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A STUDY OF THE COMPARATIVE EFFECTIVENESS OF
FIVE-FOOT SKIS AND SKIS OF REGULAR LENGTH
IN TEACHING BEGINNING SKIERS

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

Helen Hale Briwa, B.S., M.S.

The Ohio State University 1966

Approved by

[Signature]
Margaret A. Mard
Adviser
Department of Physical Education
DEDICATION

To My Family

and

To Beginning Skiers
ACKNOWLEDGMENTS

I wish to thank my committee, Dr. Margaret Mordy, chairman, Dr. Phoebe Scott, and Dr. Lewis Hess for their suggestions and guidance in the writing of this dissertation.

I am deeply indebted to Miss Carol Joy, Miss Nancy Shay, and Miss Nancy O'Connor, members of the Department of Physical Education for Women at Colorado State University, Fort Collins, Colorado, for their encouragement and help with the testing phase of this study. Also deserving my thanks are the many physical education majors at Colorado State University who unselfishly gave their time to assist with the testing and the initial assembling of the release bindings for the five-foot skis.

This study could not have been conducted without the help of the students at Colorado State University who so willingly cooperated as subjects, the Lake Eldora Ski School, and the Taylor Ski Company, Brattleboro, Vermont.
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CHAPTER I

THE PROBLEM

The sport of skiing is growing each year at a fantastic rate. Although relatively new in the overall history of popular sport, skiing will have had 5,000,000 participants in the winter of 1966.1 Within the last forty years skiing has become one of the most popular sports in the United States.

The portable ski tow, snow-making machine, and the bulldozer have made skiing available to people outside the mountain areas and natural snow belts. Previously these people had no easy access to the sport. Even in locations where the temperature does not drop low enough to manufacture artificial snow, plastic snow substitutes are being used to give approximately the same sliding effect. Television, movies, and increased newspaper and magazine coverage have made it possible for people to share in the sport of skiing vicariously and to become almost as involved in its progress as those who actively participate on the snowy slopes.

Skiing is virtually available to everyone and as a result of this growth in interest and participation many problems have arisen.

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One of these problems is that of coping with the increased numbers of beginning skiers in our college, school, recreation, and professional ski programs. How best can these skiers be taught quickly and efficiently? Are there short cuts which can be employed to reduce the number of hours necessary for a student to learn how to ski? Are our present beliefs about teaching beginning skiers up to date or have we clung to traditional ideas which perhaps should be discarded in favor of more modern and more effective methods?

Much more research needs to be done in all aspects of skiing in the light of rapid change which has affected the sport in the past years and which will probably continue to influence it in the years ahead.

**Need For The Study**

This study can contribute to the teaching of beginning skiers by determining whether the age-old procedure of ski selection is the best method. This generally accepted method of selecting a ski according to the skier's overhead reach has been handed down from generation to generation. Even among the "traditionalists" there is a trend toward choosing a slightly shorter ski; however, there is much controversy between those who favor the regular length ski\(^2\) and those who prefer the short ski.\(^3\)

Although some research has been made on the use of short

\(^2\)Definitions of terms, p. 7.

\(^3\)Ibid.
skis.\textsuperscript{4} No studies have been done with a large group and five-foot skis. It is the purpose of this study to compare the effectiveness of five-foot skis and skis of regular length in teaching beginning skiers. It will further determine whether it is possible to begin the learning process on short skis and, then, once the basic maneuvers have been learned, effectively change to long skis. If short skis are more effective than those of regular length, we should be teaching our beginning skiers on short skis. This study can help to solve the controversy about long and short skis in teaching beginning skiers. As a result, beginning ski programs can be more beneficial to the participants.

Hypotheses

Hypothesis 1. At the four-week testing period there will be no significant difference in skiing ability, as measured by speed, between Group I (five-foot skis for eight weeks) and Group II (five-foot skis the first four weeks and regular length skis the last four weeks).

Hypothesis 2. At the four-week and eight-week testing periods there will be no significant difference in skiing ability, as measured by form, between Group I (five-foot skis for eight weeks) and Group II (five-foot skis the first four weeks and regular length skis the last four weeks).

Hypothesis 3. At the four-week and eight-week testing

\textsuperscript{4}Clifton Taylor, "A Letter to All Taylor Ski Dealers" (Brattleboro, Vermont: 1965), p. 2.
periods, there will be no significant difference in skiing ability, as measured by form, between Group I (five-foot skis for eight weeks) and Group III (Regular length skis for eight weeks).

Hypothesis 4. At the four-week and eight-week testing periods there will be no significant difference in skiing ability, as measured by form, between Group II (five-foot skis the first four weeks and regular length skis the last four weeks) and Group III (regular length skis for eight weeks).

Hypothesis 5. At the eight-week testing period there will be no significant difference in skiing ability, as measured by speed, between Group II (five-foot skis the first four weeks and regular length skis the last four weeks) and Group III (regular length skis for eight weeks).

Hypothesis 6. At the eight-week testing period there will be no significant difference in skiing ability, as measured by form, between Group II (five-foot skis the first four weeks and regular length skis the last four weeks) and Group III (regular length skis for eight weeks).

Hypothesis 7. Changing from five-foot skis to skis of regular length after four weeks will not adversely affect skiing ability, as measured by form and speed.

Limitations of The Study

This study was limited to sixty-three men and women who had elected beginning skiing as part of their physical education requirement at Colorado State University, Fort Collins, Colorado, in the
Winter Quarter of 1966. They were primarily underclassmen. There was a small number of upperclass students and graduate students.

Classes met on Tuesdays, Wednesdays, and Thursdays throughout the quarter. Each class met nine times for one lesson a week on one of these three days. The first lesson was an orientation lecture on campus and the remaining eight lessons were spend skiing at the Lake Eldora Ski Area near Nederland, Colorado. Class periods on the slopes were one and one-half hours long with one-half hour before and one-half hour after the lesson available for free skiing.

Since the testing phase of this study occupied an hour of the fourth lesson and an hour of the eighth lesson, the time spent receiving ski instruction by each subject was approximately ten hours in addition to the first meeting on campus. Five of these hours came before the first testing period and five followed the first testing period.

All participants in the study used wooden skis. Anyone having the use of a pair of metal skis was automatically omitted from the study and was placed in either Group II or Group III. Data on these people were not collected.

The experimental five-foot skis were made available by the Taylor Ski Company in Brattleboro, Vermont. These skis were equipped with an adjustable Tiesler Zip Fit release binding which made it possible for many subjects to use the same pair of skis. The bindings released at the toe and also the heel in case of a side fall
or a front fall. According to the Taylor Ski Company, the five-foot ski does not vary in the amount of camber.5

The regular length skis were rented by each student at a place of his own choosing although most of the skis were rented from one local shop. Because of this, practically all of the skis had the same plastic, no-wax, base. Release bindings attached to the regular length skis were easily adjustable.

All subjects were assigned to one of three types of groups which were equated on the basis of subjects' balance scores and skiing ability. In addition, each group contained the same number of men and women. The three types were Group I (five-foot skis for eight weeks), Group II (five-foot skis the first four weeks and regular length skis the last four weeks), and Group III (regular length skis for eight weeks). These three groups were further divided into three sub-groups, each of which met once a week on one of the prescribed days (Tuesday, Wednesday, or Thursday) for eight weeks. Three sub-groups were not possible on Tuesdays because of a small enrollment of beginning skiers on that day. Thus, the beginning skiers on Tuesdays were divided into two sub-groups.

The following procedure was followed to equate the sub-groups on the factor of dynamic balance. Balance scores for all subjects registered for the same day were ranked from highest to lowest. The subject with the highest score was placed in sub-group I, the subject with the second highest score was placed in sub-group II, the subject with the third highest score was placed in sub-group III, the subject

5Definitions of terms, p. 8.
with the fourth highest score was placed in sub-group II, the subject with the fifth highest score was placed in sub-group III, the subject with the sixth highest score was placed in sub-group I, the subject with the seventh highest score was placed in sub-group III etc. This procedure was followed until all subjects were assigned to a sub-group on the prescribed day.

