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THE SUITABILITY OF A MICROCOMPUTER FOR USE AS A PRODUCT
EVALUATION TECHNIQUE IN GOLF ACTIVITY CLASSES

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**The Suitability Of A Microcomputer For
Use As A Product Evaluation Technique
In Golf Activity Classes**

Charles E. Patch

**A dissertation presented to the
Graduate Faculty of Middle Tennessee State University
in partial fulfillment of the requirements
for the degree Doctor of Arts**

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THE SUITABILITY OF A MICROCOMPUTER FOR
USE AS A PRODUCT EVALUATION TECHNIQUE
IN GOLF ACTIVITY CLASSES

APPROVED:

Graduate Committee:

Ken P. Reader
Major Professor

Ralph B. Ballou
Committee Member

Wallace R. Martin
Committee Member

Ray D. Penny
Head of the Department of Health, Physical Education,
Recreation, and Safety

Mary Trachten
Dean of the Graduate School

Abstract

The Suitability Of A Microcomputer For Use As A Product Evaluation Technique In Golf Activity Classes

Charles E. Patch

In areas of the country where inclement weather may play a significant role in the scheduling of Physical Education activities, the Mitsubishi Golf Trainer, model GL - 500, may be used as an alternative and objective test device in an indoor golf skills testing situation as a viable method of product evaluation or full swing skills assessment. This study shows that "clubhead speed," one of the golf swing parameters measured by the microcomputer, significantly relates to outdoor golf range skills testing on a reliable and repeatable basis. The findings of this study are based on the full swing golf skills of beginning golf students measured during the Fall, 1984 semester in Physical Education golf activity classes at North Carolina State University.

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Chapter I

Introduction

Forecasters of the future indicate that by the year 2035, one-third of the United States population will be sixty-five years of age or older (Dunn, 1984). We have witnessed a nationwide activity boom during the past decade as "wellness" and "fitness" have become household words. The popularity of leisure time activities coupled with the prognosis for the future, when a far greater number of people will be seeking ways to cope with increased leisure time, indicates that, from the standpoint of planning, there exists a need in the profession of Physical Education to prepare itself for that future state now. There is also a need on the part of colleges and universities to increase the scope of physical education course offerings as well as to seek ways of expanding the calendar availability of those courses. In other words, we should see the development of a greater course selection within the curriculum as well as an extension of those periods during the academic year when that particular course is offered, to the point where the restrictive times of the year for course availability are no longer a factor.

In the development of a curriculum of activity courses to be taught year round in a physical education

service program, pertinent questions addressed in that process pertain to the total amount of class time to be spent in the various instructional phases, such as the skill introduction phase, the practice phase, the performance phase, and the evaluation phase. In narrowing this inquiry to the skills evaluation phase of an activity course, Brown (1982) suggests the existence of two choices or alternatives of evaluation strategies for the practitioner: product evaluation and process evaluation.

Product evaluation is a measure of the result of a performance and is the easier of the two types to administer. Examples of a product evaluation would be a timed event such as a race in swimming, or an event where the results are measured by distances as in a field event on the track, or even a scored event where the count determines the outcome, as on a golfer's scorecard. Although all three examples use performance to measure the skill level of the participant, it can be seen that they do not accurately indicate how well each individual skill was performed. Process evaluation is form evaluation, the quality of the movement in the execution of the skill, as in gymnastics or diving events where a subjective assessment is necessary. A legitimate question may be asked as to whether the two evaluation alternatives are related. Simply phrased, it has often

been said that form determines the results. If the form is judged to be good, chances are that the results will also be good. Contrary arguments will also be presented at some future time.

