disagree, and strongly disagree. The subjects were assured that the results of the Inventory would not influence grades in Physical Education. The subjects were asked to answer as honestly as possible. In scoring the Inventory, five points were given for the ideal reaction and one point was given for the opposite reaction. Four, three, and two points were given for the intermediate reactions.

A questionnaire (See Appendix) was administered to determine each subject's bowling experience. It was also used to discover the schedule flexibility for randomization purposes.

The initial bowling skill evaluation was determined by the total of the first five games. The initial scores were collected by the tenth lesson. No attempt was made to collect scores for the five games prior to the introduction of the experimental condition because it was felt that this would have given an advantage to the experimental group. To bowl five games, beginners would have had to use some trial and error methods and this is the basis of the problem-solving approach.

#### Final Evaluation

The Drinkwater Attitude Inventory was administered again to determine if there had been a change of attitude during the semester. A questionnaire was administered to the experimental group to determine personal reactions to the problem-solving method. The questions asked were: 1) Could you see any difference in the problem-solving method that you had not found in other methods of learning skills?; 2) Were there any aspects of this method of teaching that you did not like?; and 3) Were there any aspects of this method that you particularly

enjoyed?

Final skill evaluation was based on the total of the final five games. Some subjects bowled more games than others. However, the games used to compute the final score were games nine to thirteen.

## V. STATISTICAL TREATMENT

### Bowling Scores

Scores of the initial five games of bowling for each subject were totaled and arranged alphabetically by group. Scores of games nine to thirteen were also totaled and arranged in the same manner. Means and standard deviations for each group for initial scores and final scores were computed.

A test of the significance of difference using Fisher's "t" formula for small uncorrelated groups was computed with the means of the initial bowling scores to determine whether or not the groups were similar at the beginning of the study. The same procedure was followed for the attitude scores. On the basis of these "t" values, which indicated no difference, it was determined that Fisher's "t" tests of the significance of difference could be used throughout the final evaluations.

A test of the significance of difference using Fisher's "t" formula for small uncorrelated groups was computed to determine if there was a significant difference in the means of the final scores for both groups. Fisher's "t" formula for correlated means of a small group was used to determine if there was a significant change within each group from the time of the initial collection of scores in bowling to the collection of the final scores. Finally, a test of the significance

of difference using the first formula was computed to determine if there was a difference between groups in the mean change from initial scores to final scores.

The Attitude Inventory scores were arranged alphabetically by group. Means and standard deviations for each group were computed for the initial and final tests. A test of the significance of difference using Fisher's "t" formula for small correlated groups was computed to determine if the attitude at the completion of the study was different from that at the beginning of the study within each group. A Fisher's "t" was also computed between groups using the formula for small uncorrelated groups to determine if the groups differed in the final measure of attitude.

Initial attitude scores were correlated with initial bowling scores to determine the relationship at the beginning of the study. Final attitude scores and final bowling scores were correlated to determine the relationship at the completion of the study. The Pearson Product Moment formula for correlation was used.

## CHAPTER V

### ANALYSIS OF DATA

The purpose of this study was to determine the effect of the problem-solving method on skill development in bowling. Secondly, it was the purpose to determine the effect of this method on attitude toward physical education.

Tests of significance using Fisher's "t" formula for uncorrelated means, shown in Table I, showed that at the time of the collection of scores for initial bowling skill and attitude, there was no difference between the experimental and control groups. The initial bowling score was the total of the first five games bowled. The initial attitude score was the score made on the first administration of the attitude inventory. Fisher's "t" formula for uncorrelated means was used to compute all tests of significance between groups. The formula is:

$$t = \frac{M_1 - M_2}{\sqrt{\left[ \frac{\sum x_1^2 + \sum x_2^2}{(N_1 + N_2 - 2)} \right] \left( \frac{1}{N_1} + \frac{1}{N_2} \right)}}$$

Fisher's formula for the "t" test of the significance of difference between correlated means was used to examine data within groups. The formula is:

$$t = \frac{\bar{D}}{\sqrt{\sum d^2 / [N(N-1)]}} \quad (78:320)$$

TABLE I

SIGNIFICANCE OF DIFFERENCE BETWEEN MEANS IN INITIAL  
SCORES FOR EXPERIMENTAL AND CONTROL GROUPS

Group	N	R	M	S.D.	"t"*
Bowling					
Experimental	21	239-520	417.86	62.16	.3233
Control	12	356-473	424.42	36.93	
Attitude					
Experimental	21	208-274	228.29	14.19	.3027
Control	12	209-248	226.75	12.46	

\*Criterion "t" significant at the 1% level of confidence=2.75



Table II shows means and standard deviations which were computed for both groups from final bowling scores which were totals of games nine to thirteen. The means of both groups increased, but when a test of the significance of difference was applied, using the means of the final scores of the two groups, it was found that there was no significant difference between the two groups at the time of the final collection of scores. The "t" value was .1312 and 2.75 was needed to signify a change significant at the 1% level of confidence.