The instructors for the study were members of the Professional Ski School at Lake Eldora and were well versed in the American Ski Technique which was used in this research. The same three instructors were involved in the instructional phase of the study, staying with their assigned sub-group on the prescribed day throughout the eight-week period. No exchanging of sub-groups was done by the three instructors. Because of the uneven skill breakdown causing only two sub-groups on Tuesdays, one instructor was not assigned a sub-group II during the study (Table 1).

**TABLE 1**

**INSTRUCTORS' WEEKLY SCHEDULE**

<table>
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<tr>
<td>A</td>
<td>Gr.I</td>
<td>Gr.II</td>
<td>Gr.III</td>
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<tr>
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<td>Gr.III</td>
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<td>Gr.II</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>Gr.III</td>
<td>Gr.I</td>
</tr>
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a, b, c, denote sub-groups

Gr.Ia + Gr.Ib + Gr.Ic = Group I

Although snow conditions were not typical for Colorado, there was enough snow to conduct the classes. Snow conditions did not
appear to restrict the learning of the groups. Very little powder
snow skiing was experienced by the subjects and the packed slope
conditions were quite uniform throughout the quarter.

Definition of Terms

**American ski technique.** A recent technique devised in this
country which has as its basis many other ski techniques. Primarily,
these are the Austrian, Swiss, and the Allais. This technique is
taught in most of the ski schools over the country and is the first
attempt by the Professional Ski Instructors of America to standardize
ski instruction in the United States.

**Balance.** The stability of the skier while executing a movement.

**Beginning skier.** A non-skier. One who has either never been
on skis, or who has been on skis so seldom that success in the basic
maneuvers of skiing has not been achieved.

**Camber.** The convex bend in a ski designed to distribute the
skier's weight throughout the ski.  

**Dynamic balance.** "Maintenance of posture under conditions of
continuous change of body position so as to require further muscular
activity to re-establish body posture."  

**Base of execution.** The ability of the skier to make a movement

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6Fred Iselin and A. C. Spectorisky, Invitation to Skiing (New

7Leonard Larson and Rachael Yocum, Measurement and Evaluation
in Physical, Health, and Recreation Education (St. Louis: C. V.
look effortless. The movements are executed in a relaxed manner and with no waste motion of arms and body.

**Gate.** Usually two or more poles in set patterns in a slalom course which a ski racer must pass through on his way to the finish line of a race. Recently a few races have been held using only one pole to form a gate with the racer alternately passing right and left shoulders to the series of poles.

**Position over the skis.** The alignment of the skier in relation to his skis and the hill while executing the slalom course.

**Regular length skis.** Skis which are approximately one foot longer than the skier's height. Length of ski is commonly determined by extending one hand overhead with a straight arm, while in a standing position. The tip of the ski comes to the heel of the hand or slightly below.

**Rhythm.** The movement of the skier which is marked by the regular occurrence of an accent.

**Short skis.** Skis which are shorter than six feet in length. Usually any ski falling in the range of two and one-half feet to five feet in length.

**Slalom course.** A series of gates set on a hill in different combinations which controls the pathway a racer takes. The boots of the skier must pass between the two poles bearing the same color flag.

**Snowplow.** A double stem in which the heels of the skis are pushed away from each other causing the tips of the skis to go toward each other. The result is an edging with the inside of each ski
causing a decrease in speed. This technique is used to control speed, to stop, or as a lead-up to a turn.

**Steam.** One ski leaves its parallel position to swing out at an angle to the other ski which remains in its original position. It is used primarily as a preparation for a turn.

Organization of the Remainder of the Dissertation

Chapter II consists of a survey of selected literature related to the problem. It is divided into four sections: (1) A Brief History of Skiing and Ski Techniques, (2) Short Skis, (3) Tests of Balance, and (4) A Summary of the Chapter. Chapter III is the Method of Procedure of the Study which consists of (1) Selection of Subjects, (2) Instruments of Measurement, (3) Administration of the Tests, and (4) The Statistical Procedure. Chapter IV contains (1) Results of the Tests, (2) Relationships Between Balance and Skiing Ability, (3) Significance of Length of Ski and Judges' Ratings, and (4) Absences and Practices. Chapter V presents (1) Summary, (2) Conclusions, and (3) Suggestions for Further Study.
CHAPTER II

BRIEF HISTORY OF SKIING AND SKI TECHNIQUES

The sport of skiing as we know it today dates back as far as the beginning of recorded time. What we recognize as the fore-runners of today's modern skis and ski techniques were probably known in Northern Asia two thousand years before the birth of Christ. Skiing as we know it, however, has been developed into a scientific sport only since the latter part of the nineteenth century.

The Scandinavian countries are generally considered to be the real pioneers of skiing. Even today these nations are among the leaders in the Nordic events in international competition.

From Scandinavia, where skis were counted among the necessities for the winter months, skiing spread to Europe and to the Alps. The influence of the Scandinavian countries -- especially Norway -- was very strong, and European skiers tried to adopt Norwegian methods

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3 Ibid.

to conditions existing in the Alps. This practice did not prove satisfactory because the long, sweeping, telemark turn, which was the basis of the Norwegian technique and perfectly suited to the relatively gentle slopes of Norway, could not be used successfully on the steeper slopes of the Alps which required sharper, quicker turns. Changes in equipment and technique were soon found necessary.  

Perhaps the foremost pioneer in the revision of the Norwegian style was Matthias Zdarsky. Zdarsky was an Austrian who was born in 1874. He shortened slightly the length of the ski and also invented a more stable binding. Zdarsky's main contribution to the sport of skiing was the invention of the rudiments of the stem turn. His technique was characterized by the use of one long pole which he employed as a brake to reduce his speed. Zdarsky influenced many who were to follow him. Two of these were Georg Bilgeri and Hannes Schneider. Bilgeri further refined Zdarsky's stem turn and discarded his one pole in favor of two poles. He also laid the ground work for the Austrian Alpine Technique which was later developed by Hannes Schneider.  

Hannes Schneider is considered by many to be the Father of Modern Skiing. As a racer and later as a teacher, he was able to compare ski systems existing at the time and to combine their best features into one technique. This technique he called the

\[\text{Lyttot et al., loc. cit., pp. 28-29.}\]
\[\text{K. Douglas Beakes, Skiing in Austria (R. Kiesel, Salisburg, 1953), p. 8.}\]
\[\text{Ibid., p. 9.}\]
\[\text{Ibid., pp. 11-12.}\]
\[\text{Ibid., pp. 12-13.}\]
Arlberg Technique. Schneider's most important contribution to skiing was the idea of standardizing the method of instruction within a ski school. Standardizing instruction made it possible for a skier to progress through the ski school without becoming confused by different terminology and conflicting theories. As a result, skiing received a spurt of expansion all over Austria.

Hannes Schneider sought refuge in the United States during World War II and settled in North Conway, New Hampshire. There he started his famous ski school and further spread the Arlberg Technique. Schneider gave impetus to a sport which was really just beginning to come into its own in this country.

Skiing in the United States appeared as early as 1840 when it was introduced to the Midwest region by immigrants from the Scandinavian countries. Even further west in Oregon, Colorado, and California, mail carriers in the 1840's found it necessary to use skis to negotiate the snowy sections of their routes.

Within the past forty years skiing in the United States has shown a tremendous growth. It was estimated that five million people would participate in skiing in the winter of 1966. On federally

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15Ibid.
administered public lands alone there are approximately 200 developed ski areas. 17

From utilitarian beginnings skiing has evolved into much more than a bona fide sport or a "way of life:" it is now within the realm of "big business."