Some physical education activity courses may only be taught during certain periods of the academic year. The restriction most often imposed on course offerings or a particular course's availability is usually a result of environmental factors. Golf, the subject addressed in this study, can be taught year round. Yet the environment can and will play a major role in the structure and organization of a specific class. Questions addressed during course and calendar development should consider how the evaluations or skill analyses would be conducted when inclement weather determined that the entire class time would be spent indoors. Essentially the question becomes: How does testing take place? The limitation imposed by environmental factors may preclude the use of product evaluation, as in analyzing the results of a full swing golf shot, due to a lack of indoor facilities needed for an 85 yard golf testing range. Process evaluation, perhaps more difficult to administer, then becomes the primary means of analysis.

Statement of the Problem

The purpose of this study was to determine if a

microcomputer, trade name Golf Trainer, was suitable for use as a product evaluation technique in skills testing in beginning golf activity classes within the physical education service program at North Carolina State University.

Significance of the Study

A totally objective analysis or product assessment of full swing skills in beginning golf does not exist during inclement weather periods at North Carolina State University. Those periods normally occur during the second half of the Fall semester (F2) and the first half of the Spring semester (S1). As most North Carolina State University physical education service program activity courses are of eight weeks duration (13-15 class meetings) and as golf is offered year round in the curriculum, golf classes taught during F2 and S1 are often unable to meet outside to practice and to perform full swing skills testing on the practice range. During those restricted periods, skills testing must be performed in the indoor facility where eight hitting cages are located. Skills assessment at that time consists of two methods, both of which are process evaluations. The first is a form checklist adapted for North Carolina State University's use and originating from the National Golf Foundation (1972). The second is a video tape camera and playback

machine with a monitor which is shared with other physical education activity classes.

As an evaluative tool the form checklist can be used in a relatively short time per subject by an experienced instructor, yet it remains a very subjective device. Additionally, video taping equipment has been used as a means of assessing golf swings for a number of years (DeBacy, 1970 and Smith, 1969). In all instances, however, there is an acknowledgement of subjectivity. In instances where one golf instructor rates the golf swings of all of the beginning golf students, that judgment may be of a minimal amount of variance from subject to subject. In the case of multiple instructors however, wide variations in skills analysis would seem to exist, an inherent weakness in the process evaluation technique. Other limitations, as yet unknown, may be present. As physical educators we are obligated to continue to research, to evaluate and to seek new ways to improve upon methods of skills appraisal presently in use in our field--as in this project--examining the possibility of product evaluation for the indoor golf setting.

In 1982 Mitsubishi Electric introduced the Golf Trainer, a microcomputer which is intended to measure various golf swing parameters and to visually display the

results--the product--of each golf swing to the subject. The question addressed in this endeavor was: Did the parameters displayed electronically by the Golf Trainer correlate with the results of outdoor golf swing skills tests? Then, perhaps during those periods of the academic calendar year when inclement weather is the norm, if the administration of an indoor test with the Golf Trainer does not prove to be too cumbersome or time-consuming, the Golf Trainer could be utilized as a product evaluation technique. Perhaps a more objective assessment tool in the beginning golf activity classes would aid in improving the basic course of instruction; ultimately relating directly to future societal needs and interests.

Delimitations

1. The study was limited to North Carolina State University male and female students enrolled in pre-selected golf classes in the required physical education service program during the Fall semester, 1984.

2. The study addressed only the question regarding a potential correlation between outdoor and indoor skills testing techniques and did not examine factors such as distraction or interference which may have affected the interrelationship of indoor and outdoor testing results.

3. The study was limited in the data generated by the fact that physical education service classes at North

Carolina State University meet only two times per week.

4. The study did not address the relationship of the Golf Trainer with goal-directed movement patterns in skill acquisition or learning situations (Gentile, 1972).

5. The study did not provide information as to the value of the feedback of the visual display--product of the swing--to the performer or to future performances.

6. The study did not address the enhanced skill learning environment which may have been created when the Golf Trainer was employed in coordination with other devices which have been shown by previous research to aid knowledge of performance results.

7. The study did not address the significant differences in test results created by a subject having previous experience in conditions simulated during the outdoor range test as opposed to having no previous practice experience on the Golf Trainer.