A "t" was then computed within each group to determine if there was a significant change from the time of the collection of the initial scores to the time of the collection of the final scores. The "t" value computed from the scores of the experimental group was 6.88 which was significant at better than the 1% level of confidence. A value of 3.67 was found for the control group. This, too, was significant at better than the 1% level of confidence. These data are shown in Table III. Both "t" values indicated an improvement from the first of the study to the end of the study in both groups. This suggested that both methods of teaching were apparently equally effective in terms of improving the skill level in bowling. The result might have been different if the initial bowling scores could have been collected prior to the beginning of the teaching. Within the ten lesson period during which the scores were collected, most of the teaching of skills was done. During this time, practice and the acquisition of new skills might have caused some improvement in the skill level of the subjects. It was possible that the differences between the initial bowling scores and the final bowling scores were not true indications of the amount of improvement from the beginning to the end of the course in bowling.

TABLE II

SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF FINAL  
BOWLING SCORES FOR EXPERIMENTAL AND CONTROL GROUPS

Group	N	R	M	S.D.	"t"*
Experimental	21	363-590	494.71	57.04	.1312
Control	12	416-580	497.5	56.57	

\*Criterion "t" significant at the 1% level of confidence=2.75

TABLE III

SIGNIFICANCE OF DIFFERENCE OF CHANGE FROM  
INITIAL TO FINAL BOWLING SCORES WITHIN  
THE EXPERIMENTAL AND CONTROL GROUPS

Group	N	R	M	S.D.	$\bar{D}$	"t"
Experimental	21					
Initial		239-520	417.86	62.16		
Final		363-590	494.71	57.04	82.09	6.88**
Control	12					
Initial		356-473	424.42	36.93		
Final		416-580	497.5	56.57	73.08	3.67**

\*Criterion "t" significant at the 1% level of confidence=2.75

\*\*Significant at better than the 1% level of confidence.

Finally, Table IV shows the "t" value which was used to determine if there was a significant difference in the mean changes from initial scores to final scores between the two groups. However, a value of .414 indicated that there was no significant difference in the change. These findings supported Ray's (61) conclusions. His study dealt with the effect of the problem-solving method on transfer. However, he found at the end of his study that there was no difference between the "discovery" group and the "directed" group. Both groups showed an increase from the beginning of the study to the end. The difference between the two groups became apparent through a test of retention after a period of six weeks.

Garland's (72) study of the problem-solving method and learning of skills was also supported by these results. She, too, found no statistical difference between the experimental and control groups at the completion of the study. One of her conclusions was that transfer of learning from one swimming skill to another was easier under the discovery method. This was not apparent in this study perhaps because there are fewer opportunities in bowling for transfer to occur.

The results of the present study were in agreement with the results found in other bowling methods studies. The problem-solving method stressed comfort as did Barzanti's (28) rhythmical approach, and analysis as did Kearn's (75) analytical approach. Since these two studies showed no statistical difference between experimental and control methods at the completion of the study, it would be expected that the problem-solving method should cause improvement, but not greater than the control method. The use of several aiming and delivery methods evolved from the problem-solving method. There have not

TABLE IV

SIGNIFICANCE OF DIFFERENCE OF MEAN CHANGES FROM  
INITIAL TO FINAL BOWLING SCORES BETWEEN  
EXPERIMENTAL AND CONTROL GROUPS

Group	$\bar{D}$	"t"*
Experimental	82.09	.414
Control	73.08	

\*Criterion "t" significant at the 1% level of confidence=2.75

been consistent research results to show one best method of aiming or delivery. Therefore, the variety within the problem-solving method should not have affected the results, as in fact, it did not.

The questionnaire brought out some points that help to explain the results and interpret the worth of the problem-solving method. Several of the students stated that they felt lost at first and did not know what they were expected to do during the first few lessons. This could have put the experimental group behind the control group in terms of learning rate. Others felt that under the problem-solving method it took a longer time to learn skills. This element was pointed out in an article by Gross. (45) He believed that improvement was slower at first, but as the teacher and students became accustomed to the problem-solving method, improvement increased. This might indicate that if the final score had been based on more games, the improvement of the experimental group could have been greater.

In answer to the question about why the student enjoyed this method, many felt that it was more challenging to discover one's mistakes and correct them. Several commented that they learned better and they thought that the learning would be more lasting. It would appear from the point of introspective analysis by the subjects, that the problem-solving method was beneficial to the student beyond the attainment of skill.

