THE EFFECTS OF THE HOOK, STRAIGHT BALL, AND

PRACTICE ON BOWLING SKILL ACHIEVEMENT

BY

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ABSTRACT

Title: The Effects of the Hook, Straight Ball, and Practice
         on Bowling Skill Achievement

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The purpose of this study was to determine if improvement in bowling scores and skills (obtaining strikes and spares) were exclusive of type of delivery. The subjects were students enrolled in three bowling activity classes at Appalachian State University during the spring semester of 1979. Classes were assigned randomly to the following treatments:

1.   The hook ball delivery with the spot point of aim, and the four step approach.

2.   The straight ball delivery with the spot point of aim, and the four step approach.

3.   Instruction on the straight and hook deliveries, but no specification on the type of delivery used, with the spot point of aim and the four step approach.

The investigator taught all three classes. The treatments were administered during nine class meetings, each lasting fifty minutes. Each class took a pre-test before the treatment, and a post-test after the treatment.

Three games were bowled for the pre-test, and three games were bowled for the post-test. The mean scores obtained for each student on the pre- and post-test were converted logarithmically so improvement gains from different initial scores could be assessed.

The mean bowling improvement scores for each of the groups were compared by using $\underline{t}$ tests of significance (differences between two small independent means). The hook ball delivery group, the straight ball delivery group, and the group in which delivery was not specified had mean bowling improvement scores of -0.2411, 0.3846, and 0.1993 respectively. There were no significant differences found between the three groups tested at the 5 percent level of significance.

The mean number of spares bowled by each of the groups (hook, straight, nonspecified) were compared using the $\underline{t}$ tests of significance (differences between two small independent samples). The hook ball delivery group bowled 47.11 mean number of spares; the straight ball group had 48.38 mean number of spares, and the nonspecified delivery group had 56.36 mean number of spares. There were no significant differences found between the three groups at the 5 percent level of significance.

The mean number of strikes bowled by each of the groups (hook, straight, nonspecified) were compared using

t tests of significance (differences between two small
independent means). The hook ball delivery group bowled
26.22 mean number of strikes; the straight ball delivery
group had 27.69 mean number of strikes, and the nonspecified
delivery group had 28.54 mean number of strikes. There were
no significant differences found between the three groups at
the 5 percent level of significance.

The following conclusions were made by the investi-
gator under the conditions which were placed on the study:

1. Improvement in bowling scores appears not to be
influenced by the delivery method taught (hook, straight,
nonspecified), but may be attributed to practice.

2. The ability to obtain spares and strikes appears
not to be influenced by the delivery method taught (hook,
straight, nonspecified) but could be attributed to practice.

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Chapter 1

INTRODUCTION

Bowling has been one of the nation's most popular recreational activities. It may be said that the United States has been the bowling capital of the world since it has been estimated that nearly thirty-five million bowlers spend over a billion dollars on bowling every year (14: 3). According to Pezanno surveys taken in the early 1970's rated bowling only behind football, baseball and basketball in popularity as the sport people liked most to follow, and was the number one participant sport (15: 18).

There have been many different opinions concerning techniques that should be used in teaching beginning bowlers. Hyde, as cited by Inabinett, (9: 1-2) surveyed forty-five schools that taught bowling in regularly scheduled bowling classes about the techniques taught in their bowling classes. The results showed that twenty-six schools taught the straight ball delivery exclusively, eighteen taught both the straight ball delivery and hook delivery, and one school taught the hook delivery exclusively. There was no scientific evidence to show which of these techniques was most efficient. Experts have differed in opinion, and there has also been a difference in findings of research studies as to the most effective methods of teaching beginning bowlers.

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There are four different types of ball delivery including curve, back-up, hook, and straight ball delivery. The literature on bowling has not emphasized the curve and back-up deliveries, except for a paragraph or two recognizing their existance. This has limited the problem of selecting to the hook delivery or straight ball delivery.

The two basic methods of teaching beginning students ball delivery in bowling have been the hook delivery and the straight ball delivery. Upon observation of beginning bowlers, the investigator had noted that beginning bowlers who have not had instruction usually have used the straight ball delivery. The majority of professional bowlers have used the hook delivery. Neither the hook delivery nor the straight ball delivery has been conclusively found to be superior for teaching beginners. Most instructors of bowling have relied on their judgement, and the method that worked best for them when deciding which delivery to teach. Thus, there has been a need for research and information to determine the most effective method of delivery that should be taught, or to determine if the improvement in bowling score has been only from practice exclusive of type of delivery.