Definitions

Activity class A structured class setting at North Carolina State University where the student is exposed to qualified instruction in a sport-related skill or skills; and which may take the form of individual, dual, team, aquatic, or rhythmic physical education experiences.

Golf Trainer A commercially available microcomputer, model GL-500, manufactured by Mitsubishi Electric of Japan

which visually displays nine aspects of the results of a single golf swing.

Physical education service program The physical education curriculum of North Carolina State University from which currently enrolled male and female students may select physical education activity courses to enable them to meet North Carolina State University general education graduation requirements.

Basic Assumption

1. The golf skills test as performed on the outdoor golf range is a valid and reliable measure of the beginning golf swing skills of North Carolina State University male and female students.

Hypotheses

For the purposes of this study, the following hypotheses have been developed:

1. Regardless of the terminology of the measured product parameters of the Golf Trainer, a correlation will be found to exist between the results of the golf range test and the results of the Golf Trainer tests.
2. There will be a significant difference in male and female test results on the Golf Trainer.
3. As beginning golf classes are made up of students exhibiting a wide range of previously acquired golf swing skills, there will be a significant range of scores

achieved with the Golf Trainer just as with the outdoor range test.

4. There will be a significant increase in skills test scores from the first or initial Golf Trainer skills testing sequence to the second Golf Trainer skills testing sequence as a result of the learning experiences of each student.

Review of Related Literature

During the past five decades, there has been a tremendous amount of golf-related literature published. A reason for the relatively high volume of publications may be related to statistics published in 1975, which state that approximately twelve million Americans enjoyed golf on a regular basis (National Golf Foundation, 1975). Much of the literature has been directly concerned with ways to improve the game of the individual golfer--an approach to qualitative enhancement of leisure time. Here it should also be noted that the commercial market represented by those figures is extremely large. To give additional credence to that reference to commercialism, in a ten-year period since October of 1975, there have been forty-four articles published in Golf magazine directly concerned with the golf swing or its related parts. Of that total, in three of those articles some mention is made of analysis through the use of visually

oriented equipment, such as sequence cameras or movie cameras. Tolhurst (1977) discussed the still camera and movie equipment without spending much time on any one aspect of scientific analysis. Later (Tolhurst, 1983), he commented briefly about computer simulation of the swing and how much it would someday improve golf teaching. In both of those articles, the thrust appeared to be more related to the potential for commercial endeavors, rather than to the practitioner's viewpoint of improved teaching methods. In the third article, Barkow (1978) interviewed Ariel, noted for analysis of athletic movement with computer-enhanced equipment. Ariel underscored one of the basic premises of this study in emphasizing the need for electronic analysis of the golf swing, as he stated:

the human eye cannot quantify human movement. The important things--timing, relative speeds of dozens of limbs and body segments, changes in centers of gravity--must be measured, weighed and compared to be of value. The best coaches cannot see these things with their own two eyes. Even exterior movements, which they can see, are hard to follow. They happen too fast. How can anyone see the position of the clubface at impact when the ball is on the clubface less than one millisecond, .8

to be exact? A coach or player may guess right, but if not, much time is lost, maybe a career, for taking the wrong tack (Barkow, 1978, p. 59).

Golf has experienced its share of adjunct devices introduced into the classroom, with the basic intent of those devices to supplement and to improve the course of instruction as well as in aiding the analysis of the golf swing. A review of some of the commercially available equipment will indicate the wide variety and long time availability of that equipment.

Chui (1965) described the Golf-O-Tron as a device used to simulate the game of golf. He found that improvement results gained through the use of the Golf-O-Tron were not significantly greater than those results gained with conventional practice range methods.

Roberts (1966) investigated the effect of utilizing an oversized golf ball in the initial stages of beginning golf classes. She found that although initial skill gains occurred at a faster rate when using an oversized golf ball, long term development of the golf skills of an individual were not significantly affected.

Gensemer (1968) tested the effectiveness of the Golflite in improving swing patterns and found that the improvement of the experimental group (Golflite) was not significantly greater.