## II. ATTITUDE

Means and standard deviations for final scores on the attitude inventory were computed for both groups. There were fifty-eight questions. A perfect score would have resulted from responding in the most

favorable way to each statement. A value of five points was given for each of these answers making a perfect score equal to 290. Answering each question with the next most favorable response would have resulted in a final score of 232 or four times fifty-eight. This would have indicated a favorable response. If the student had reacted to each statement with the "undecided" response, her score would have been three times fifty-eight or 174. This would indicate a neutral attitude toward physical education. The next score was two times fifty-eight or 116. The least ideal score would have been fifty-eight indicating that the student had reacted exactly opposite to the ideal response on all statements and would have suggested a poor attitude toward physical education. Combinations of the various responses could result in any score from fifty-eight to 290. Definition of the student's attitude toward physical education could be made by comparing her score to the nearest of the five scores cited above. The means of both groups showed that each group as a whole expressed a favorable attitude toward physical education. A "t" test of the difference between the means of the final test scores of both groups was computed and a .181 was obtained, as shown in Table V. This indicated that there was no significant difference between the two groups in terms of attitudes at the time of the final analysis. In Table VI, the "t" test of the significance of difference of the change within each group also showed no difference indicating that neither the experimental nor the control method had a positive effect on attitudes. Although there was no increase in attitudes toward physical education within the experimental group, the mean attitude score was maintained indicating that the problem-solving method did not have a significant negative effect on attitude toward physical education.

TABLE V

SIGNIFICANCE OF DIFFERENCE BETWEEN THE  
MEANS OF FINAL ATTITUDE SCORES FOR  
EXPERIMENTAL AND CONTROL GROUPS

Group	N	R	M	S.D.	"t"*
Experimental	21	144-271	228.05	27.005	.181
Control	12	207-252	226.5	12.9	

\*Criterion "t" significant at 1% level of confidence=2.75



TABLE VI

SIGNIFICANCE OF DIFFERENCE OF THE CHANGE FROM  
INITIAL TO FINAL ATTITUDE SCORES WITHIN  
THE EXPERIMENTAL AND CONTROL GROUPS

Group	N	R	M	S.D.	"t" *
Experimental	21				
Initial		208-274	228.29	14.19	.0488 (1)
Final		144-271	228.05	27.005	
Control	12				
Initial		209-248	226.75	12.46	.139 (2)
Final		207-252	226.5	12.9	

\*Criterion "t" significant at the 1% level of confidence =

(1) 2.845

(2) 3.1

It should be noted that the means of the final test were slightly lower than those of the initial test which suggested that there was some negative change in attitudes in both groups from the beginning of the study to the end. However, neither change was significant.

In Table VI, it can be seen that the standard deviation of the final experimental scores was quite different from the standard deviation of the initial scores. It appeared that the one very low score of 144 increased the range of scores causing the larger variability. The subject making that score on the inventory gave no indication during the semester that she was indifferent to or disliked physical education. The investigator suspected that the student scored her inventory incorrectly because the difference between her initial and final scores was seventy points which was inconsistent with the other differences. However, there was no way to substantiate this, so the score was not eliminated from the data. Without this score, the mean would have been 232.25 and the standard deviation 19.87. Although not significant, it would show a positive increase in attitude rather than the slight decrease.

The initial attitude scores were correlated with the initial bowling scores. The correlation was  $r = .501$  and is shown in Table VII. Also shown is the correlation between the final attitude scores and the final bowling scores which was  $r = .191$ . The correlation between the initial scores was significant at better than the 1% level of confidence and indicated a significant positive relationship between attitude and skill at the beginning of the study. The final correlation was not significant and indicated that there was not a relationship between the

TABLE VII

CORRELATIONS OF INITIAL ATTITUDE SCORES WITH  
 INITIAL BOWLING SCORES AND FINAL ATTITUDE  
 SCORES WITH FINAL BOWLING SCORES

Scores	N	r*
Initial	33	.501**
Final	33	.191

\*Criterion r significant at the 1% level of confidence=.449

\*\*Significant at better than the 1% level of confidence.

attitude and skill at the completion of the study. This might have occurred because the skill level changed, but the attitude did not during the course of the study. This result was not in agreement with the conclusions made in the Kappes' study. (51) She found a significant positive relationship between attitude and estimated skill level. In the present study, attitude apparently did not have an effect on the development of skill.

## CHAPTER VI

### SUMMARY, CONCLUSIONS, AND SUGGESTIONS FOR FURTHER STUDY

The purpose of this study was to determine the effect of the problem-solving method on skill development in bowling. It was the dual purpose to determine the effect of this method on attitude toward physical education.

Subjects were selected from three bowling service classes at the University of North Carolina at Greensboro on the basis of their past experience in bowling and totals of their first five games in bowling. Twenty-one subjects from two classes were used as the experimental group and twelve subjects from a third class served as the control group. The first five game totals were used as initial scores in bowling and scores from the Drinkwater Attitude Inventory were used as initial scores of attitude. The experimental group received thirty-one class periods of bowling instruction under the problem-solving method. The control group was taught for the same length of time by the control method which was based on the generally accepted methods of instruction in bowling. Final bowling scores were the totals of games nine to thirteen and final attitude scores were the scores on the attitude inventory which was readministered on the last day of class.

The data were treated statistically to determine if changes in bowling and attitude occurred within the groups from the beginning of

the study to the end, to determine if there was a difference between the groups at the end of the study, and to determine the relationship between attitude and skill. The following results were obtained:

1. There was no significant difference between the groups in bowling or attitude at the conclusion of the study.
2. There was a significant difference between the initial and final bowling scores for both groups.
3. There was no significant difference in the change from the initial to the final bowling scores between the two groups.
4. There was no significant difference between the initial and final attitude scores for both groups.
5. There was a low positive relationship between attitude and skill at the beginning of the study.
6. There was no statistically significant relationship between attitude and skill at the completion of the study.