In addition to the ski techniques already mentioned there are many others which have been developed and refined all over the world. Recently, representatives of leading ski techniques met in Badgastein, Austria to share ideas and demonstrate their techniques. Six major ski nations were represented: Austria, Japan, Switzerland, France, Canada, and the United States. 18

The systems of each country have as their aim the teaching of controlled skiing. In general, all systems agree on the overall format of instruction. Most teach the snowplow, snowplow turn, stem, stem christie, parallel, and wedeln in that order. However, their approach differs, especially in the starting position and in the timing and amount of lift in an action. A finished form stem christie of one nation differed from a finished form stem christie of the other nations. 19

The recent (1964) American Ski Technique is a combination of many techniques. The American Ski Technique is in use in most ski

17 Ibid.
19 Ibid.
schools in the United States and is gaining in popularity. It is the first attempt by the Professional Ski Instructors of America to standardize ski instruction in the United States. Standardization makes it possible for a beginner to start lessons in Maine and then transfer to a California ski school without losing a step in the progression. As in Austria, the formation of one technique will probably lead to a rapid rise in ski participation.

Short Skis

Ski length has varied greatly over the years, ranging from the length of a human foot to a twelve-foot long hickory board used in this country after the Civil War. The idea of a short ski is not new. Peasants in the Austrian province of Carniola used skis about five feet long in 1689. The short ski did not really gain popularity until about 1960 when Clifton Taylor, President of the Taylor Ski Company and a leading exponent of the short ski, unveiled his thirty-inch "Shortee Ski." Most of the literature related to short skis is confined to articles in popular magazines and in newspapers. A few ski companies have written articles on short skis. Actual reports of formal research using short skis are lacking. There are a few reports of

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20Seakes, loc. cit.
21Robinson, loc. cit., p. 6.
22Lytton et al., loc. cit., p. 24.
informal research being carried out with a small number of subjects involved. The investigator can find no studies done with short skis and a large group of subjects.

Controversy regarding the short ski has been carried on among leading ski experts. Some experts feel that the short ski has real merit in teaching skiing; others feel the short ski is a fad and has no place in a ski school.

Clifton Taylor has written two books on the subject of short skis. He advocates their use in teaching all levels of skiing, including the beginning level. Taylor estimates that in 1962 20,000 pairs of short skis were in use. "He predicts that the revolution will continue until, within the decade, most skiers will be converts." Lowell Thomas is a confirmed user of short skis. He feels that Taylor is "an evangelist dedicated to rescuing skiers from years of struggle with long boards." Other short ski converts are Jack Paar, Commander Edward Whitehead, and Art Linkletter. Gretchen Fraser, the first United States ski Olympic Gold Medalist, has also changed to short skis.

Hans Garger, Head of the Lake Eldora Ski School, Colorado, feels that ideally beginners should be taught on short skis, five

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25Kocivar, loc. cit.
26Ibid.  
27Ibid.  
28Clifton Taylor, Ski In a Day (New York: Grosset and Dunlap, 1964), p. 68.  
29Interview, Salt Lake City, Utah, Jan. 1966.
feet in length, and then move on to a longer length as they progress. Donald Leonard, Director of the Hidden Valley Ski School, Estes Park, Colorado, sees merit in using short skis for teaching beginning skiers. He concurs with Garger.

The Head Ski Company which makes metal short skis feels that in some cases it is definitely more beneficial to the student for him to begin on shorter skis. For older people starting to ski or for those who have to cope with some kind of fear of the slopes, the shorter ski would certainly be the best to learn on. However, I think that most people who are advocates of short skis are skiers who are not concerned with improving their technique or advancing to a greater level of proficiency. They simply find the shorter ski easy to ski on and much less demanding than a longer ski.

The founder of the Modern Austrian technique, Professor Stefan Kruckenhauser of St. Christoph, Austria, says, "In my opinion beginners should use a ski only 150 centimeters (four feet eleven inches) long. One can learn to ski parallel very quickly, and there are fewer injuries with a shorter ski." Stewart relates that "the short-ski concept has been successfully tested at the Karl Koller Ski School in Kitzbuhel for the last fifteen years." Ski manufacturer Howard Head feels that short skis are valuable in avoiding ski-school dropout.

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34 Ibid. 35 Ibid., p. 62.
Mountain Ski Area in Iron Mountain, Michigan, feels that beginning skiers can be prevented from being discouraged and dropping out of ski schools by being taught on short skis.\footnote{Anon., "Short Ski May Prevent Beginning Skier Dropout," Central Skiland, United States Ski Association (November, 1965), p. 20.}

Douglas Pfeiffer, Editor of Ski magazine and a respected expert on the subject of ski technique, suggests that short skis, after the initial period actually tend to retard a person's progress. He feels that short skis might have possible value as a remedial aid.\footnote{Letter, October 25, 1965.}

Much more research needs to be done to settle all aspects of the controversy between short skis and long skis.

This investigator's masters thesis revealed some correlation (.49) between skiing ability and motor ability.\footnote{Helen Hale Briwa, "The Relationships of Leg Strength and Motor Ability to Form and Speed in Skiing," (unpublished Master's dissertation, Dept. of Physical Education, Smith College, 1957).} It was felt that a higher correlation would be found between one of the components of motor ability and skiing ability. Because the author felt that one of the most important single factors in skiing ability also found in motor ability was the factor of balance, it was decided to equate the groups used in this study primarily on the scores of a balance test (other equalizing factors were skiing experience and the sex of the subjects). Thus, the task remained to review tests of balance and literature related to balance.

Tests of Balance

Tests of balance are divided into two classifications: those
measuring static balance and those measuring primarily dynamic balance. Over the years many tests of both static and dynamic balance have been devised. Only those felt by the author to be the most important are reviewed here.

Ruth Bass, in 1939, devised the Stepping Stone Test of Dynamic Balance and the Stick Balance Test of Static Balance. She found a reliability coefficient of .95 for her Stepping Stone Test of Dynamic Balance and coefficients ranging from .72 -- .90 for her Stick Test of Static Balance. Bass found a significant relationship between static balance with motor ability and rhythm, and between dynamic balance and general motor ability, and ratings in rhythm. Dynamic balance showed a greater relationship to general motor ability than did static balance.

Seashore, in 1941, devised a test on the balance beam which tested both static balance and dynamic balance. The reliability of the balance beam test is .85 and "it was found that an age-by-age increase in balance occurs from five to eighteen."

M. Gladys Scott devised a test of dynamic balance which she

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40 Ibid.


42 Ibid., p. 168.
called the Sideward Leap. It has a reliability of .88 and was tested using one hundred and sixteen college women as subjects. Scott, Lundquist, Russell, and Keener devised a test of static balance called Balance on a Stick Test. This test has a reliability coefficient of .72; however, Roloff found a coefficient of .86 using a similar group. The Balance on a Stick Test requires a spotter to prevent injury to a subject. Scott also invented a test of static balance called the Stork Stand.

Balance is generally considered to be a factor in athletic performance. Willgoose states,

'Naturals' for athletic events ... appear to have the will and general ability to excel in motor activity. Specifically, they have general motor ability, a qualitative component of physical capacity; demonstrated eye-hand coordination; power; strength; endurance; ability; speed; balance; eye-foot coordination; peripheral vision; and rhythm.

Many research studies have been conducted using balance as a factor. Slater-Hammel, using the Reynolds' Balance Test (static) found significant differences in balance scores among these groups: varsity athletes, physical education majors, and liberal arts majors. Scores ranged in descending order for these groups.

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48Ibid., p. 249.
Gross and Thompson found the following results in their study:

1. In general, individuals who have better dynamic balance, as determined by the Bass Test of Dynamic Balance, can swim faster than individuals who have poor dynamic balance.

2. Individuals with better swimming ability, as determined by expert judgment, tend to have better dynamic balance than individuals with poor swimming ability.