Thomas (1969) used a visual perceptual device, a Y swing mat in teaching the downswing. He found significance at the .01 level favoring the experimental group over the control group when the groups were tested with both a 5 iron and a 9 iron.

Thompson (1969) used a "graph-check-sequence" camera and found that the immediate external feedback provided by the camera facilitated learning of both the 5 iron shot and the golf drive.

Both Parchman (1970) and Griffiths (1970) used cinematographic equipment in assessing golf strokes. In the Parchman study, the purpose was to cinematographically analyze the movement and timing of selected body segments during the execution of the golf drive. Her descriptive analysis related to the lack of straight lines formed by the club, hands, and arms at address; wrist angle changes early in the backswing; back knee (knee farthest from the target) movement during the backswing; lateral versus rotational hip motion initiating the downswing; and finally, differing wrist uncocking positions during the downswing. Griffiths compared the skilled and unskilled golfer's drive shots cinematographically to determine differences existing between the two groups and to analyze what factors were essential for a well-executed drive. A partial listing of her conclusions follows:

- (1) swing patterns were essentially the same from one

club to another, (2) individual swing errors were compensated for when square clubhead contact with the ball was achieved, (3) subjects hitting greater distances exhibited a more upright swing plane with nearly the same plane for the backswing and downswing, (4) greater distances were a result when shoulders turned more on the backswing than did the hips, (5) greater pelvic rotation at impact occurred with the skilled golfers, and (6) wrist cock was maintained farther into the downswing by the skilled golfers.

Matthews (1971) found that a video tape replay was an effective instructional aid in teaching the golf swing, that a significant skill improvement was accomplished through its use.

Yost, Strauss, and Davis (1976) tested the "golfer's groove," a piece of equipment which can be seen in current use at many courses, clinics, and schools today. They found that the device significantly influenced the accuracy of the drives of male and female college students. Skrinar and Hoffman (1978) reexamined that same "golfer's groove" as an instructional adjunct and found evidence contrary to that of Yost, et al. Skrinar and Hoffman found no significant advantage for the subjects using the "golfer's groove" and stated that the reasons for the

discrepancy in their findings in respect to Yost, et al. were due to the type of testing and the methods utilized by Yost, et al. From this cursory examination it appears that a recognizable need for product evaluation in relationship to teaching golf has been evident and has been searched for within the profession for a number of years.

Of paramount concern to the practitioner in physical education classes should be the learning experience of each and every student. That concern should take shape and find expression in an ongoing search for significant ways to improve upon those learning experiences. In this study, that search for improved teaching addresses the need for a better method or technique to be used in evaluating full swing golf skills. Product evaluation--the performance result--is probably of more importance to most average or weekend golfers than is process evaluation, the form exhibited during that performance. In golf there is a trite but true expression, "It ain't how, but how many!" To further illustrate the need for continued research, Suttie's (1983) study suggests that

there have also been attempts by golf instructors to evaluate the beginner's golf swing through the use of rating systems. When using this method, the instructor relies on his sense of vision and his

knowledge gained from years of teaching experience. This method of rating the beginner's golf swing is little more than an opinionated guess and seems to be a very subjective and unscientific method of evaluation (p.7).

McKee (1949) sought a way of testing the skills of golf students indoors which would correlate to outdoor skills testing. She used cotton balls for the indoor skills test and found that the range (distance the cotton ball traveled) was a valid and reliable measure of the product of the full golf swing. Since that early research, it has been found that a full swing skills test, when performed on an outside range, can be statistically reliable in its relationship to the existence of golf swing skills. A putting test on the other hand, has been found to be highly nondiscriminating (Rowlands, 1974). In continuing, other studies have shown that a multiple battery of tests would prove a more effective predictor of ability levels than would a single test (Green, 1972). Researchers have also considered the effect on skills testing that changing the sequence or order of instruction would have on the students, as in presenting the whole method or the part-whole method, and subsequently found out that no significant differences existed (Holt, 1970; Wurzer, 1972; Mason & Burkhardt, 1973; Kraft, 1983).