On the basis of these results, the following conclusions were made within the limitations of this study.

1. Both methods result in favorable skill development in bowling as determined by game scores.
2. Neither method of instruction appears to be superior to the other in skill development in bowling.
3. Favorable attitude toward physical education is maintained under the problem-solving method of instruction.
4. The effectiveness of the problem-solving method appears to be in the students' interest and response to this method rather than in skill development.

From the results of this study and the review of literature on the problem-solving method of instruction, the writer could make three suggestions for further study.

1. A study of the retention of bowling skill of this group of subjects after a period of time.
2. A study of this same group of subjects in more sports taught with the problem-solving method.
3. A study of the effect of the problem-solving method on the development of skill in bowling allowing more practice between the initial test and the final test of skill.

MEMORANDUM

1. 1952

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ARTICLE IV

... THE FOLLOWING LIST OF STATEMENTS ...  
... HAS BEEN PREPARED TO DETERMINE ...  
... MEDICAL EDUCATION ...  
... REGULAR ACTIVITY ...  
... INCLUDING ...  
... ARE AS FOLLOWS ...  
... OPINION OF EACH STATEMENT IS ...  
... (a) PLEASE READ EACH STATEMENT ... (b) ...

APPENDIX

(c) Mark in the space between the ...  
... THE FOLLOWING KEY:

- 1 - I strongly agree
- 2 - I agree
- 3 - I am undecided (no opinion)
- 4 - I disagree
- 5 - I strongly disagree

DATE: 1. 1. 1954

... THIS TEST WILL ...  
...

END OF STATEMENTS



## ATTITUDE INVENTORY

DIRECTIONS: PLEASE READ CAREFULLY: The following list of statements has been prepared to discover what attitudes college women have toward physical education. In answering these statements please consider the words physical education as referring only to the regular activity course, not including intramural or recreational activities. There are no right or wrong answers. You are asked merely to express your personal opinion of each statement in accordance with the following instructions: (a) Please read each statement carefully. (b) Turn to the answer sheet and find the number corresponding to that statement. (c) Black in the space between the dotted lines under the number which best expresses your opinion of that statement, using the following key:

- 1 - I strongly agree
- 2 - I agree
- 3 - I am undecided (use sparingly)
- 4 - I disagree
- 5 - I strongly disagree

SAMPLE: 1. 1 2 3 4 5  
" " " " "  
" " " " "  
" " " " "

Your answers on this test will in no way affect your physical education grade.

ANSWER ALL STATEMENTS

1. Skills learned in physical education classes are essential to social life.
2. Physical education should be a required subject for college women.
3. Regular participation in physical education classes is necessary for organic health.
4. Physical education activities are likely to be emotionally upsetting to many girls.
5. Physical education classes are looked forward to with enthusiasm.
6. Physical education offers little of importance in the general education of college women.
7. Physical activities are relaxing.
8. The time spent in physical education classes would be better spent in study.
9. Physical education classes provide excellent opportunities for making friends.
10. One period each day should be devoted to physical education.
11. Physical education classes are interesting.
12. There are no cultural values in physical education.
13. The body is as an important an instrument for daily living as is the mind.
14. Physical education should be one of the first subjects taken from the curriculum if a cut is necessary.
15. The skills learned in physical education classes will provide you with means for recreation after you leave college.
16. Physical education should be required for boys, but not for girls.
17. Aesthetic appreciation and expression can be learned from physical activities.
18. Physical education should be offered in high school and elementary grades, but not in college.
19. Physical education activities develop socially desirable standards of conduct.

20. Learning to play effectively together toward common goals is a major contribution of physical education.
21. The expenditure of funds for "exercise" and "play" is unnecessary and wasteful.
22. Physical education makes important contributions to mental health.
23. There are many opportunities for the development of moral and ethical conduct in physical education.
24. No opportunities are offered for students to become leaders in the physical education classes.
25. Girls who lack skill should be excused from physical education if they wish.
26. Physical education is not worth the trouble involved in dressing for class.
27. Physical education for leisure is as important as education for work.
28. Physical education classes are not fitted to the individual student's interest.
29. Physical education is "unfeminine".
30. Physical education activities provide opportunities for satisfying social experiences.
31. Physical education should be elective rather than required.
32. Informal recreation periods should take the place of physical education.
33. Tests are unnecessary in physical education class.
34. No outside preparation should be required for a physical education class.
35. Participation in physical education is likely to result in accidents.
36. The activities in the physical education program are too strenuous for the average woman.
37. Group loyalties are formed through athletic competition.
38. Physical education activities provide an outlet for suppressed emotions.
39. Only girls who play well are wanted on intramural teams.