Statement of the Problem

The purpose of this study was to determine the effectiveness of instruction in two methods of delivery, the hook and the straight ball, and to determine if practice was the major factor in bowling skill acquisition. A subproblem

was to determine if the number of spares and strikes bowled were influenced by the type of delivery used.

Subproblems

This is a list of subproblems that were encountered in the study:

1. The selection of subjects and the assignment of treatments.

2. The application of treatments and testing.

3. The organization and analysis of data.

Hypothesis

The following hypotheses were tested:

1. There would be no significant difference between the mean bowling improvement scores of the group instructed with the hook ball and the group instructed with the straight ball.

2. There would be no significant difference between the mean bowling improvement scores of the group instructed with the hook ball and the group permitted to use the hook or straight ball.

3. There would be no significant difference between the mean bowling improvement scores of the gorup instructed with the straight ball and the group permitted to use the hook or straight ball.

4. There would be no significant difference between the mean number of spares bowled by the group instructed with the straight ball.

5. There would be no significant difference between the mean number of spares bowled by the group instructed with the hook ball and the group permitted to use the hook or straight ball.

6. There would be no significant difference between the mean number of spares bowled by the group instructed with the straight ball and the group permitted to use the hook or straight ball.

7. There would be no significant difference between the mean number of strikes bowled by the group instructed with the hook ball and the group instructed with the straight ball.

8. There would be no significant difference between the mean number of strikes bowled by the group instructed with the hook ball and the group permitted to use the hook or straight ball.

9. There would be no significant difference between the mean number of strikes bowled by the group instructed with the straight ball ad the group permitted to use the hook or straight ball.

Definition of Terms

Four step approach. This approach consisted of three steps and a step-slide taken in a straight line with a brisk and gliding movement of the body in preparation to delivering the ball at the foul line.

Hook delivery. The hook delivery was executed by the release of the ball with the thumb pointed towards ten o'clock or eleven o'clock and the fingers pointed towards four o'clock. The thumb and index finger formed a V. The hand was held in this position throughout delivery and follow through. About two thirds of the way down the lane the counterclockwise spin caused the ball to veer to the left (definition for right handed person).

Straight ball delivery. The straight ball delivery was executed by the release of the ball with the thumb and fingers forming a V, with the thumb pointed up at twelve o'clock. The thumb remained at the twelve o'clock position throughout the entire delivery and follow through. The ball travels end-over-end the full length of the lane.

10, 11, 12 o'clock. This referred to the face of a clock in the horizontal in order to relate the position of the thumb and fingers during the ready position throught the delivery.

Spot aim. The spot aim was the method where the bowler aimed at a spot or between spots that were embedded in the lane, rather than aiming directly at the pins.

Basic Assumptions

For the purposes of this study, it was necessary to make the following assumptions:

1. The difference in the time of day the classes met would not have an effect on the rate of learning bowling skills.

2. Motivation in all three classes was equivalent, since the same emphasis and procedures were used in all classes.

3. It was assumed that the subjects honored the request not to practice bowling outside of regularly scheduled classes.

4. It was assumed that the lanes were equivalent and did not affect scores on the pre- and post-tests.

Delimitations

The delimitations for this investigation included:

1. The subjects were students enrolled in three bowling classes, sections 111, 112, 113 at Appalachian State University during the spring semester 1979.

2. All three groups were taught the four step approach, as well as the spot point of aim. One group was taught the hook delivery, another group the straight ball delivery, and the final group received basic instruction and was permitted to choose the method of delivery they preferred.

3. Bowling scores were used as an indication of bowling skill after a correction for beginning skill was made logarithmically (8: 113-19).

Limitations

This study was limited in the following ways:

1. The subjects were not randomly selected; three of the beginning bowling classes at Appalachian State University were used for the study.

2. The participants differed greatly in their bowling skills, and although scores were adjusted to account for this, they also differed in their physical strength, coordination, and agility.

3. Delimition the approach to the four step approach may have limited some bowlers who would have found the three or five step approach easier to master.

4. Having to assume that the subjects did not practice outside of class since ther was no way to control this on a college campus, was a limiting factor.

Chapter 2

REVIEW OF LITERATURE

The question of which method of delivery should be taught to beginners has been a very controversial issue. There had been much speculation as to which method was superior, but little research had been done as to which method was the most effective in teaching beginning bowlers. The following studies indicated the wide range of opinions regarding the two methods of delivery.