Much of the research in relationship to skills testing would prove to be both awkward and difficult to duplicate in a formal class setting, such as using grip pressure transducers (Budney, 1979) in teaching the correct grip. In the case of multiple club testing (Keth, 1967; Budney & Bellow, 1979), it would also prove to be very time consuming and in an activity class of limited duration, the time allotment is of prime importance.

Several studies (DeBacy, 1970; Smith, 1969; Matthews, 1971; Melville, 1983) have researched golf swing skills using video tape equipment in conjunction with a particular research topic. In the conclusions reached by Smith (1969) for example, students in the tested groups felt that because they were able to view their own performances, they had a better understanding of that particular golf shot. To refer again to Brown (1982) and the "product versus process" approach in evaluation techniques, an increase in the objectivity of the skill movement analysis can best be accomplished through the product approach. With computer technology as it is, a product analysis through electronic means should be possible within a framework of limitations, most notably time and space. Additionally, an examination of the product of a specific golf swing through the use of computerized equipment which is suitable for classroom use should also enhance the

learning experiences of the students. In this manner, specific attributes of the golf swing which are needed for the best possible results may be more easily learned by the student. According to Gentile,

the learner must recognize that the task is to produce a particular outcome. The learner must realize that the means through which the outcome is produced are his responsibility. Under the requirements imposed by the goal to be attained, the student must organize a specific movement that matches environmental demands (Gentile, 1972, p. 15).

As an addendum to Gentile's statement, the teacher, in establishing the organization and structure of the class, should be desirous of the highest possible levels of objectivity attainable in the evaluating procedures to be used. However, Gentile feels that

given the unique structural configurations of each individual and diversity in units of movement available through prior learning, it is naive to assume that one form of movement organization, precisely delineated by the teacher, will yield goal-accomplishment for all performers (Gentile, 1972, p. 17).

Recently published research on the Golf Trainer (Owens, Bunker, & Gansneder, 1984) found two problems

with the machine. One, a "lack of accurate (valid) information in comparison to field test data," and two, "a differential level of accuracy based on sex" (Owens, Bunker, and Gansneder, 1984, p. 306). It should be pointed out that the study cited was made up of golfers of advanced skill levels (handicaps of four or less), an ability group within which discrimination of swing characteristics would be a near impossible task for even an experienced teacher to qualitatively assess through the use of a process technique. In the study conducted at North Carolina State University in the physical education service program, the beginning golf skill levels of the males and females evaluated required a lesser degree of discrimination.

Chapter II

Methods

This study was conducted during the second half of the Fall semester, F2 - 1984, at North Carolina State University. The objective of the study was to determine if a correlation existed between the results of a golf skills test on an outdoor range with the results obtained with a Mitsubishi Golf Trainer, model GL - 500, hereafter referred to as "Mitsubishi," at an indoor testing station. The study involved four beginning golf classes, with a minimum enrollment of nineteen and a maximum enrollment of twenty-two, meeting twice a week for periods of 45 minutes duration, Tuesday-Thursday sections, at 12:15pm, 1:20pm, 2:25pm, and 3:30pm. The same instructor was assigned to all four classes. Additionally, all four classes received the same treatment in respect to teaching methods and course content, with the exception of testing differences as noted in the description of the testing completed within each class. The male-female makeup of the classes was assigned by computer during registration, and all of the students were currently enrolled students at North Carolina State University. The skill levels in each class ranged from the total beginner to a very limited number of competent

golfers.

The classes were identified as follows:

12:15TH - Group 1, N=19, consisting of 11 males
and 8 females.

1:20TH - Group 2, N=20, consisting of 15 males
and 5 females.

2:25TH - Group 3, N=22, consisting of 14 males
and 8 females.

3:30TH - Group 4, N=21, consisting of 12 males
and 9 females.