- 40. There are many opportunities in the physical education program for the character development of the students.
- 41. Every girl should develop to her greatest physical capacity.
- 42. Physical education is too formal.
- 43. Learning to play by the rules of the game will teach people to live by the rules of the land.
- 44. Every community should have good facilities for physical activities.
- 45. Most girls do not enjoy physical education classes.
- 46. Girls who excel in sports are not as intellectual as other girls.
- 47. Girls should have varsity sports in college instead of intramurals.
- 48. Girls with good grades in academic subjects should not be required to take physical education.
- 49. Physical education cannot be considered a profession.
- 50. Competitive activities tear down emotional controls.
- 51. Competing against other girls establishes poor social standards.
- 52. By the time a girl reaches college age her physical development can no longer be improved by exercise.
- 53. If physical education were not required, I would advise all my friends to elect it.
- 54. Every girl should have the experience of belonging to a "team".
- 55. The mind and body cannot be separated for the purposes of education.
- 56. Everyone should have at least one hour a day of vigorous activity.
- 57. Game strategy is identical with the thinking that characterizes any other situation in life.
- 58. Educated people rarely take part in physical activities.

Directions: Please answer questions as honestly as you can.

1. How many times have you bowled?  
1\_\_2\_\_3\_\_4\_\_5\_\_6\_\_7\_\_8\_\_9\_\_10 or more\_\_
2. How many times have you bowled in the last three years?  
1\_\_2\_\_3\_\_4\_\_5\_\_6\_\_7\_\_8\_\_9\_\_10 or more\_\_
3. How many lessons in bowling have you had?  
1-5\_\_ 6-10\_\_ 11-15\_\_ 16-20\_\_ over 20\_\_
4. By whom were they taught?  
Professional teacher \_\_ School teacher \_\_ friend\_\_
5. What is your schedule for the following times?  
8-9 A.M. Tuesday, Thursday \_\_\_\_\_  
9-10A.M. Tuesday, Thursday \_\_\_\_\_  
10-11A.M. Tuesday, Thursday \_\_\_\_\_  
12-1P.M. Monday, Wednesday \_\_\_\_\_

## LESSON PLANS FOR PROBLEM-SOLVING GROUP

Lesson 1

## Objectives:

1. Discuss problem-solving method
2. Determine initial attitude

## Activities:

1. Discussion
  - a. encourages thinking and understanding
  - b. given problem
  - c. given time to work out solution
  - d. discuss solutions
  - e. given time to practice
  - f. teacher guides by questioning
  - g. student must think, concentrate, watch others, help self and others
  - h. try to correct own patterns
  - i. develop at own rate

Lesson 2

## Objectives:

1. Orientation to facilities, equipment, game
2. Discuss safety and etiquette
3. Select ball
4. Experience total bowling pattern
5. Begin development of approach

## Activities:

1. Explanation of goals of the game, facilities and equipment used
2. Discussion of safety and etiquette
  - a. What do you think points of etiquette should be?
  - b. How can you avoid disturbing other bowlers?
  - c. Is there any way you can keep the game moving?
3. Selection of ball
  - a. Pick up and swing several balls near you
    - 1) Can you feel any difference?
    - 2) Could differences affect bowling skills?
  - b. Could this help you decide what ball to select?
  - c. Problem: In light of the discussion about differences, select a ball that is comfortable to you.

4. Exploration of total pattern
  - a. Roll the ball to hit the pins. Roll it any way you wish.
  - b. Think about this pattern in these ways:
    - 1) Was it easy or hard?
    - 2) Was it comfortable, or awkward?
    - 3) Did you feel a strain on any part of your body?
    - 4) What happened to the ball?
    - 5) Was it smooth or uneven?
    - 6) Was it fast or slow?

Evaluation:

1. Did not include discussion of etiquette because of time
2. Need to emphasize how to determine if the solution is effective and efficient
3. Students appeared fairly relaxed when the first ball was rolled
4. Students slow to answer questions

Lesson 3

Objectives:

1. Guide through the problem of development of swing, delivery, approach

Activities:

1. Review swing
  - a. Why do it?
  - b. Does the pattern change?
  - c. How can you make it go straight?
  - d. Problem: Develop a one-motion, smooth, straight swing.
2. Develop approach
  - a. What did you do in preparation to throwing the ball?
  - b. Did the length of the approach affect results?  
Smoothness? Speed?
  - c. Did path of swing affect results?
  - d. Did body position affect results?
  - e. Did point of delivery affect results?
  - f. Problem: Can you make a smooth approach and a quiet delivery and still down several pins?
3. Individual help

Evaluation:

1. Good to speak in terms of quietness and smoothness
2. To combine swing and approach, asked students to do swing as they moved forward
3. Did not attempt to change any patterns of approach that developed.

Lesson 4

## Objectives:

1. Develop aim

## Activities:

1. Discussion of aim
2. Problem: What is the effect of the ball on the pins?
  - a. Noted while watching teacher roll balls
3. Problem: Develop a point of aim for a strike that utilizes what you have discovered about pin and ball action.