Professional Opinions

Johnson (10: 17) advocated the use of a hook ball delivery for the beginner. He felt the hook was not that difficult to throw or control. Johnson realized that many instructors started their novice bowlers bowling a straight ball and then advanced them to throwing a hook. Johnson felt the hook was more desirable because it's curving action would cause the pins to mix and bounce off one another causing a chain reaction that was likely to result in a strike.

The thumb position should be kept between the nine o'clock position and eleven o'clock position, but nothing beyond these limits. If the thumb was at the twelve o'clock position, this would cause the bowler to roll a straight ball. Welu and Levine (19; 39) felt that good bowling was

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never achieved with anything but a ball that had spin on it as it careens toward the pocket. This spinning action occurred when the thumb position was between the nine to the eleven o'clock positions.

Falcaro and Goodman (7: 21-23) recommended that for a good score in bowling, the beginning bowler should take one thing at a time. For this reason the beginning bowler should learn to bowl the straight ball. It has been a natural delivery, and the easiest method of delivery.

Burton (5: 40-44) realized that bowlers vary in their release, and the variance very often was becuase of physical limitations or physical superiority. This was not because one bowler was doing things the wrong way, while others were going about the delivery correctly. Burton felt that no matter how the beginner delivered the ball, he should do it consistantly.

Bellisimo and Neal (2: 48) felt women should be taught the straight ball delivery. The slower and lighter the ball, the more it curved. Excessive curve made accuracy too much of a problem, Bellisimo and Neal felt women were too weak to execute a hook ball delivery.

Barsanti (1: 36-39) held the view that most people could easily roll a straight ball, and since this was the simplest delivery to master, she recommended it for most beginners. Later when the bowler was concerned with developing higher skill and a better score, the needed adjustments could be made to obtain a release that caused more pin action.

Berger and Boger (4: 45) were convinced that a beginner should master the straight ball delivery. After the bowler had mastered their own delivery and follow through, Berger and Boger recommended that the hook delivery be used for all-around use.

Kirkman (11: 20) felt that a bowler may show improvement faster by learning the straight ball delivery. He also felt because of the limited striking power of the straight ball, the bowler eventually must learn to roll a hook ball. However, he felt that it was better to teach the beginner the straight ball before advancing to the hook ball.

Clause and McBride (6: 73-75) were convinced that the hook delivery was for the experienced bowler. They felt that the bowler must first be experienced with the straight ball before experimenting with the more advanced techniques.

Zikes (20: 69-71) stated that, "the hook ball delivery was the most effective and most professionals used it." He gave two reasons why a bowler should roll a hook ball. First because it was breaking sharply from right to left when it came in contact with the pins, and the hook ball was not deflected as readily as other types of delivery, specifically the curve ball or the straight ball. The hook ball powers its was through the standing pins. The second reason Zikes recommended the hook ball was because of the eggbeater effect it had upon the pins. It mixed the pins furiously. The rolling of the ball was what caused the

mixing action.   Often the pins would ball even though the ball was not squarely in the 1-3 pocket.   This was because of the mixing action.

Zikes felt that anybody could be taught the hook delivery.   It was completely natural.   It was not necessary for the bowler to employ and fancy tricks with his fingers or wrist as the ball was released.   Zikes also stated that the straight ball delivery had some value.   Even though it did not have the devasting power of the hook, it was easy to learn and control.   The straight ball travels on a straight path to the pins, which makes aiming less complex. He recommended that beginners be taught the straight ball. He reasoned that since the straight ball involved a simpler delivery than the hook, it enabled the novice to concentrate on his footwork, timing, and other facets of the game. When the bowler was accomplished in his footwork and timing, he could switch to the hook delivery.

Mackey (13: 13) felt that the instructor should decide when the bowler was ready for the hook.   He acknowledged, that the straight ball was easier to control and highly recommended this delivery for the beginner.

Research on the Straight Ball and Hook Ball

Summers (11: 77-84) took four random groups of college women who were novice bowlers, and taught them four combinations of techniques resulting from two variations of

delivery and two variations of point of aim. The variations
of delivery were the straight ball and hook, and the subjects
aimed at the spots on the lanes or the pins. The study was
conducted over a seven week period. Comparisons of these
instructional techniques were based on the cumulative twenty-
four game average. The comparison indicated that beginners
achieved similar results in bowling scores when taught the
hook ball or the straight ball. · Summers concluded that since
a majority of advanced and professional bowlers favored the
hook ball delivery, it would seem reasonable that this type
of delivery should be taught immediately to beginners. She
also felt that possibly more time was needed for treatment
of the subjects.