The testing was designated as either Range test #1, Range test #2, Mitsubishi test #1, or Mitsubishi test #2. The range test used has been conducted at North Carolina State University for the past twelve years, with the total number of students tested on the practice range in excess of twelve thousand. The range testing was conducted in the following manner. Each student hit ten shots to a target "green" with an eight iron. The males were stationed 85 yards from the target while the females were at a 70 yard distance. The target was an elevated area approximately twenty-five yards wide and thirty-five yards deep in relationship to the students. The scoring areas were clearly defined to the students prior to the testing. The scoring of each shot was determined by the impact of the ball in the scoring area as follows:

4 - ball landed on the elevated portion

- 3 - ball landed within ten yards of the green,
long, short, left, or right
- 2 - ball reached the halfway point in the air,
regardless of the trajectory of the shot
- 1 - ball and club contacted, may have had no
ball flight
- 0 - a swing and miss, counted as a swing trial.

Procedure

Range testing began voluntarily with from one to six students per test group, when each student determined that he or she was ready. Each student was allotted two practice shots on the range at the beginning of the test, the scores for which were not recorded.

The Mitsubishi skills test consisted of hitting ten shots by each student after two practice shots on the device had been taken. There were no prior practice swings on the machine, but a suitable warmup period in the golf room was allotted each student. There were six areas of measurement visually displayed by the Mitsubishi, which were recorded following each swing trial. Those parameters are as follows:

1. Accuracy - in relationship to the target
line
2. Hitting area - Toe, Sweetspot, Heel
designation for contact point with the
clubface

3. Path - Left, Straight, Right, indicating the direction of the shot
4. Face angle - in degrees, in relationship to the target line
5. Carry - in yardage, of ball travel in the air, discounting external factors
6. Speed - miles per hour of clubhead speed upon contact with the ball.

The Mitsubishi has additional parameters indicating forms of error in the swing trial. An "E" displayed indicates error which means that the golf club struck the mat platform too forcefully, and the microcomputer was unable to respond. A "T" recorded on the test data sheet means that the sole of the golf club was more than three-quarters of an inch from the surface of the mat platform and the electronic sensor for the microcomputer could not detect any swing parameters as a result. In addition, the machine will on occasion partially print out a swing result for a reason known only to itself.

All data were collected and recorded by one instructor. The testing sequence was conducted in the following manner:

Group 1 - Range test #1	- Range test #2
Group 2 - Range test #1	- Mitsubishi test #2
Group 3 - Mitsubishi test #1	- Range test #2

Group 4 - Mitsubishi tests #1 and #2.

The Mitsubishi response variables were: accuracy (Macc), carry (Mcarry), face angle (Mangle), hitting area (Mhit), path or shot direction (Mpath), the percentage of bad shots (Mmuff), and speed (Mspeed). The classification variables were: class, handedness (left or right), sex, and social security number (SS). Transformations were done in the following variables:

1. face angle (Mangle):

code	numerical value
open and degrees	+ degrees
closed and degrees	- degrees
zero face angle	0

2. hitting area (Mhit):

code	numerical value
T (toe)	1
S (sweet spot)	0
H (heel)	-1

3. path (Mpath):

code	numerical value
S (straight)	0
L1 (left one unit)	-1
L2 (left two units)	-2
L3 (left three units)	-3
R1 (right one unit)	1

R2 (right two units) 2

R3 (right three units) 3.

During the testing, all recorded scoring was labeled by swing trial number, so that the first through the tenth swing test trial of each test type (practice range and Mitsubishi) were comparable by rank order. The testing methods and procedures used were recommended by Dr. A. C. Linnerud, Associate Professor of Statistics, North Carolina State University.

Every student was classified in only one of the four test sequence possibilities. There were two types of data sets, "M" and "O", which correspond to those students who took the Mitsubishi test and those who took the original or range test. Hereafter for clarification and computation purposes, the term "original" will be substituted for "range" in discussing the testing.