3. Dynamic balance, as measured in this study, is not a chance factor and may be an important factor in speed and ability in swimming. Further study is needed to determine whether there is a cause and effect relationship between these factors.49

Scott states,

Balance tests appear to be useful in somewhat of a diagnostic or interpretive way. For example, poor balance may explain erratic performance on certain skills, tension in trying to perform static activities, poor performance on activities such as skating, skiing, diving, dancing, trampolining, or others where dynamic balance is important.50

A great number of studies have been done, in addition to the ones already mentioned, which determine the relationships between balance and other physical skills. Other types of studies involve balance and modern dance ability; balance and agility; static balance and badminton playing ability; balance and selected physical education activities; dynamic balance and social dance skill; dynamic balance and bowling ability.51


50 Scott and French, loc. cit., p. 320.

Summary

Skiing has had a long history; however, it has been only since the latter part of the nineteenth century that skiing has become popularized. Instead of being used for such utilitarian purposes as travel and mail delivery, skiing is now a bona fide sport. In addition, it is "big business" and a source of income for millions of people.

Many skiing techniques have been developed by various people throughout the history of skiing. The technique becoming popular in the United States is the American Ski Technique. The American Ski Technique is an eclectic one as it is a combination of many other systems.

Short skis, although not a new idea, have just begun to come into their own due primarily to the efforts of pioneers like Clifton Taylor. Taylor has traveled across the country publicizing and demonstrating his short skis. There is controversy among leading ski experts as to the value of short skis. At this time no formal research has been recorded using five-foot skis and the American Ski Technique.

Many tests have been devised to measure static and dynamic balance. One of the tests of dynamic balance is the Bass Stepping Stone Test and was selected for this study because of its high reliability (.95), its use for college students, and its ease of administration.
A wealth of research studies have been conducted using balance as a factor. No studies have determined the relationship of the single factor of dynamic balance to skiing ability. None have compared the relative effectiveness of short skis and regular length skis in teaching beginning skiers.
CHAPTER III

SELECTION OF SUBJECTS

Subjects were selected from men and women who were enrolled in beginning ski classes for physical education credit at Colorado State University in the Winter Quarter of 1966. They had volunteered for this study and were primarily underclassmen.

All subjects were divided into three groups which were equated on the basis of balance, skiing experience, and sex. Balance was determined by the Bass Test\(^1\) of dynamic balance: skiing experience was determined by interview. Any student expressing an opinion against or in favor of either the short or the regular length ski was placed in the group of his choice. Thus, the variable of student bias was eliminated from the study.

Only wooden skis were used by the subjects. A student owning metal skis could not participate in the study as a subject but was allowed to join either Group II or Group III so that he still might receive college credit for the course. His data were not collected.

At the time of the balance testing, which was after the first orientation meeting and before the first lesson at the ski area, the investigator explained the adjustment of the Zip Fit binding on the five-foot skis and the system of ski pick-up and delivery to be used by all subjects throughout the quarter.

The investigator had hoped to divide each of the three types of groups (Group I -- five-foot skis for eight weeks; Group II -- five-foot skis the first four weeks and regular length skis the last four weeks; Group III -- regular length skis for eight weeks) into three sub-groups, each of which would meet once a week on one of the prescribed days. An uneven enrollment skill breakdown made this plan impossible on Tuesday. Three sub-groups were possible on Wednesday and Thursday with the following numbers: fourteen in sub-group I; sixteen in sub-group II; fifteen in sub-group III. The numbers for the two sub-groups which were possible on Tuesday were: eight in sub-group I; eleven in sub-group III.

Three professional ski instructors employed by the Lake Eldora Ski School taught all subjects. Each instructor had a different sub-group each day but remained with that sub-group on that day for the entire eight weeks (Table 1). For example: Instructor A taught sub-group I on Tuesday, sub-group II on Wednesday, and sub-group III on Thursday. Due to the uneven skill breakdown on Tuesday, one instructor did not teach a sub-group II. This rotation of group types for each instructor was done to eliminate the variable of instructor bias.
Instruments of Measurement

**Base Stepping Stone Test**

This test requires a diagram painted on the floor consisting of eleven circles with a diameter of eight and one-half inches. The circles are placed in a zigzag pattern (Appendix). The subject leaps from one circle to the next using alternate feet and landing on the ball of the foot. Each subject tries to stay in each circle a maximum of five seconds; the overall time will approach fifty seconds. Errors are sliding, touching the heel to the floor, touching the opposite foot to the floor, missing a circle, landing on the line of the circle, and hopping to keep balanced within a circle.

The score is the total time for the trip plus fifty, minus three times the total number of errors. A maximum of three practices is allowed and then the better of the next two trials is counted. The test was chosen for this study because of its ease of administration, its use for college students, and its high (.95) reliability.

**Skiing ability test**

The skiing ability test (Appendix) was an easy slalom course consisting primarily of open gates. It was set by the Head of the Lake Eldora Ski School on a gentle slope. The course was basically the same at the four-week testing period as it was at the eight-week testing period. The poles had to be removed after the four-week testing period to free the ski space for weekend skiers. There was

---

2Tbid.
some change in snow conditions from day to day which made it im-
possible to compare times between days.

Each subject was allowed two trials. The students were timed
and given a form rating by each judge for each run. Three timers
were used and four judges gave form ratings on each run for each
subject. If two watches agreed that time was used. If none agreed
the middle time was recorded.

A flag system of starting was used. The starter and flag
were stationed in the middle of the hill where they were clearly
visible to the assistant starter at the top of the course and the
timers at the finish line. Subjects were started by the assistant
starter at the top of the hill standing next to the starting gate.
The assistant starter spoke the starting signal for each subject.
The signal used by the assistant starter in unison with the waving
of the flag by the starter was: "Skier ready? One, go!" On "Skier
ready?" the starter circled the flag above his head. On the signal
"Go!" the starter touched the flag to the snow. The "Go" signal
spoken by the assistant starter coincided with the touch of the flag
to the snow. The timers started the watches when the flag hit the
snow and they stopped the watches when the boots of the skier were
through the finish gate.

The same order was followed by the subjects for both trials so
snow conditions did not favor one group. Skiers from each group raced
alternately until all had gone twice. For example: a Group I skier
skied first; a Group II skier skied next; a Group III skier skied next;
a Group I skier skied next. This procedure was followed until each subject had had two trials.

The four judges subjectively rated each skier as he negotiated the slalom course. Each judge gave a rating for form based on the skier's rhythm, balance, ease of execution, and position over the skis. The rating used for the testing was Excellent -- near perfect position, well-balanced, a regular rhythm and moves easily and gracefully; Good -- the skier is more cautious, may sometimes falter, is usually well-positioned over the skis, and has an efficient and controlled rhythm and grace; Poor -- the skier has definite trouble negotiating the course and controlling his descent, is awkward in rhythm and has an extreme position over the skis. This rating system was used at both testing periods with the addition of a numerical rating given at the eight-week testing period. At the eight-week testing period each judge, after deciding on Excellent, Good, or Poor, gave a numerical rating from seven to one. Seven is higher than one and is a better rating. For example, the best rating a skier could have received was an excellent-seven. The poorest rating possible was a poor-one. It was felt that for the final testing this system of rating would be a more discriminating evaluation of skill level.

The judges had no difficulty using the rating system. Each had had previous experience in giving form ratings in skiing and some had experience in giving form ratings in other sports as well. The judges rated each subject taking into consideration that each one had started as a beginning skier at the beginning of the season.

A record was kept of the absences and extra practice periods
outside of the class day. Subjects who did spend some time in outside practice were asked to indicate whether the time was spent in receiving instruction or in free skiing. They also reported how many hours were actually spent on the slopes. Subjects were told that any skiing done outside of class for the duration of the experiment must be done on the same length wooden skis they were using in class.

Administration of the Tests

The Bass Test of dynamic balance was given to each subject prior to the first meeting at the ski area. All groups meeting on the same day were tested in a two day period. Exceptions to this were subjects who registered late for the course. These few late registrants were tested as soon as they could be scheduled for one of the testing sessions. Because the gymnasium was used throughout the day the testing appointments were scheduled for the hours between 3:45 p.m. and 6 p.m. All balance testing was completed within six days.

Two courses were drawn on the floor for the Bass Test. One course was used for practice and the other was used for the actual testing. This was made necessary because of the large groups being tested at the same time. Both courses were painted on the floor with a washable paint. It was necessary to re-paint the circles at the end of each day’s testing due to the wear given the course by the subjects.