Inabinett (9: 21-22) compared the effectiveness of
teaching the hook ball and straight ball to beginning
bowlers. The treatment was conducted over a fifteen week
period. She taught forty-five minutes per week. Fifteen
games were bowled per subject at a rate of one game per week.
Inabinett reported that the group that was taught the
straight ball reached a plateau while the group that was
taught the hook ball continued to improve throughout the fif-
teen week period. She felt this indicated the hook ball
delivery took longer to learn. She also found that improve-
ment for both groups was statistically significant at the
1 percent level of confidence in the areas of better game
scores, more strikes, and fewer gutter balls. Therefore,
she concluded no matter which type of delivery was taught,

college women could improve their bowling scores when sub-jected to fifteen lessons in bowling.

Stofko (17: 12-15) took two classes of twenty-four students in each class, and randomly assigned either the hook ball delivery or the straight ball delivery. The hook ball group received the same treatment for the entire length of the study, while the other group changed from the straight ball to the hook ball halfway through the experimental period. The four step approach and the spot aim were used by both groups. The study was conducted for nine weeks. The standard method of scoring was used and the 5 percent level of confidence was used in statistical analysis. Stofko compared the two groups' means at various intervals through-out the study. He found that there was no significant improvement when the straight ball was used, but both groups improved when they used the hook ball. Stofko concluded that the hook ball was superior to the straight ball delivery, and he recommended teaching the hook ball to beginners immediately.

McIntyre as cited by Stofko (17: 9-11) compared the effectiveness of two techniques of bowling, type of delivery and point of aim. He used one hundred and twelve men stu-dents enrolled in eight physical education classes at the State University of Iowa. Each class bowled seven games before the treatments were assigned. McIntyre estimated the reliability of the data by the Interclass Correlation Formula from the scores of the last three games of the intial

seven-game series and the last five games bowled. He used a random number table to assign two classes to each of the treatments. The four types of treatments were (1) the hook ball delivery with the spot point of aim, (2) the hook ball delivery with the pin aim, (3) the straight ball delivery with the pin aim, and (4) the straight ball delivery with the spot point of aim. The bowling scores of the last five of the first seven games, games eight to seventeen, games eighteen to twenty-seven, games twenty-eight to thirty-seven, and games thirty-eight to forty-seven were used to compare the effectiveness of the style of delivery and point of aim. The mean gain score for this study was the difference between the mean of the last five games of one series and the last five games of another series, and was used to compare between treatment groups rather than the actual mean scores.

In the comparison of the mean gain scores of the initial seven-game series and the fourth ten-game series, and the comparison of the second ten-game and the fourth ten-game series, no statistically significant differences were found for the effect of interaction, the effect of style of delivery, or the effect of the point of aim. McIntyre did find a significant difference in style of delivery, when he compared the mean gain scores that were derived from (1) the initial seven-game series and the first ten-game series and (2) the initial seven-game series and the second ten-game series. He found the straight ball to be superior to the

hook ball. The difference was attributed to the difficulty in controlling the hook ball in the early part of the study.

Hyde (9: 6) as cited by Inabinett did a study and compared the thumb-up and the V hand positions in teaching beginning bowlers. The V position of the hand resulted in a hook ball delivery and the thumb-up position resulted in a straight ball. Hydes' study compared the effectiveness of the two hand positions in relation to velocity and accuracy. She concluded that the V hand position, when taught to the novice bowlers, resulted in final velocity and accuracy performances as good as those obtained in classes taught the thumb-up hand position. This was true except for the poorest fifteen percent.

> There is a general agreement that the value of the hook ball, usually obtained when using the V hand position, lies in its effectiveness in scattering the pins. This better 'pin action,' as called by some is due to the rotation of the ball. While the accuracy scores showed no significant differences between the thumb-up and V hand positions in this regard. The measure of accuracy was found to be unreliable. A better indication could be gained by observing the frequency of strike and gutter balls.

Bennett (3: 30-31) did a study on the effect of three instructional approaches to delivery on the development of accuracy in bowling. She obtained her data from sixty-five sophomore, junior and senior high school beginning bowlers who were enrolled in three physical education classes during the fall semester, 1966. Beginning bowlers were determined from a brief questionnaire completed by the students. The questionnaire indicated the number of games the subjects had bowled in their lifetime.

Classes were designated as the hook ball delivery group, the straight ball delivery group, and the straight-hook ball delivery group. The classes meet two days per week for fifty minute periods. The study was conducted for thirteen weeks and a total of twenty-six class periods.

Bennett found that none of the bowling delivery methods used in her study appeared to be more effective than the others for instruction of beginning bowlers. Bennett felt since it was almost universally accepted by experts that the hook ball delivery offered the more efficient means for developing a high level of bowling skill, it seemed practical to teach initially the type of bowling delivery which allowed continuous progress to a high level of skill development.