Lesson 5

## Objectives:

1. Emphasize smoothness and quietness of approach and delivery
2. Explain rules
3. Develop spare bowling

## Activities:

1. Review approach and delivery
2. Problem: Read Rules Sheet and do Scoring Assignment for the next class.
3. Problem: Adjust bowling techniques to down the remainder of the pins which were left by the first ball.
  - a. Think in terms of aim, delivery changes, and path of ball

## Evaluation:

1. Began to give smaller problems
2. Did not speak of scoring in class

Lesson 6 and 7

## Objectives:

1. Continue working on problem of bowling at full set then remainder.

## Activities:

1. Problem: Continue to improve attempts to make strikes or spares.



Evaluation:

- 1. Problems using examples of skills of familiar sports or practical situations appear to be successful for aiming difficulties
- 2. Assignments showed that scoring can be learned effectively without using class time for explanations.
- 3. Discovered that more time for making and correcting errors was needed before guidance was given to allow student opportunities to change patterns and really solve the problems.

Lessons 8 and 9

Objectives:

- 1. Develop accuracy in bowling at specific spares
- 2. Stress smoothness, quietness, and accuracy

Activities:

- 1. Bowl 3 balls at: 1-2-5, 2-4-7, 7-8, 6-9-10, 3-7, and 5
- 2. Problem: Develop and remember a point of aim for each small set-up.

Evaluation:

- 1. Aim causes most difficulty
- 2. Gave several situations that emphasized aim such as throwing crayon to partner from several distances
  - a. Tried to emphasize importance of follow-through for accuracy

Lessons 10, 11, 12, 13, 14

Objectives:

- 1. Increase skill in total bowling patterns as found in game

Activities:

- 1. Bowl games
- 2. Problem: Make as many strikes and spares as possible and become consistent in bowling patterns

Lessons 15 and 16

Objectives:

- 1. Introduce spot aiming

Activities:

- 1. Problem: Spot bowling is a way of aiming. It involves the use of the arrows on the alley as points of aim. Can you discover

how it could work with the pattern of bowling you have developed?

2. Discuss relationship of arrows to pins, to starting points, and to release points
3. Use Spot bowling Check Sheet
  - a. Roll 10 balls at assigned arrows
  - b. Keep same starting position
  - c. Record delivery point, where ball crossed arrows, where it contacted pins, path of ball, and number of pins downed.
  - d. With data, select arrow which is most effective as an aim for a strike

Evaluation:

1. Seemed to be a valuable way to introduce spot aiming
2. Some expressed interest in this method of aiming

Lesson 17

Objectives:

1. Develop spot aiming for spare pick-ups

Activities:

1. Discussion
2. Practice with three spares
3. Problem: From what you observed in your 10 throws and this practice, how can we decide on a point of aim for any spare leave?

Lessons 18, 19, 20

Objectives:

1. Practice in game situation

Activities:

1. Bowl game with individual guidance as needed

Lesson 21

Objectives:

1. Review (because of vacation) skills

Activities:

1. Discussion of important elements of approach, delivery, and aim
2. Game

Lessons 22, 23, 24, 25, 26, 27, 28

## Objectives:

1. Develop skill in game

## Activities:

1. Bowl games with individual help as needed.

Lessons 29 and 30

## Objectives:

1. Ascertain skill with skills test

## Activities:

1. Spare pick-up and full set-up bowling for points

Lesson 31

## Objectives:

1. Review for examination
2. Determine final attitude

## Activities:

1. Answered all questions
2. Give attitude inventory

Lesson 1

## Objectives:

1. Determine initial attitude

## Activities:

1. Administer attitude inventory and questionnaire

Lesson 2

## Objectives:

1. Orientation to facilities, equipment, game
2. Explain safety and etiquette
3. Explain selection of ball and grip
4. Learn pendular swing

## Activities:

1. Explanation of history of game, facilities and equipment, safety and etiquette
2. Explanation of ball selection
3. Grip and swing

Lesson 3

## Objectives:

1. Present 4-step approach
2. Present straight ball delivery

## Activities:

1. 4-step approach
2. Coordinated swing and approach
3. Coordinated swing and approach with delivery

Lesson 4

## Objectives:

1. Present spot aiming for strike
2. Review coordinated approach and swing

## Activities:

1. 1-3 pocket aim
2. Review approach
3. Combine approach, delivery with aim

Lesson 5

## Objectives:

1. Review spot aim for strike
2. Present scoring
3. Explain rules
4. Introduce to game situation

## Activities:

1. For review, bowl at 1-3-5
2. Explain scoring techniques and rules
3. Bowl a game

Lesson 6

## Objectives:

1. Review approach, aim, delivery
2. Bowl game

## Activities:

1. Approach without ball
2. Approach with ball with no pins
3. Approach and delivery at 1-3-5
4. Game

Lesson 7

## Objectives:

1. Present spot aim for spare pick-ups
2. Review aim
3. Practice for spare pick-ups

## Activities:

1. Review spot aiming
2. Explain how to aim for any spare
3. Explain cross alley bowling
4. Bowl at 1-2-5, 2-4-7, 7-8, 5-8, 4