At the same appointment time the subjects were weighed in street clothes and given a reach test. The reach test consisted of measuring how far a subject could reach up a wall by extending his arm easily
above his head. In a standing position the measurement was taken to the center of the palm. The reach test approximates the method used by most ski shops to determine length of ski suitable for a beginning skier.

The skiing ability test was administered after the first half-hour of the fourth lesson and after the first half-hour of the eighth lesson. Each subject met with his instructor and was guided through the course one time so there would be no question as to where he should go during the actual test. Subjects were told to ski as well as they could and as fast as they could as they would be judged on form as well as speed.

Statistical Procedure

Each subject was assigned a form rating and a speed rating which were based on his performance on the two runs of the slalom course. The form rating was a total of the form grades given by all four judges. Both runs by each subject were counted toward the form total. The terms Excellent, Good, and Poor, which were used by each judge as form scores, were converted to the numerical values of thirty, twenty, and ten respectively. Form ratings given at the eight-week testing period were computed by adding thirty, twenty, or ten to the numerical rating already assigned by the judges. For example: a rating of E-seven given by a judge for one trial was converted to thirty plus seven or thirty-seven; a rating of P-four was changed to ten plus four or fourteen.

A speed rating for each subject was also determined. The
Speed rating was the time in seconds and tenths of seconds taken by each skier for his faster trial of the two trials recorded on the slalom course. Due to an uncontrollable variable of difference in speed between the five-foot ski and the regular length ski no comparison of times between groups using five-foot skis and groups using regular length skis seemed possible. Testing was done to compare the speed of the five-foot ski and the regular length ski but no formula was discovered to equalize the difference in speed between the two lengths of ski. In a straight downhill run of varying distance, alternating the short ski and the regular length ski and using skiers of different weights, the five-foot ski was consistently slower than the regular length ski.

Speed comparisons between groups using the same length ski were possible. After the fourth week it was possible to compare times recorded by Group II and Group III as they were performing on the same length skis. Times for Group I and Group II for the first four weeks could be compared since the subjects were all using five-foot skis. Because snow conditions varied from day to day it was not possible to compare times made by a sub-group on one day with times made by a sub-group on another day.

Correlations were determined between factors of form and speed, balance and form, and balance and speed. Correlation coefficients between these factors were computed for each sub-group. Form and balance correlations were computed for all sub-groups meeting on the same day after the four-week testing period and after the eight-week testing period. The Spearman Rank Order Method of Correlation was used.
Chi Square and the t test (Critical Ratio) were applied to test the Null Hypothesis at the .05 level of significance. Chi Square for each trial was computed on the basis of the judges' form ratings and length of ski. This was done at four weeks and again at eight weeks. The t test was used for form and speed ratings at the eight-week testing period to compare Group II and Group III to test the Null Hypothesis. Other comparisons of skiing ability, as measured by form, were made at the four-week testing period and at the eight-week testing period between Group I and Group II; Group I and Group III; Group II and Group III. Groups were compared to test for significant difference at the .05 level. Means, standard deviations, standard error of the means, ranges, and numbers were computed for each group. Standard error of the difference was also computed for compared groups.

Instructors and students involved in the study gave their impressions of the length of ski, and note was made of this. No effort was made to poll all subjects because it was felt that the comments gathered would be based on limited experience with one length of ski (except for Group II which had experienced both the five-foot ski and the regular length ski) and would add subjectivity to a study which the author had tried to keep as objective as possible.

Advice guiding the statistical procedure of this study was obtained from personnel in the Mathematics and Statistics Department at Colorado State University, Fort Collins, Colorado and The Ohio State University, Columbus, Ohio.
RESULTS OF THE TESTS

Bass Stepping Stone Test

Three practice trials of the Bass test of dynamic balance were allowed. Practice trials were taken on an adjacent course which was the same as the test course. These three trials were immediately followed by two counted trials on the test course. Subjects were allowed to rest between trials. The better of the two trials was counted as the subject's balance score. Balance scores were computed using the formula: balance score = total time for the trip plus fifty, minus three times the total errors.

Individual scores on the balance test ranged from thirteen to one-hundred. The mean score for all sixty-three subjects was 68.84. The standard deviation was 20.85. Group I had a mean score of 64.65, a standard deviation of 19.97, and a number of twenty-two. Group II had a mean score of 73.00, a standard deviation of 21.64, and a number of sixteen. Group III had a mean score of 67.46, a standard deviation of 22.11, and a number of twenty-six. A listing of means, standard deviations, and numbers for each group on each day appears in Table 2.

On application of the t test the difference in means between
Group I and Group II, Group I and Group III, and Group II and Group III was not significant.

### TABLE 2

RESULTS OF THE BASS TEST

<table>
<thead>
<tr>
<th></th>
<th>Group I</th>
<th></th>
<th>Group II</th>
<th></th>
<th>Group III</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T</td>
<td>W</td>
<td>Th</td>
<td>T</td>
<td>W</td>
<td>Th</td>
</tr>
<tr>
<td>Mean</td>
<td>53.87</td>
<td>73.17</td>
<td>74.0 X</td>
<td>64.63</td>
<td>76.37</td>
<td>67.0</td>
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<tr>
<td>Std. dev.</td>
<td>11.96</td>
<td>18.05</td>
<td>18.94 X</td>
<td>23.81</td>
<td>20.26</td>
<td>24.21</td>
</tr>
<tr>
<td>Number</td>
<td>8</td>
<td>6</td>
<td>8</td>
<td>0</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

**Skiing Ability Test**

Subjects were given the skiing ability test at the fourth week and again at the eighth week. One practice trial was given, followed by two trials which were timed and judged. A regular order was followed for both trials on which data were collected. In this way one group did not receive an advantage in snow conditions.

**Form—four-week testing period**

At the four-week testing period the judges' ratings of Excellent, Good, and Poor were converted to numerical ratings of thirty, twenty, and ten respectively. Form scores for each subject were computed by adding the ratings given by the four judges for both trials. Individual four-week form scores ranged from eighty (the poorest possible score) to two-hundred and forty (the highest rating possible). At the four-week testing period Group I had a mean of 145.71 and a standard deviation of 46.32; Group II had a mean score of 160.67 and a standard deviation of 43.17; Group III had a
mean score of 152.80 and a standard deviation of 14.61. Numbers for each group were: Group I -- twenty-one; Group II -- fifteen; Group III -- twenty-five.

Comparisons of skiing ability, as measured by form, were made at the end of four weeks. Group I was compared to Group II, Group II was compared to Group III, and Group III was compared to Group I. The t test was applied to test the Null Hypothesis at the .05 level of significance. None of the values found for t were significant at the .05 level. Group comparisons appear in Table 3.

**TABLE 3**

GROUP COMPARISONS OF FORM
SKIING ABILITY TEST
FOUR-WEEK

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>M</th>
<th>Std. Dev.</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>21</td>
<td>145.71</td>
<td>46.32</td>
<td>.98</td>
</tr>
<tr>
<td>II</td>
<td>15</td>
<td>160.67</td>
<td>43.17</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>15</td>
<td>160.67</td>
<td>43.17</td>
<td>.46</td>
</tr>
<tr>
<td>III</td>
<td>25</td>
<td>152.80</td>
<td>57.48</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>25</td>
<td>145.71</td>
<td>46.32</td>
<td>.45</td>
</tr>
<tr>
<td>III</td>
<td>25</td>
<td>152.80</td>
<td>57.48</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I &amp; II</td>
<td>36</td>
<td>151.67</td>
<td>45.03</td>
<td>.09</td>
</tr>
<tr>
<td>III</td>
<td>25</td>
<td>152.80</td>
<td>57.48</td>
<td></td>
</tr>
</tbody>
</table>

Speed—four-week testing period

At the four-week testing period a speed rating was also assigned to each subject. The speed rating was the time recorded in seconds and tenths of seconds that a subject took to complete one trial of the slalom course. The better time, of the two trials, was recorded
as the subject's speed rating. At the four-week period only Group I and Group II could be compared for skiing ability as measured by speed. At that time, both these groups were using the five foot skis.