Chapter 3

PROCEDURES

Subproblem One

The first subproblem encountered was the selection
of subjects, and the assignment of treatments to each group.
The subjects were students who signed up to take bowling as
a physical education activity class in sections 111, 112,
113, during spring semester 1979 at Appalachian State
University. There was a maxium of twenty-four students in
each of the three classes. The three classes were randomly
assigned to the following treatments:

1. The hook ball delivery with the spot point of
aim, and the four step approach.

2. The straight ball delivery with the spot point of
aim, and the four step approach.

3. Instruction on straight and hook delivery, but no
specification on type of delivery used, with the spot point
of aim and the four step approach.

It was a consensus of the literature reviewed that
the spot point of aim and the four step approach were the
best methods to be taught in a bowling class (18: 77-84,
2: 25, 30, 11: 14, 26). It was easier to aim at the spots
embedded in the lane a few feet away, than to aim at the pins
which were sixty feet away. In the four step approach the

step pattern was rhythmical, and nearly all bowlers can master it. With each succeeding step, step length and forward momentum increased from the first step which was short and slow, to the forth step, which was the longest and fastest. The first step was taken with the right foot. The second step was on the left foot, and the third step was on the right foot. The fourth step was on the left foot and was a sliding motion. In the final position the trunk was inclined forward slightly, knees were flexed, body weight was over the forward supporting foot (left), and the right leg was back with the right foot slightly behind the supporting foot (explanation for right handed person).

Subproblem Two

The second subproblem encountered in the study was the application of treatments. The investigator taught all the classes. Identical lesson plans were prepared for all groups except for the type of delivery. The students were informed that they could miss no more than two class periods.

Classes met for fifty minutes, two days a week, for a total of fourteen meetings. During the first class period scoring was introduced, and the students were informed of how to choose a ball, and rules of etiquette. Each received a bowling handbook. During class periods two and three, the subjects took a bowling pre-test. The pre-test consisted of the average of three games bowled. The subjects received help in scoring, and bowled one game during class meeting two, and the two additional games during the third class.

During the fourth class meeting the stance and four step approach were discussed and demonstrated. On the fiftth meeting of the classes, the investigator reviewed the stance, and four step approach. The type of delivery which had been assigned each group was also taught. On the sixth day of class meetings, the instructor reviewed delivery and taught the spot point of aim. During the seventh day of class meetings, the instructor reviewed delivery and the spot point of aim. Questions were answered and students were helped with any problems they encountered. During class meetings eight through twelve, the subjects practiced the techniques they had been taught, and the investigator helped students who were having problems. On the thirteenth class meeting, the subjects began taking the bowling post-test. The post-test consisted of the average of three games bowled. During the thirteenth class meeting one game was bowled, and during the fourteenth class meeting two games were bowled.

The data were collected from the bowling score sheets of each subject during the spring semester 1979 at Appalachian State University. The subjects were asked to record the number of pins they knocked down with each ball rolled. This enabled the investigator to check the addition on each score and prevented the inclusion of false scores in the data.

Before the pre-test and post-test, each subject was permitted to roll one frame of warm-up balls, since warm-up had been demonstrated to have an effect on bowling scores.

Singer and Beaver (16: 372-75) did a study on bowling and the effects of warm-up. They found that frame one was the only frame to result in a poorer performance as compared to the other nine frames in a game. They recommended that a bowler be permitted to roll two practice balls (one frame) prior to rolling for a score.

Subproblem Three

The third subproblem encountered in the study was the organization and analysis of data. The average scores obtained for each student on the pre-test and post-test were used for analysis. A difference was calculated for each person by subtracting the average score of the pre-test from the average score of the post-test. Each student was then ranked according to the calculated difference. The average scores obtained for each student on the pre-test and post-test were converted logarithmically so improvement gains from different initial scores could be converted into units for comparison to determine the rank gain for each student, considering initial position, gain, and difficulty of gain from the initial position. The formula derived for this computation by Patricia Hale and Robert Hale (3: 113-19) was found to be:

$$A = \frac{e^{\alpha(x + \Delta x)} - e^{\alpha x}}{e^{\alpha x} - 1} \cdot 100$$

A was expressed as a percentage and denoted the mean bowling improvement score for each student. A summation of the mean bowling improvement scores was calculated for each group.