Lessons 8 and 9

## Objectives:

1. Review elements of aiming for spares
2. Practice on cross-alley bowling

## Activities:

1. Review aim verbally
2. Bowl at 10, 6-10, 6-9-10

Lessons 10, 11, 12, 13, 14

## Objectives:

1. Increase skill in game situation

## Activities:

1. Bowl games with individual help as needed

Lesson 15

## Objectives:

1. Review 4-step approach and swing
2. Review delivery

## Activities:

1. Without ball, do approach with individual checks of starting position, stance, final position and follow-through
2. With ball, individual check of total pattern
3. Bowl at spot with pinsetter telling where ball goes

Lesson 16

## Objectives:

1. Review spot aiming for spare pick-ups

## Activities:

1. Bowler find point of aim for 2-4, 9-10, or 5
2. Pinsetter remove pins
3. Bowler rolls ball at aim
4. Pinsetter tells success or failure

Lessons 17, 18, 19, 20

## Objectives:

1. Practice in game situation

## Activities:

1. Bowl games with individual help

Lessons 21, 22, 23, 24

## Objectives:

1. Review skills
2. Bowl games

## Activities:

1. Two approaches without ball
2. Bowl games

Lessons 25, 26, 27, 28

## Objectives:

1. Practice in game situation

## Activities:

1. Bowl games

Lessons 29 and 30

## Objectives:

1. Ascertain skill with skills test

## Activities:

1. Spare pick-up and full set-up bowling for points

Lesson 31

## Objectives:

1. Review for examination
2. Determine final attitude

## Activities:

1. Discuss questions
2. Give attitude inventory

## INITIAL SCORES FOR EXPERIMENTAL AND CONTROL GROUPS

<u>Subject</u>	<u>Bowling Games</u>					<u>Total</u>	<u>Attitude</u>
	1	2	3	4	5		
Experimental:							
1	85	102	95	88	106	476	236
2	100	117	88	103	96	504	226
3	92	57	85	81	77	392	235
4	83	86	67	91	95	422	274
5	94	65	61	77	77	374	220
6	34	50	34	56	65	239	218
7	82	94	69	67	103	415	234
8	49	74	66	75	85	349	208
9	58	83	89	101	117	448	222
10	89	68	61	81	77	376	211
11	65	73	77	79	95	389	239
12	78	88	85	106	109	466	241
13	96	72	133	121	98	520	216
14	86	67	52	61	106	372	232
15	66	86	86	63	82	383	223
16	81	112	73	84	117	467	241
17	75	85	86	90	84	420	234
18	114	71	75	75	94	429	229
19	81	102	91	112	86	472	214
20	75	80	48	83	92	378	227
21	99	106	94	87	98	484	214
Control:							
1	93	87	83	99	64	426	218
2	69	114	83	51	64	381	220
3	95	91	99	96	59	440	248
4	47	96	101	108	91	443	239
5	69	96	67	82	123	437	213
6	67	72	84	107	106	436	209
7	88	129	81	67	100	465	239
8	76	94	106	75	122	473	233
9	78	78	83	67	66	372	237
10	80	72	113	59	76	400	233
11	84	76	121	98	85	464	222
12	67	67	69	90	63	356	210



## FINAL SCORES FOR EXPERIMENTAL AND CONTROL GROUPS

Subject	<u>Bowling Games</u>					<u>Total</u>	<u>Attitude</u>
	1	2	3	4	5		
<b>Experimental:</b>							
1	81	104	112	99	111	507	220
2	105	132	109	95	149	590	235
3	101	112	122	84	143	562	218
4	80	104	116	75	168	543	271
5	107	83	102	81	79	452	214
6	82	109	80	80	72	423	215
7	117	62	103	77	116	475	249
8	75	59	84	59	86	363	178
9	126	97	93	80	76	472	204
10	130	83	71	107	90	481	240
11	83	114	90	128	81	496	259
12	83	89	60	110	81	423	247
13	108	87	130	89	130	544	237
14	101	90	115	74	91	471	247
15	126	109	85	91	109	520	244
16	150	94	140	89	116	589	233
17	68	93	74	95	106	436	233
18	101	113	83	100	77	474	232
19	82	136	110	122	101	551	235
20	108	104	76	88	103	479	234
21	97	132	93	121	95	538	144
<b>Control:</b>							
1	82	93	87	99	66	427	216
2	81	107	72	82	92	434	221
3	119	132	74	115	100	540	252
4	73	69	90	115	87	434	239
5	123	65	88	72	68	416	211
6	118	96	132	86	148	580	207
7	107	86	103	103	88	487	232
8	117	66	101	128	103	515	229
9	111	119	85	96	135	546	227
10	82	127	105	126	128	568	235
11	110	112	99	116	106	543	237
12	93	95	88	107	97	480	212

SCORING RULES SHEET

- Each line on the score sheet represents one game for one player.
- A game or line is made up of 10 frames. 

- For every frame, a player bowls twice.