Individual four-week speed ratings ranged from 11.8 seconds to 101.7 seconds. The mean speed rating for Group I was 29.44 seconds with a number of twenty-one and a standard deviation of 22.05 seconds. The mean speed rating for Group II was 40.83 with a number of fifteen and a standard deviation of 29.63. The t test was applied to test the Null Hypothesis at the .05 level of significance. A t of 1.32 was found between Group I and Group II at the four-week testing period. This was not significant at the .05 level of significance.

Form—eight-week testing period

At the eight-week testing period the form ratings were computed in a slightly different manner. In addition to the Excellent, Good, and Poor rating, the judges had also given a seven to one rating. The form rating, then, was a total of the thirty, twenty, or ten, and the number already assigned by each judge. For example: Excellent five was computed to thirty-five. In every other respect form ratings were assigned as they had been at the four-week testing period.

Individual form ratings at the eight-week period ranged from 107 to 293. Group I had a mean form rating of 206.63, a standard deviation of 49.00, and a number of sixteen. Group II had a mean form rating of 187.60, a standard deviation of 49.56, and a number of ten. Group III had a mean form rating of 197.38, a standard deviation of 54.30, and a number of thirteen.
Comparisons of skiing ability, as measured by form, were made between groups at the eight-week testing period. Group I was compared to Group II; Group II was compared to Group III; Group III was compared to Group I. The t test was applied to test the Null Hypothesis at the .05 level of significance. None of the values for t were significant at the .05 level of significance. Group comparisons appear in Table 4.

**TABLE 4**

| GROUP COMPARISONS OF FORM SKIING ABILITY TEST EIGHT-WEEK |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| Group           | N   | M   | Std. Dev. | t       |
| I               | 16  | 206.63 | 49.00 | .96   |
| II              | 10  | 187.60 | 49.56 |       |
| II              | 10  | 187.60 | 49.56 | .44   |
| III             | 13  | 197.38 | 54.30 |       |
| I               | 16  | 206.63 | 49.00 | .78   |
| III             | 13  | 197.38 | 54.30 |       |

Speed--eight-week testing period

Individual speed ratings were assigned exactly as they had been at the four-week period. Because the course was changed slightly from the four-week period, comparisons of times from the fourth week to the eighth week were not possible. A comparison of skiing ability, as measured by speed, could be made at the eight-week period between Group II and Group III. These two groups were using regular length skis at that time. Group II had a number of ten, a mean speed rating of 51.56 seconds, and a standard deviation of 31.57. Group III had
a number of thirteen, a mean of 36.89, and a standard deviation of 18.36 seconds. The t test was applied to test the Null Hypothesis at the .05 level of significance. A t value of 1.40 was found. This was not significant at the .05 level of significance.

Relationships Between Balance and Skiing Ability

Correlation coefficients were computed at the four-week testing period and at the eight-week testing period by the Spearman Rank Order Correlation Method. Relationships were determined between the factors of speed and form, balance and form, and balance and speed. Correlations between factors were determined for each separate sub-group on each day. For example: within sub-group I on Thursday; with sub-group II on Thursday; within sub-group III on Thursday. Coefficients for balance and form were also determined by combining all groups meeting on the same day (Table 5). Because it was impossible to compare speeds between groups it was also impossible to compute a correlation coefficient involving speed for all groups meeting on the same day.

Significance of Length of Ski and Judges Ratings

Chi Square was computed for each separate trial on the basis of judges' ratings of Excellent, Good, and Poor, and length of ski. Chi Square was computed at both the four-week period and the eight-week period. Values found for Chi Square for the four-week period were: 1.233 for the first trial and 2.049 for the second trial. Values found for the eight-week period were: 1.531 for the first
<table>
<thead>
<tr>
<th></th>
<th>GROUP I</th>
<th>GROUP II</th>
<th>GROUP III</th>
<th>ALL GROUPS</th>
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<tbody>
<tr>
<td></td>
<td>4 wk</td>
<td>N  N 8 wk</td>
<td>4 wk  N  N</td>
<td>4 wk   N  N</td>
</tr>
<tr>
<td><strong>Balance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>02 8 5</td>
<td>43 8 8</td>
<td>00 8 8</td>
<td>43 8 8</td>
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<tr>
<td>with</td>
<td></td>
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<td></td>
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<tr>
<td>W</td>
<td>40 4 5</td>
<td>70 6 8</td>
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<td>24 6 6</td>
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<tr>
<td>Form</td>
<td>28 8 5</td>
<td>80 7 4</td>
<td>00 7 4</td>
<td>80 7 4</td>
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<td><strong>Balance</strong></td>
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<tr>
<td>T</td>
<td>06 8 5</td>
<td>43 8 8</td>
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<td>43 8 8</td>
</tr>
<tr>
<td>with</td>
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<tr>
<td>W</td>
<td>80 4 5</td>
<td>50 6 8</td>
<td>-19 6 8</td>
<td>49 6 6</td>
</tr>
<tr>
<td>Speed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Th</td>
<td>39 8 5</td>
<td>50 7 4</td>
<td>38 7 4</td>
<td>58 7 4</td>
</tr>
</tbody>
</table>

*Significant at the .05 level.
trial and 1.689 for the second trial. These values did not approach the value of 5.99 necessary to reject the Null Hypothesis at the .05 level of significance with two degrees of freedom (Table 6).

**TABLE 6**

**CHI SQUARE VALUES**

<table>
<thead>
<tr>
<th></th>
<th>Trial 1</th>
<th>Trial 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>4th week</td>
<td>1.233</td>
<td>2.049</td>
</tr>
<tr>
<td>8th week</td>
<td>1.531</td>
<td>1.689</td>
</tr>
</tbody>
</table>

The percentage of people receiving the form ratings of Excellent, Good, and Poor was computed for the five-foot ski and the regular length ski. This was done for each trial at the four-week testing period and again at the eight-week period. Percentage was computed by dividing the total number of observed frequencies into the observed frequency for each cell (Table 7).

At the four-week period the regular length skiers were slightly ahead of the five-foot group in receiving better form ratings. This trend was reversed at the eight-week period. The difference was not significant at the .05 level.

**Absences and Practices**

The number of absences and practices for each group was computed. Group I had a mean practice time of 1.32 hours and a mean of .68 times (classes) for absences. Group II had a mean of .87 hours
TABLE 7
PERCENTAGE OF SKIERS FROM EACH SKI LENGTH
IN EACH FORM RATING

<table>
<thead>
<tr>
<th></th>
<th>Excellent</th>
<th></th>
<th></th>
<th>Good</th>
<th></th>
<th></th>
<th>Poor</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trial 1</td>
<td>Trial 2</td>
<td>Trial 1</td>
<td>Trial 2</td>
<td>Trial 1</td>
<td>Trial 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5' skiers (4th wk.)</td>
<td>26</td>
<td>22</td>
<td>40</td>
<td>44</td>
<td>33</td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reg. skiers (4th wk.)</td>
<td>27</td>
<td>29</td>
<td>46</td>
<td>43</td>
<td>27</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>5' skiers (8th wk.)</td>
<td>34</td>
<td>39</td>
<td>42</td>
<td>44</td>
<td>23</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reg. skiers (8th wk.)</td>
<td>27</td>
<td>35</td>
<td>41</td>
<td>39</td>
<td>31</td>
<td>26</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

of practice and a mean of .47 times (classes) for absences. Group III had a practice mean of 1.15 hours and a mean for absences of .56 times (Table 8).

TABLE 8
ABSENCES AND PRACTICES MEANS

<table>
<thead>
<tr>
<th></th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absences (classes)</td>
<td>.68</td>
<td>.47</td>
<td>.56</td>
</tr>
<tr>
<td>Practices (hours)</td>
<td>1.32</td>
<td>.67</td>
<td>1.15</td>
</tr>
</tbody>
</table>

It is interesting to note that the group (Group II) having the lowest number of absences per person also had the fewest hours of practice. The group (Group I) having the most absences per person
also had spent more time in practice per person. The investigator
feels that since the absences and practices were so even for each
group, this was not a factor influencing the results of the study.