First, the interest of the study was to analyze the original and the Mitsubishi tests for the degree of repeatability or reliability of the tests through the use of correlation coefficients in the form of a correlation matrix. Then the original and the Mitsubishi tests were examined--as in OM and MO test sequencing--to find if any of the response variables in the Mitsubishi test would significantly correspond to the original test, again through a computed correlation matrix, at a level of significance of .05 or less.

Chapter 3

Results

In analyzing the data, first for reliability of the tests, Tables 1 and 2 deal with the original test while Tables 3, 4, and 5 relate to the Mitsubishi testing. Table 1 shows the results of original test #1 and the retest, original test #2, in terms of mean and standard deviation. In Table 2, the sample correlation coefficients with subsequent levels of significance are shown. On the basis of the information shown, the degree of repeatability of the original test is at an acceptable level, where the correlation coefficient is .895 at a .0001 level of significance.

Table 1

Original Test Repeatability

Variable	N	Mean	Std Dev
Original 1	19	2.597	0.692
Original 2	18	2.644	0.647

Table 2

Correlation of Original Tests

	Original 2
Original 1	0.895 ^a
	0.0001 ^b

Note. ^a Correlation coefficient, ^b Level of significance.

Table 3 shows the results of the Mitsubishi test (#1) and Mitsubishi retest (#2) in terms of the mean and the standard deviation of the dependent variables. In Table 4, a Mitsubishi Test #1 correlation has been run. In Table #5, Mitsubishi Test #2 has been handled in the same fashion. In Table #6, the sample correlation coefficients with subsequent levels of significance are indicated in a correlation matrix.

On the basis of the information in Table 6, only four of the dependent variables reflect an acceptable degree of reliability at levels of significance less than .05. They are: angle (.621), clubhead speed (.518), muff--percentage of bad shots--(.506), and path (.572). Of the remaining three dependent variables, only accuracy is within striking distance of acceptable significance levels.

Table 3
Mitsubishi Test Repeatability

Variable	N	Mean	Std Dev
Macc 1 ^a	19	4.16	2.82
Macc 2	17	5.68	3.30
Mangle 1	19	-0.89	4.06
Mangle 2	19	0.16	3.52
Mcarry 1	18	67.89	30.14
Mcarry 2	19	83.11	30.80
Mhit 1	18	-0.36	0.57
Mhit 2	18	-0.14	0.68
Mmuff 1	18	0.39	0.26
Mmuff 2	19	0.37	0.31
Mpath 1	19	-0.02	0.71
Mpath 2	19	0.16	0.41
Mspeed 1	19	50.31	10.07
Mspeed 2	19	56.55	12.75

Note^a M designates Mitsubishi followed by specific parameters for Test #1 or Test #2.

Table 4

Correlation of Mitsubishi Test #1 Parameters

	Macci	Mangle1	Mcarry1	Mhit1	Mmuff1	Mpath1
Macci	1.000 ^a					
	.0000 ^b					
Mangle1	.502					
	.0287					
Mcarry1	.567	.571				
	.0142	.0133				
Mhit1	.130	.483	.358			
	.6080	.0424	.1588			
Mmuff1	-.554	-.502	-.570	-.752		
	.0139	.0286	.0135	.0003		
Mpath1	-.010	.097	.423	-.102	.272	
	.9675	.6924	.0807	.6872	.2597	
Mspeed1	.513	.489	.941	.417	-.554	.059
	.0248	.0337	.0001	.0854	.0139	.8090

Note ^a Correlation coefficient, ^b Level of significance

Table 5

Correlation of Mitsubishi Test #2 Parameters

	Macc2	Mangle2	Mcarry2	Mhit2	Mmuff2	Mpath2
Macc2	1.000 ^a					
	.0000 ^b					
Mangle2	-.123					
	.6394					
Mcarry2	.697	.318				
	.0019	.1840				
Mhit2	.093	.418	.126			
	.7225	.0842	.6195			
Mmuff2	.096	-.370	.103	-.487		
	.7138	.1189	.6762	.0403		
Mpath2	.498	-.050	-.044	.115	-.035	
	.0418	.8375	.8586	.6497	.8875	
Mspeed2	.683	.299	.982	.087	.140	-.050
	.0025	.2141	.0001	.7308	.5665	.8378