- The number of pins downed by the first ball is placed in the first small square: 

3	

- The number downed by the second ball is placed in the second small square: 

3	5

- The total number is placed in the square and is the score for that frame: 

3	5
8	

- The score is the cumulative total-the score for frame 2 is the total for that frame plus the score from the previous frame:  
 frame; score  
 2:  $2+7+8=17$ 

	1		2	
3	5	2	7	
8		17		

- If all ten pins are downed with 2 balls, it is called a spare. To score a spare, add the total of that frame (10) plus the pin fall of the first ball in the next frame to the previous score. A spare is indicated by a slash(/) in the second small square:  
 frame: score

		2	3	4													
3	:	$10+4+17=31$	<table border="1" style="display: inline-table;"><tr><td>2</td><td>7</td></tr><tr><td>17</td><td> </td></tr></table>	2	7	17		<table border="1" style="display: inline-table;"><tr><td>3</td><td>/</td></tr><tr><td>31</td><td> </td></tr></table>	3	/	31		<table border="1" style="display: inline-table;"><tr><td>4</td><td>3</td></tr><tr><td>38</td><td> </td></tr></table>	4	3	38	
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17																	
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4	3																
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3																	
38																	

- If the ten pins are downed with the first ball, it is called a strike. To score a strike, add the total of that frame (10) plus the pin fall of the next 2 balls to the previous score. A strike is indicated by an X in the first small square.

		4	5	6													
5	:	$10+5+3+38=56$	<table border="1" style="display: inline-table;"><tr><td>4</td><td>3</td></tr><tr><td>38</td><td> </td></tr></table>	4	3	38		<table border="1" style="display: inline-table;"><tr><td>X</td><td> </td></tr><tr><td>56</td><td> </td></tr></table>	X		56		<table border="1" style="display: inline-table;"><tr><td>5</td><td>3</td></tr><tr><td>64</td><td> </td></tr></table>	5	3	64	
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64																	

To score 2 strikes in a row:  
 frame: score

		6	7	8	9																	
7	:	$10+10+5+64=89$	<table border="1" style="display: inline-table;"><tr><td>5</td><td>3</td></tr><tr><td>64</td><td> </td></tr></table>	5	3	64		<table border="1" style="display: inline-table;"><tr><td>X</td><td> </td></tr><tr><td>89</td><td> </td></tr></table>	X		89		<table border="1" style="display: inline-table;"><tr><td>X</td><td> </td></tr><tr><td>107</td><td> </td></tr></table>	X		107		<table border="1" style="display: inline-table;"><tr><td>5</td><td>3</td></tr><tr><td>115</td><td> </td></tr></table>	5	3	115	
5	3																					
64																						
X																						
89																						
X																						
107																						
5	3																					
115																						
8	:	$10+5+3+89=107$	<table border="1" style="display: inline-table;"><tr><td>64</td><td> </td></tr><tr><td>89</td><td> </td></tr></table>	64		89		<table border="1" style="display: inline-table;"><tr><td>X</td><td> </td></tr><tr><td>107</td><td> </td></tr></table>	X		107		<table border="1" style="display: inline-table;"><tr><td>5</td><td>3</td></tr><tr><td>115</td><td> </td></tr></table>	5	3	115						
64																						
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107																						
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115																						
9	:	$5+3+107=115$	<table border="1" style="display: inline-table;"><tr><td>64</td><td> </td></tr><tr><td>89</td><td> </td></tr></table>	64		89		<table border="1" style="display: inline-table;"><tr><td>X</td><td> </td></tr><tr><td>107</td><td> </td></tr></table>	X		107		<table border="1" style="display: inline-table;"><tr><td>5</td><td>3</td></tr><tr><td>115</td><td> </td></tr></table>	5	3	115						
64																						
89																						
X																						
107																						
5	3																					
115																						

- If a strike or a spare is made in the tenth frame, 2 or 1 extra balls are rolled. Note that the score of the extra balls is not added again to the total.

		9	10 total								
10	:	$10+10+4+100=124$	<table border="1" style="display: inline-table;"><tr><td>2</td><td>4</td></tr><tr><td>100</td><td> </td></tr></table>	2	4	100					
2	4										
100											
		<table border="1" style="display: inline-table;"><tr><td>X</td><td>X</td></tr><tr><td>124</td><td> </td></tr></table>	X	X	124		<table border="1" style="display: inline-table;"><tr><td>4</td><td> </td></tr><tr><td>124</td><td> </td></tr></table>	4		124	
X	X										
124											
4											
124											

11. If an error is made, it is noted on the score sheet as - in the second square: 

6	-

12. If a split remains standing, it is noted on the score sheet by placing a small circle in the upper left corner of the first small square: 

◦7	2

13. If a foul occurs, place an F in the appropriate square: 

3	F

When a foul occurs on the first ball, the pins are reset and the score for the frame is the total made on only the second ball. When it occurs on the second ball, the score for the frame shall be the total number of pins downed by only the first ball.

14. Pins are not counted if downed by:
- ball that left the alley before reaching pins,
  - pin setter,
  - ball when a foul is committed.



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