There was a loss of subjects between the four-week testing
period and the eight-week testing period which affected the numbers
in each group. This loss was due partially to injuries forcing a
subject to drop the course and partially to temporary illness caus-
ing a subject to miss the final testing period. The subjects lost
represented a cross-section of the subjects and were of varying
skill. Their loss did not affect the study results.
SKIING as we know it today has had a long and colorful history. However, only since the latter part of the nineteenth century has skiing developed into a scientific sport. The popularization of the sport has brought about many changes in every aspect of skiing, including changes in technique and equipment.

Within the history of skiing the length of ski used has ranged from one the size of the human foot to one twelve feet in length. There now appears to be a trend toward selecting a shorter ski, and short skis have again appeared on the skiing scene. Primarily through the efforts of Clifton Taylor, a leading exponent of short skis, they are becoming very popular.

With the advent of the short ski much controversy has arisen between the "traditionalists" who favor the regular length ski, and the short ski enthusiasts, who feel that the short ski has a definite place not only in recreational skiing but as an aid in teaching beginning skiers.

It was the purpose of this study to determine the comparative effectiveness of five-foot skis and regular length skis in teaching
beginning skiers. It was hoped that the results of the study could shed some light on the controversy between short skis and regular length skis.

Over the years many tests of balance have been devised. One of the most reliable (.95) of these is the Bass Stepping Stone Test of dynamic balance. The Bass Test was given to each subject before the first meeting at the ski area. On the basis of each subject's balance scores, sex, and skiing ability, three groups were equated. The groups were: Group I (five-foot skis for eight weeks); Group II (five-foot skis the first four weeks and regular length skis the last four weeks); Group III (regular length skis for eight weeks). Each of these three groups was further divided into three sub-groups, each of which met once a week on one of the three prescribed days for eight weeks. Because of an uneven skill breakdown there was no sub-group II on Tuesday.

Subjects were sixty-three volunteers enrolled in beginning ski classes in the Winter Quarter of 1966 at Colorado State University, Fort Collins, Colorado. These subjects were men and women who had elected skiing as part of their physical education requirement. Classes met at the ski area once a week for eight weeks. Lessons were one and one-half hours long. One-half hour before the lesson and one-half hour after the lesson was available for added practice.

All three groups were taught by three professional ski instructors employed by the Lake Eldora Ski School. Each instructor had an opportunity to teach each type of group, with one exception. Because of the uneven skill breakdown one instructor did not teach
sub-group II. Each instructor stayed with one sub-group on one day for the entire eight weeks. For example, Instructor A taught sub-group I on Tuesday, sub-group II on Wednesday, and sub-group III on Thursday for the entire eight weeks.

This study was limited to wooden skis. The five-foot wooden skis were made available by the Taylor Ski Company of Brattleboro, Vermont. The regular length wood skis were rented from (primarily) one local ski shop. Subjects were told that any outside practice must be done on the same length wooden ski that they were using in class. A record of practices and absences was kept.

After the first half-hour of the fourth lesson and the eighth lesson, the skiing ability test was administered to each subject. The skiing ability test consisted of an easy slalom course of mostly open gates. Each subject was allowed one practice trial before being given two trials which were timed and judged.

Four judges gave form ratings of Excellent, Good, and Poor for each subject for each of the two trials. At the eight-week testing period the rating was changed slightly by the addition of a seven to one rating with seven high. At the eight-week period a judge’s form rating of Excellent--seven for a trial was the highest rating possible; poor--one was the lowest rating possible.

Each subject was timed through the course from the start to the finish. He was assigned a speed rating which was his faster time of the two trials. This rating was recorded in seconds and tenths of seconds.

Comparisons of skiing ability, as measured by form, were made
between Group I and Group II, Group II and Group III, and Group I
and Group III. These comparisons were made at the four-week testing
period and again at the eight-week period. The t test was applied
to test the Null Hypothesis at the .05 level of significance. Especi-
ally important was the comparison of Group II with Group III at the eight-
week testing period. If both groups were equal in skiing ability at
that time it would show that it is possible to change from a five-
foot ski to a regular length ski after four weeks without retarding
skiing ability, as measured by form and speed.

Comparisons of skiing ability, as measured by speed, were also
made between Group I and Group II at the four-week testing period,
and between Group II and Group III at the eight-week testing period.
At those times compared groups were using the same length ski. Other
group comparisons were not possible as it was found that the five-
foot ski was considerably slower than the regular length ski. When
the t test was applied none of the values for t were found to be
significant at the .05 level.

Chi Square was also computed on the basis of length of ski and
the judges' form ratings of Excellent, Good, and Poor. A Chi Square
value was computed for each trial at the four-week testing period
and again at the eight-week testing period. None of the values found
for Chi Square approached the value needed to reject the Null
Hypothesis at the .05 level of significance. The percentage of skiers
receiving the three form ratings was computed for the five-foot ski
and the regular length ski. At the four-week period the regular length
ski was slightly ahead and at the eight-week period the five-foot ski was slightly ahead. The difference was not significant at the .05 level.

Correlations were made between factors of form and balance, speed and balance, and form and speed. Rankings within each sub-group were made as well as form and balance rankings for all groups meeting on the same day. The Spearman Rank Order Method of Correlation was then applied to compute correlation coefficients between the two factors. The correlations found within the separate sub-groups ranged widely; however, many of them were not significant at the .05 level of significance. Highest significant correlations were found between the factors of form and speed for sub-group II on Thursday.

The most important statement coming from talks with the instructors was that it was easier to teach edge control to the five-foot ski classes. When talking to some of the students in Group II who changed from short skis to regular length skis, the investigator found they felt the five-foot ski was easier to ski on than the regular length ski.

Conclusions

Based on the data collected and the results of the statistical procedure, and within the limitations of this study, the following conclusions were formed:

1. All seven hypotheses were substantiated.
   a) Hypothesis 1. At the four-week testing period there
was no significant difference in skiing ability, as measured by speed,
between Group I (five-foot skis all eight weeks) and Group II (five-
foot skis the first four weeks and regular length skis the last four
weeks).

b) Hypothesis 2. At the four-week and eight-week testing
period there was no significant difference in skiing ability, as
measured by form, between Group I (five-foot skis all eight weeks)
and Group II (five-foot skis the first four weeks and regular length
skis the last four weeks).

c) Hypothesis 3. At the four-week and the eight-week
testing period there was no significant difference in skiing ability,
as measured by form, between Group I (five-foot skis all eight weeks)
and Group III (regular length skis all eight weeks).

d) Hypothesis 4. At the four-week and the eight-week
testing period there was no significant difference in skiing ability,
as measured by form, between Group II (five-foot skis the first four
weeks and regular length skis the last four weeks) and Group III
(regular length skis all eight weeks).

e) Hypothesis 5. At the eight-week testing period there
was no significant difference in skiing ability, as measured by speed,
between Group II (five-foot skis the first four weeks and regular
length skis the last four weeks) and Group III (regular length skis
all eight weeks).

f) Hypothesis 6. At the eight-week testing period there
was no significant difference in skiing ability, as measured by form,
between Group II (five-foot skis the first four weeks and regular
length skis the last four weeks) and Group III (regular length skis all eight weeks).

g) Hypothesis 7. Changing from five-foot skis to regular length skis after four weeks did not adversely affect skiing ability, as measured by form and speed, and demonstrated by Group II (five-foot skis the first four weeks and regular length skis the last four weeks).

2. Because no significant differences were found between groups using the five-foot skis and groups using skis of regular length, it is possible to conclude that the use of five-foot skis is as effective but, according to the evidence, no more effective than the use of regular length skis in teaching beginning skiers.