Note^a Correlation coefficient, ^b Level of significance

Table 6

Mitsubishi Test #1 and Test #2

	Mitsubishi Test #1	
Macc2	.438 ^a	.079 ^b
Mangle2	.621	.005
Mcarry2	.366	.135
Mhit2	.309	.228
Mnuff2	.506	.027
Mpath2	.572	.011
Mspeed2	.518	.023

Note. ^a Correlation coefficient,
^b Level of significance

Table 7 relates to the question regarding a possible correlation between the two test types--original and Mitsubishi--within the class testing sequence of OM and MO. Table 8 shows the comparison of the original test with the dependent variables of the Mitsubishi test through the use of a correlation matrix. As indicated by these data, only four of the dependent variables: carry (.0001), hit (.0118), muff (.0104), and speed (.0001), are less than a .05 level of significance and therefore of sufficient correlation to the original test to be acceptable for use in objective skills testing.

Table 7

Comparison of Original and Mitsubishi Tests

Variable	N	Mean	Std Dev
Original	42	2.60	.618
Macc	40	7.22	4.079
Mangle	41	-.04	4.760
Mcarry	41	80.91	25.368
Mhit	41	-.14	.604
Mnuff	42	.29	.260
Mpath	40	-.04	.780
Mspeed	41	56.21	10.925

Table 8

Original and Mitsubishi Test Correlations

	Orig.	Macc	Mangle	Mcarry	Mhit	Mmuff	Mpath
Orig.	1.00000 ^a						
	.0000 ^b						
Macc	.263						
	.1010						
Mangle	.034	.266					
	.8350	.0976					
Mcarry	.566	.449	.073				
	.0001	.0036	.6494				
Mhit	.389	.213	.512	.167			
	.0118	.1863	.0006	.2980			
Mmuff	-.391	-.055	-.041	-.335	-.491		
	.0104	.7346	.7970	.0322	.0011		
Mpath	-.145	-.051	.742	-.079	.229	-.031	
	.3713	.7595	.0001	.6267	.1687	.8489	
Mspeed	.571	.451	.059	.971	.156	-.289	-.074
	.0001	.0035	.7156	.0001	.3296	.0668	.6479

Note. ^a Correlation coefficients, ^b Levels of significance

The statistical results of this study show that:

1. Only the Mitsubishi dependent variables of muff and speed are found to correlate to the original test on a reliable or repeatable basis; therefore, the test correlation hypothesis is accepted in regard to those two variables and rejected in respect to the remaining variables of accuracy, angle, carry, hit, and path

2. Female test results were too small in number to either accept or to reject the sex difference hypothesis

3. The range of skills test scores is not relevant with respect to accepting or rejecting as a hypothesis

4. The learning experiences of the students in respect to testing on the Mitsubishi did not prove to be an important consideration of this study as the question of repeatability has shown; therefore, the hypothesis is rejected.

Discussion

The Mitsubishi Golf Trainer may be used as an objective and alternative test device in an indoor test situation. This study shows that there is an acceptable relationship between the test results gained by the two methods of testing. One immediate question should be addressed. It would seem that during the range test, product results for each student would be aided by the ball flight characteristics, a significant factor in

that particular learning experience. In the Mitsubishi testing however, a question should be directed to the influence on a beginning golfer upon learning that his or her clubhead speed was of an "X" value without the benefits of the ball flight characteristics.

Additionally, it would appear that a computed multiple regression analysis would be necessary in order for the Mitsubishi to be used as a skills test assessment tool, due to the fact that related test scores would be very difficult to compute during each test incident. To achieve that end, some time would elapse before a sufficient number of scores could be collected and computed.

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