From this summation, a mean bowling improvement score was calculated for each group. The mean bowling improvement score for each group was tested against the mean improvement score for the other two groups using t tests (differences between two independent means). The t tests determined if there were any significant differences in the mean improvement scores of the three groups at the 5 percent level of significance.

The mean number of spares bowled by each group during the instructional time (day three through day twelve) was tested against the mean number of spares bowled in the other two groups. The t test of significance (differences between two small independent means) was used to determine if there were any significant differences in the mean number of spares bowled in the three groups at the 5 percent level of significance.

The mean number of strikes bowled by each group during the instructional time (day three through day twelve) was tested against the mean number of strikes bowled in the other two groups. The t test was used to determine if there were any significant differences in the mean number of strikes bowled in the three groups at the 5 percent level of significance. The mean number of spares and strikes were calculated by letting n be defined as the number of games bowled per person.

Chapter 4

RESULTS AND DISCUSSION

Results

The mean bowling improvement score for the hook ball delivery group was found to be -0.2411 and the mean bowling improvement score for the straight ball delivery group was found to be 0.3846. The group in which delivery was not specified had a mean bowling improvement score of 0.1933 (see Table 1).

Table 1

Mean Bowling Improvement Scores of the
Hook, Straight, and Nonspecified
Delivery Groups

Type of Delivery	Mean Bowling Improvement Scores
Hook Ball Delivery Group	-0.2411
Straight Ball Delivery Group	0.3846
Nonspecified Delivery Group	0.1933

The calculated t found in the hypothesis test between the mean improvement score of the hook delivery group and the mean improvement score of the straight ball

delivery group was -1.1985. The calculated t was found to be -0.7657 in the hypothesis test between the mean improvement score of the hook delivery group and the mean improve-score of the group in which delivery was not specified. The calculated t was found to be 0.3104 in the hypothesis test between the mean improvement score of the straight ball delivery group and the group in which delivery was not specified.

The mean bowling improvement score of the hook delivery was not found to be significantly different from the straight ball delivery group, and the group in which delivery was not specified. There was no difference in the mean improvement scores of the straight ball delivery group and the group in which delivery was not specified (see Table 2).

Table 2

Calculated t for the Hook vs. Straight,
Hook vs. Nonspecified, and Straight
vs. Nonspecified Hypothesis Tests

Hypothesis Test Comparing Mean Bowling Improvement	Calculated[a] t Scores
Hook vs. Straight	-1.1985
Hook vs. Nonspecified	-0.7657
Straight vs. Nonspecified	0.3104

[a]t tested at the 0.05 level of significance.

The mean number of spares bowled by the hook ball delivery group was found to be 47.11 and the mean number of spares bowled by the straight ball delivery group was 48.38. The group in which delivery was not specified bowled a mean number of spares of 56.36 (see Table 3).

Table 3

Mean Number of Spares Bowled by the Hook,
Straight, and Nonspecified
Delivery Groups

Type of Delivery	Mean Number of Spares
Hook Ball Delivery Group	47.11
Straight Ball Delivery Group	48.38
Nonspecified Delivery Group	56.36

The calculated t found in the hypothesis test between the mean number of spares bowled by the hook ball delivery group and the mean number of spares bowled by the straight ball delivery group was -0.0689. The calculated t was found to be -0.4930 in the hypothesis test between the mean number of spares bowled by the hook delivery group and the mean number of spares bowled by the group in which delivery was not specified. The calculated t was found to be -0.4066 in the hypotheis test between the mean number of spares bowled by the straight ball delivery group and the

mean number of spares bowled by the group in which delivery was not specified.

The mean number of spares bowled by the hook delivery group was not found to be significantly different from the straight ball delivery group and the group in which delivery was not specified. There was no difference in the mean number of spares bowled by the straight ball delivery group and the group in which delivery was not specified (see Table 4).

Table 4

Calculated t for the Hook vs. Straight, Hook vs.
Nonspecified, and Straight vs. Nonspecified
Hypothesis Tests Comparing Number of Spares

Hypothesis Tests Comparing Spares	Calculated[a] t Scores
Hook vs. Straight	-0.0689
Hook vs. Nonspecified	-0.4930
Straight vs. Nonspecified	-0.4066

[a]t tested at the 0.05 level of significance.

The mean number of strikes bowled by the hook ball delivery group was found to be 26.22 and the mean number of strikes bowled by the straight ball delivery group was found to be 27.69. The group in which delivery was not specified bowled a mean number of strikes of 28.54 (see Table 5).