Form means at the four-week testing period showed one five foot group (Group II) slightly ahead of the regular length group (Group III). Interestingly enough, the other group using five-foot skis at that time (Group I) showed a lower form mean than both the regular length group (Group III) and the short ski group (Group II). However, both short ski groups together (Group I and Group II) showed a form mean barely below the form mean for the regular length group (Group III). Standard deviations showed that scores for the regular length group were spread more than those of either of the short ski groups.

At the eight-week testing period the short ski group (Group I) had a higher form mean than the group using regular length skis (Group III). The group that had changed from short to regular length skis (Group II) dropped to third place in mean form scores. Standard deviations showed that scores for the regular length group were spread more than the other two groups. This situation was exactly as it had
been at the four-week testing period. None of the differences found at either the four-week or the eight-week testing periods were significant at the .05 level of significance and most were only significant at the .05 level. The form ratings seemed to slightly favor the regular length skis at the four-week testing period and to favor the five-foot skis at the eight-week testing period.

3. Group II (five-foot skis the first four weeks and regular length skis the last four weeks) and Group III (regular length skis for all eight weeks) showed no significant difference in skiing ability, as measured by form and speed, at the eight-week testing period. Group III was ahead of Group II in both the form and speed ratings at that time and showed a larger standard deviation. However, since these differences were not significant at the .05 level (the form t was not even significant at the .05 level; the speed t was significant at the .20 level), it is possible to conclude that changing from five-foot skis to regular length skis after four weeks did not adversely affect Group II.

4. Because the highest correlation between balance and form for all groups was .58 and .88 within sub-groups, it is possible to conclude that a test of balance might indicate a tendency toward, but would not be a highly effective means of, predicting skiing ability. A test of balance might be more highly effective if used in combination with other factors such as agility, courage, motivation, reaction time. There is also the outside possibility that a test of static balance might show a higher correlation coefficient than did dynamic balance.
Perhaps using advanced or intermediate skiers the coefficient could be raised. These possibilities need to be explored.

What has this study found which can be used to help beginning skiers master the sport of skiing and make ski programs more effective? What implications can be drawn from the results?

This study has proved that (1) five-foot skis and skis of regular length are equally effective in teaching beginning skiers; (2) a person can start on five-foot skis and after four weeks change to skis of regular length (this is really a period of five hours); (3) the factor of balance might give some indication of skiing success on the beginning level but balance does not seem to be highly correlated with skiing ability, as measured by form and speed.

Based on these objective results found in this study the author wishes to present the following possible implications:

a) A beginning skier could select ski length by preference rather than having to use the "traditional" method of reaching the arm overhead and choosing a ski which came to the heel of the hand.

b) A purchasing agent with the assignment of buying ski equipment for a beginning ski program would have more freedom for bargaining and obtaining the best "deal" with the added choice of five-foot skis. New five-foot skis made of metal cost eighty dollars without the bindings (Head Ski Company 1965 catalog). The most inexpensive new metal regular length skis from the same company cost one hundred and ten dollars without bindings. This is a saving on new metal skis of thirty dollars per pair and would be a great saving to a school or organization ordering several pairs. The difference
in price between five-foot wooden skis and regular length wooden skis would be in approximately the same proportion.

c) A beginning skier wishing to purchase his own equipment could save the same amount by buying five-foot skis. This would be extremely important to the beginning skier starting skiing on a limited budget. The money thus saved on the five-foot skis could be spent on lessons or the purchase of a better boot. The author feels that the boot is probably the most important piece of equipment for skiing success.

d) A beginning skier, having once started on five-foot skis, could make the adjustment to regular length skis if necessary. It would be necessary in cases where the skier wished to achieve great speeds in downhill running or to be a slalom or downhill racer. Five-foot skis are slower than skis of regular length and because of their shorter length would not be quite as stable as a longer ski in a downhill run.

The subjects in Group II who changed from short skis to regular length skis felt it took them the first half-hour of the fifth lesson to make the adjustment and "feel at home" on the regular length skis. The author feels that some of the adjustment was made necessary by the difference in speed between the two lengths of skis as well as the difference in length itself.

e) Skis of regular length require more storage space than do five-foot skis. A school or organization having to store equipment in a limited space could at least begin to solve their space problem by purchasing five-foot skis. Also, a program which of necessity
transports students and equipment to a ski area would find five-foot skis more convenient to load than the regular length skis. For programs which must transport equipment by hiring two or more equipment carriers the five-foot ski might cut the hiring in half and thus be economically advantageous.

Based on subjective evidence produced as a result of this study other implications are possible.

a) Five-foot skis appeared to the author to be easier to handle as observed in kick turns, step around turns, sidestepping, herringboning, recovering from a fall, and even maneuvering into the starting gate of the skiing ability test. (Perhaps a different type of skiing ability test which forced a subject to use other skills such as climbing and kick-turning to an opposite direction would have shown a significant difference between ski lengths).

b) The author has skied on five-foot skis and on skis of regular length on varying terrain and finds the five-foot skis much easier for mogul skiing. (Beginners who usually ski moguls incorrectly would probably find five-foot skis even easier than the author has found them.)

c) The author has seen hundreds of beginners take their first steps on long skis and feels that much of the awkwardness and discouragement could be eliminated by the use of the five-foot ski in the beginning stages. If extra length serves no purpose for initial learning why should there be that extra length to add to the unwieldiness of the ski?
d) A beginning skier trying to carry a pair of regular length skis is a safety hazard to any people in the immediate area and a potential destroyer of windows, lamps, and breakable objects in his way. He is much less awkward, more self-confident, and less dangerous with five-foot skis.

e) Students in Group II (those who changed from five-foot skis to skis of regular length) felt that five-foot skis were easier than regular length skis. One subject who wanted to be a racer felt that five-foot skis were too easy to ski on and did not make him work hard enough to improve his technique.

f) Edge control, which is necessary for all skiing techniques, was taught more quickly and more easily to the five-foot group.

g) The shorter length of the five-foot ski makes it potentially safer than the regular length ski in a situation when the ski tip is dug into the snow and the release binding does not come free. The added length of the regular length ski in the same situation adds to the possibility that, with the greater leverage, a leg bone might be more easily broken.

h) One or all of the previously mentioned factors might have a psychologic effect on a beginning skier's outlook toward the sport of skiing. Just the awkwardness of carrying a regular length pair of skis might discourage a beginning skier in the early stages of learning. Having confidence in his five-foot skis, knowing that they have less of a danger potential than the regular length ski, might give added inducement for learning.

If all the evidence, both subjective and objective, was taken
into consideration the author would favor buying five-foot skis for ski programs, which include the teaching of beginning skiers, instead of regular length skis as is now the practice in schools and colleges across the country. The final decision should be left with the individual or the school. Skiing can be learned on either five-foot or regular length skis. If a student is willing to work hard the rewards of learning this great sport will far outweigh the trouble taken and the money spent.

Suggestions for Further Study

As a result of the work done on this study, some suggestions for further research have appeared.

1. A study of the comparative effectiveness of five-foot skis and regular length skis in teaching beginning skiers -- using metal skis.

2. A similar study using two and one-half foot skis as starters and then progressing to three-foot skis, four-foot skis, five-foot skis, and regular length skis.

3. A similar study using older people as subjects.

4. A similar study using "problem beginners" or "ski school drop-outs" as subjects.

5. A similar study using beginners who have recently recovered from a ski injury.

6. A similar study using four-foot skis instead of five-foot skis.
7. A study of the interest and skiing ability of the subjects used in this experiment as they appear in five years.

8. A study to determine the relationships between skiing ability and balance using Intermediate or Advanced skiers.

9. A study of the relationships of the factors of fear, reaction time, agility and other selected factors to form and speed in skiing.
APPENDIX
DIAGRAM OF THE SKIING ABILITY TEST

- Pathway of skier

START

X

X

Slope 20°

Approx. 30' between gates

FINISH

X

15' X Gate

X
DIAGRAM OF THE BASS STEPPING STONE TEST
OF DYNAMIC BALANCE

Finish

○ 8½" in diameter
X = Starting circle
18" from X to ➊
33" between the other circles
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