Table 5

Mean Number of Strikes Bowled by the Hook,
Straight, and Nonspecified
Delivery Groups

Type of Delivery	Mean Number of Strikes
Hook Ball Delivery Group	26.22
Straight Ball Delivery Group	27.69
Nonspecified Delivery Group	28.54

The calculated t found in the hypothesis test
between the mean number of strikes bowled by the hook ball
delivery group and the mean number of strikes bowled by the
straight ball delivery group was -0.1390. The calculated
t was found to be -0.2324 in the hypothesis test between
the mean number of strikes bowled by the hook delivery group
and the number of strikes bowled by the group in which
delivery was not specified. The calculated t was found to
be -0.0774 in the hypothesis test between the mean number
of strikes bowled by the straight ball delivery group and the
number of strikes bowled by the group in which delivery was
not specified.

The mean number of strikes bowled by the hook ball
delivery group was not found to be significantly different
from the straight ball delivery group and the group in which

delivery was not specified. There was no significant difference in the number of strikes bowled by the straight ball delivery group and the group in which delivery was not specified (see Table 6).

Table 6

Calculated t for the Hook vs. Straight, Hook vs. Nonspecified, and Straight vs. Nonspecified Hypothesis Tests Comparing Number of Strikes

Hypothesis Tests Comparing Spares	Calculated[a] t Scores
Hook vs. Straight	-0.1390
Hook vs. Nonspecified	-0.2324
Straight vs. Nonspecified	-0.0774

[a]t tested at the 0.05 level of significance.

Discussion

This study found that none of the bowling delivery methods used (hook, straight, nonspecified) appeared to be more effective than the others for instruction of beginning bowlers. This was in agreement with Summers (11: 77-84), Inabinett (4: 21-22), and Bennet (3: 30-31) who also found no significant differences between the hook ball delivery and the straight ball delivery.

These results, however, were contradictory to the findings of Stofko (17: 12-15) who found the hook ball delivery was superior to the straight ball delivery. They were also contradictory to the findings of McInyre as cited

by Stofko (17: 9-11), who found the straight ball delivery
be superior to the hook ball delivery.

The investigator failed to find any interrelation
between this study and related studies in the amount of
time used for treatments and statistical disclosures.
Summers' study was conducted over seven weeks, Inabinett's
encompassed fifteen weeks and Bennett's encompassed
twenty-six weeks. All three failed to find any significant
differences between the hook and straight ball deliveries.

The investigator felt the reason the hook ball
delivery group in this study failed to improve was because
of the subjects inability to obtain spares. The subjects
were unable to control the hook when all ten pins were not
standing.

Classes met two days a week (Mondays and Wednesdays).
The investigator was convinced that all three groups (hook,
straight, nonspecified) could have improved more if classes
had met on Fridays also. This extra day would have given
the subjects more practice and the amount of time between
instruction days would have been decreased.

Chapter 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to determine the effectiveness of instruction in two methods of delivery, the hook ball delivery and the straight ball delivery; it was also a study to determine if practice was the major factor in bowling skill acquisition. A secondary purpose was to determine if the number of spares and strikes bowled were influenced by the type of delivery used. Three beginning bowling classes at Appalachian State University were used for the study. Classes were assigned randomly to the following treatments:

1. The hook ball delivery with the spot point of aim, and the four step approach.

2. The straight ball delivery with the spot point of aim, and the four step approach.

3. Instruction on the straight and hook deliveries, but no specification on type of delivery used, with the spot point of aim and the four step approach.

The subjects' scores in each group were equated logarithmically. This calculation permitted the initial position, gain, and difficulty of gain from the initial position to be taken into consideration. The mean bowling improvement

score for the hook ball delivery group was found to be -0.2411. The mean bowling improvement score for the straight ball delivery group was found to be 0.3846. The mean bowling improvement score for the group in which type of delivery was not specified was found to be 0.1933. The mean improvement scores of each of the groups were compared by the t test of significance. There were no significant differences found.

The mean number of spares bowled by the hook ball delivery group was found to be 47.11. The mean number of spares bowled by the straight ball delivery group was found to be 48.3846. The mean number of spares bowled in the group in which type of delivery was not specified was found to be 56.36. The mean number of spares bowled by the three groups were compared by the t test of significance. There were no significant differences found.

The mean number of strikes bowled by the hook ball delivery group was found to be 26.22. The mean number of strikes bowled by the straight ball delivery group was found to be 27.69, and the mean number of strikes bowled by the group in which delivery was not specified was found to be 28.54. The mean number of strikes bowled by the three groups were compared by the t test of significance. There were no significant differences found.

Conclusions

The following conclusions were made by the investigator under the conditions which were placed on the study:

1. Improvement in bowling scores appears not to be influenced by the delivery method (hook, straight, non-specified), but may be attributed to practice.

2. The ability to obtain spares and strikes appears not to be influenced by the delivery method (hook, straight, nonspecified), but may be attributed to practice.

Recommendations

People differ in their preference to the type of approach and aim that they use while bowling. The following is a list of recommendations for futher study:

1. A study in which three deliveries (hook, straight, nonspecified) should be studied relative to the three, four and five step approach and the spot point of aim.

2. A study in which three deliveries (hook, straight, nonspecified) should be studied relative to the three, four and five step approach and the pin method of aim.

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APPENDIXES

APPENDIX A

Table 7

Hook Ball Delivery Group

Student	Pre-Test	Post-Test	Diff.	Rank	A%	Rank
1	123.33	91.67	-31.66	19	-2.570	18
2	107.33	116.00	8.67	5	.743	6
3	126.00	145.33	19.33	3	2.404	1
4	98.00	95.67	-2.33	8	-.159	8
5	109.67	94.67	-15.00	15	-1.113	15
6	141.67	113.33	-28.34	18	-3.121	19
7	113.00	121.33	8.33	6	.777	5
8	114.00	110.33	-3.67	9	-.317	9
9	63.00	71.00	8.00	7	.345	7
10	94.67	85.33	-9.34	13	-.574	13
11	98.67	84.00	-14.67	14	-.921	14
12	61.00	78.67	17.67	4	.798	4
13	87.00	78.33	-8.67	12	-.476	10
14	104.67	97.67	-7.00	10.5	-.511	11
15	110.33	103.33	-7.00	10.5	-.557	12
16	118.33	102.00	-16.33	16	-1.370	16
17	105.33	77.00	-28.33	17	-1.785	17
18	71.67	105.67	34.00	1	2.068	2
19	100.67	121.33	20.66	2	1.759	3

APPENDIX B

Table 8

Straight Ball Delivery Group

Student	Pre-Test	Post-Test	Diff.	Rank	A%	Rank
1	117.33	119.00	1.67	8	.158	8
2	109.00	110.33	1.33	10	.111	9
3	105.33	139.00	33.67	2	3.428	2
4	130.67	116.67	-14.00	15	-1.445	15
5	104.00	139.33	35.33	1	3.573	1
6	110.67	108.00	-2.67	12	-.220	12
7	86.00	110.00	24.00	4	1.676	4
8	122.00	112.00	-10.00	13.5	-.931	14
9	74.33	92.67	18.34	5	1.022	5
10	134.67	133.33	-1.34	11	-.162	11
11	87.67	118.67	31.00	3	2.353	3
12	153.33	134.67	-18.66	17	-2.637	17
13	92.67	82.67	-10.00	13.5	-.593	13
14	74.67	91.00	16.33	6	.900	6
15	97.67	104.33	6.66	7	.485	7
16	82.67	84.33	1.66	9	.092	10
17	109.00	91.33	-17.67	16	-1.272	16

APPENDIX C

Table 9

Nonspecified Delivery Group

Student	Pre-Test	Post-Test	Diff.	Rank	A%	Rank
1	138.67	113.67	-25.00	18	-2.693	18
2	150.00	155.67	5.67	10	.915	8
3	46.67	103.00	56.33	1	2.825	1
4	94.33	116.00	21.67	3	1.687	5
5	116.00	121.33	5.33	11	.509	10
6	122.00	138.67	16.67	6.5	1.908	4
7	158.33	118.33	-40.00	19	-5.246	19
8	100.00	79.33	-20.67	16	-1.267	16
9	136.00	128.67	-7.33	14	-.864	14
10	99.00	105.00	6.00	9	.443	11
11	83.00	104.00	21.00	4	1.366	6
12	77.00	93.67	16.67	6.5	.955	7
13	104.67	104.33	-.34	13	-.025	13
14	109.33	90.00	-19.33	15	-1.382	17
15	90.67	67.67	-23.00	17	-1.202	15
16	129.00	129.33	.33	12	.037	12
17	94.67	125.33	30.66	2	2.584	2
18	67.00	81.33	14.33	8	.691	9
19	136.33	153.33	17.00	5	2.432	3

APPENDIX D

Table 10

Sum of Spares, Strikes, and Games Bowled by Hook,
Straight, and Nonspecified Delivery Groups

Type of Delivery	Total Spares	Total Strikes	Total Games
Hook Ball Delivery Group	424	236	183
Straight Ball Delivery	629	360	250
Nonspecified Delivery Group	620	314	254